Local Government Energy Audit Report

Thomas Jefferson Elementary

August 8, 2024

Prepared for:
Morris School District BOE
101 James Street
Morristown, New Jersey 07960

Prepared by:
TRC
317 George Street
New Brunswick, New Jersey 08901

Disclaimer

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

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

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

Incentive values provided in this report are estimated based on previously run state efficiency programs. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. Please review all available utility program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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

Table of Contents

1 Executive Summary 1

1.1 Planning Your Project 4

Pick Your Installation Approach 4

Options from Your Utility Company 4

Options from New Jersey's Clean Energy Program 5

2 Existing Conditions 6

2.1 Site Overview 6

2.2 Building Occupancy 6

2.3 Building Envelope 6

2.4 Lighting Systems 8

2.5 Air Handling Systems 11

Unit Ventilators 11

Unitary Electric HVAC Equipment 11

Packaged Units 12

Air Handling Units (AHUs) 13

2.6 Heating Steam Systems 14

2.7 Building Automation System (BAS) 15

2.8 Domestic Hot Water 16

2.9 Food Service Equipment 17

2.10 Refrigeration 18

2.11 Plug Load 19

2.12 Water-Using Systems 20

3 Energy and Water Use and Costs 22

3.1 Electricity 24

3.2 Natural Gas 25

3.3 Water 26

3.4 Benchmarking 28

Tracking your Energy Performance 29

3.5 Understanding Your Utility Bills 29

4 Energy Conservation Measures 31

4.1 Lighting 34

ECM 1: Install LED Fixtures ... 34
ECM 2: Retrofit Fixtures with LED Lamps ... 34
4.2 Lighting Controls ... 35
ECM 3: Install Occupancy Sensor Lighting Controls ... 35
ECM 4: Install High/Low Lighting Controls ... 35
4.3 Motors ... 36
ECM 5: Premium Efficiency Motors ... 36
4.4 Unitary HVAC ... 36
ECM 6: Install High Efficiency Air Conditioning Units ... 37
4.5 Gas-Fired Heating ... 37
ECM 7: Install High Efficiency Steam Boilers ... 37
4.6 HVAC Improvements ... 37
ECM 8: Implement Demand Control Ventilation (DCV) ... 37
4.7 Domestic Water Heating ... 38
ECM 9: Install Low-Flow DHW Devices ... 38
4.8 Food Service and Refrigeration Measures ... 38
ECM 10: Replace Refrigeration Equipment ... 39
4.9 Custom Measures ... 39
ECM 11: Retro-Commissioning Study ... 39
ECM 12: Replace Gas Fired Water Heater with Heat Pump Water Heater ... 40
4.10 Measures for Future Consideration ... 41
Heating System Conversion from Steam to Hot Water ... 42
Upgrade to a Heat Pump System ... 42
Window Replacements ... 43
5 Energy Efficient Best Practices ... 44
Energy Tracking with ENERGY STAR Portfolio Manager ... 44
Weatherization ... 44
Doors and Windows ... 44
Window Treatments/Coverings ... 44
Lighting Maintenance ... 45
Motor Controls ... 45
Motor Maintenance ... 45
Thermostat Schedules and Temperature Resets ... 45
Economizer Maintenance ... 45

AC System Evaporator/Condenser Coil Cleaning 45
HVAC Filter Cleaning and Replacement 46
Steam Trap Repair and Replacement 46
Boiler Maintenance 46
Optimize HVAC Equipment Schedules 46
Water Heater Maintenance 46
Compressed Air System Maintenance 47
Refrigeration Equipment Maintenance 47
Procurement Strategies 48

6 Water Best Practices 49

Getting Started 49
Leak Detection and Repair 49
Toilets and Urinals 49
Faucets and Showerheads 50

7 On-Site Generation 51

7.1 Solar Photovoltaic 52
7.2 Combined Heat and Power 54

8 Electric Vehicles 55

8.1 EV Charging 55

9 Project Funding and Incentives 57

9.1 New Jersey's Clean Energy Program 58
9.2 Utility Energy Efficiency Programs 65

10 Project Development 67

11 Energy Purchasing and Procurement Strategies 68

11.1 Retail Electric Supply Options 68
11.2 Retail Natural Gas Supply Options 68

Appendix A: Equipment Inventory & Recommendations A-1

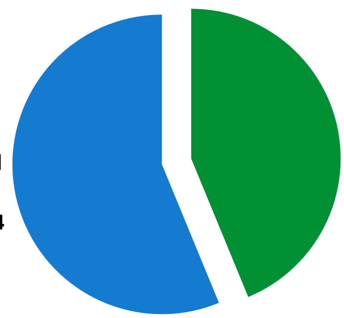
Appendix B: ENERGY STAR Statement of Energy Performance B-1

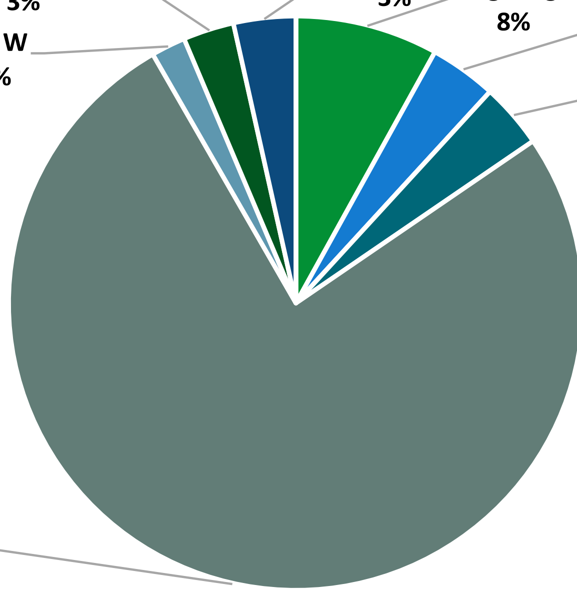
Appendix C: Glossary C-1

1 Executive Summary

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

BUILDING PERFORMANCE REPORT

Annual Energy Utilities	Costs: $62,265 Electricity: 197,060 kWh Natural Gas: 28,016 Therms Water: 346,348 Gallons	
ENERGY STAR® Benchmarking Score	38 *(1-100 scale)*	This building performs at or below the national average. This report contains suggestions about how to improve building performance and reduce energy costs.



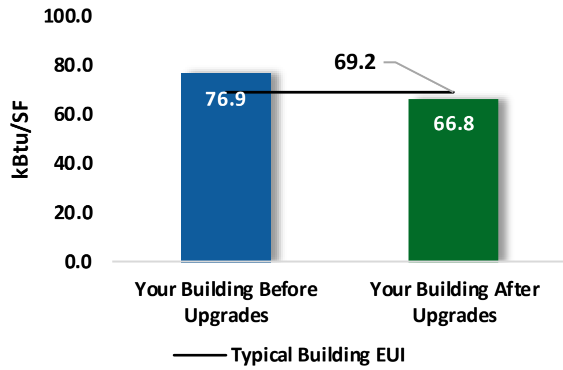
Energy Use by System

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.

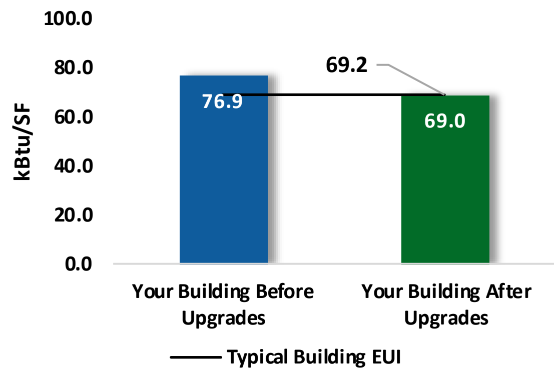
Scenario 1: Full Package (All Evaluated Measures)

Installation Cost	$163,180
Potential Rebates & Incentives[1]	$8,700
Annual Cost Savings	$10,158
Annual Energy Savings	Electricity: 46,812 kWh Natural Gas: 2,948 Therms
Greenhouse Gas Emission Savings	41 Tons
Simple Payback	15.2 Years
Site Energy Savings (All Utilities)	13%



Scenario 2: Cost Effective Package[2]

Installation Cost	$69,480
Potential Rebates & Incentives	$6,200
Annual Cost Savings	$9,238
Annual Energy Savings	Electricity: 49,778 kWh Natural Gas: 1,883 Therms
Greenhouse Gas Emission Savings	36 Tons
Simple Payback	6.9 Years
Site Energy Savings (all utilities)	10%



On-site Generation Potential

Photovoltaic	High
Combined Heat and Power	None

[1] Incentives are based on previously run state rebate programs. Contact your utility provider for current program incentives that may apply.

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

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**25,313**	**3.9**	**-4**	**$3,450**	**$12,510**	**$700**	**$11,810**	**3.4**	**25,016**
ECM 1	Install LED Fixtures	Yes	6,539	0.0	0	$904	$6,250	$350	$5,900	6.5	6,585
ECM 2	Retrofit Fixtures with LED Lamps	Yes	18,773	3.9	-4	$2,546	$6,260	$350	$5,910	2.3	18,431
Lighting Control Measures			**14,866**	**3.2**	**-3**	**$2,013**	**$22,060**	**$5,100**	**$16,960**	**8.4**	**14,570**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	10,418	2.6	-2	$1,411	$17,830	$2,090	$15,740	11.2	10,210
ECM 4	Install High/Low Lighting Controls	Yes	4,448	0.6	-1	$602	$4,230	$3,010	$1,220	2.0	4,360
Motor Upgrades			**649**	**0.2**	**0**	**$90**	**$2,100**	**$0**	**$2,100**	**23.4**	**654**
ECM 5	Premium Efficiency Motors	No	649	0.2	0	$90	$2,100	$0	$2,100	23.4	654
Unitary HVAC Measures			**2,621**	**3.3**	**2**	**$387**	**$25,900**	**$600**	**$25,300**	**65.5**	**2,865**
ECM 6	Install High Efficiency Air Conditioning Units	No	2,621	3.3	2	$387	$25,900	$600	$25,300	65.5	2,865
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**26**	**$320**	**$53,100**	**$1,900**	**$51,200**	**159.9**	**3,000**
ECM 7	Install High Efficiency Steam Boilers	No	0	0.0	26	$320	$53,100	$1,900	$51,200	159.9	3,000
HVAC System Improvements			**0**	**0.0**	**12**	**$149**	**$3,000**	**$0**	**$3,000**	**20.2**	**1,392**
ECM 8	Implement Demand Control Ventilation (DCV)	No	0	0.0	12	$149	$3,000	$0	$3,000	20.2	1,392
Domestic Water Heating Upgrade			**0**	**0.0**	**7**	**$87**	**$210**	**$100**	**$110**	**1.3**	**820**
ECM 9	Install Low-Flow DHW Devices	Yes	0	0.0	7	$87	$210	$100	$110	1.3	820
Food Service & Refrigeration Measures			**6,538**	**0.7**	**0**	**$904**	**$8,400**	**$300**	**$8,100**	**9.0**	**6,584**
ECM 10	Replace Refrigeration Equipment	Yes	6,538	0.7	0	$904	$8,400	$300	$8,100	9.0	6,584
Custom Measures			**-3,176**	**0.0**	**256**	**$2,758**	**$35,900**	**$0**	**$35,900**	**13.0**	**26,754**
ECM 11	Retro-Commissioning Study	Yes	3,061	0.0	189	$2,783	$26,300	$0	$26,300	9.5	25,190
ECM 12	Replace Gas Fired Water Heater with Heat Pump Water Heater***	No	-6,237	0.0	67	-$25	$9,600	$0	$9,600	-384.0	1,564
TOTALS (COST EFFECTIVE MEASURES)			**49,778**	**7.9**	**188**	**$9,238**	**$69,480**	**$6,200**	**$63,280**	**6.9**	**72,178**
TOTALS (ALL MEASURES)			**46,812**	**11.4**	**295**	**$10,158**	**$163,180**	**$8,700**	**$154,480**	**15.2**	**81,653**

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

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

*** - Negative payback explained in section 4.9

All Evaluated Energy Improvements[3]

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

[3] TRC bases estimated material and labor costs primarily on RS Means cost manuals as well as on our experience at similar facilities. This approach is based on standard cost estimating manuals and is vendor neutral. Cost estimates include material and labor pricing associated with one for one equipment replacements. Cost estimates do not include demolition or removal of hazardous waste. The actual implementation costs for energy savings projects are anticipated to be significantly higher based on the specific conditions at your site(s). We strongly recommend that you work with your design engineer or contractor to develop actual project costs for your specific scope of work for the installation of high efficiency equipment. We encourage you to obtain multiple estimates when considering measure installations.

1.1 Planning Your Project

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

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

Pick Your Installation Approach

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

Options from Your Utility Company

Prescriptive and Custom Rebates

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

Direct Install

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

Engineered Solutions

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

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

Options from New Jersey's Clean Energy Program

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

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

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

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

Successor Solar Incentive Program (SuSI)

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

Ongoing Electric Savings with Demand Response

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

Large Energy User Program (LEUP)

LEUP is designed to promote self-investment in energy efficiency for the largest energy consumers in the state. Customers in this category spend about $5 million a year on energy bills. This program incentivizes owners/users of buildings to upgrade or install energy conserving measures in existing buildings to help offset the capital costs associated with the project. The efficiency upgrades are customized to meet the requirements of the customers' existing facilities, while advancing the State's energy efficiency, conservation, and greenhouse gas reduction goals.

For more details on these programs please visit New Jersey's Clean Energy Program website.

2 EXISTING CONDITIONS

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Thomas Jefferson Elementary. This report provides information on how your facility uses energy, identifies energy conservation measures (ECMs) that can reduce your energy use, and provides information and assistance to help you implement the ECMs.

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

2.1 Site Overview

On April 24, 2024, TRC performed an energy audit at Thomas Jefferson Elementary located in Morristown, New Jersey. TRC met with Jeff Maegerlein to review the facility operations and help focus our investigation on specific energy-using systems.

The Thomas Jefferson Elementary is a one-story, 45,178-square-foot building built in 1958. The building includes classrooms, gymnasium, multipurpose room, offices, corridors, a kitchen, and mechanical spaces.

Lighting for the facility is primarily provided by linear LED tube fixtures. Cooling in certain offices and classrooms is provided by window air conditioners, while heating is supplied mainly by steam boilers. The site is interested in upgrading the controls for the HVAC system, which is mostly pneumatically controlled. The facility's Standard Energy Performance (SEP) indicates that its gas and electric Energy Use Intensity (EUI) is notably higher compared to the national average.

2.2 Building Occupancy

The facility is occupied Monday through Friday during regular school hours. The facility is occupied intermittently on weekends, as needed for maintenance and operations.

The school is fully occupied from September through June. Typical weekday occupancy is 51 staff and 310 students. During the summer, occupancy primarily involves ongoing maintenance tasks and limited use of office space, with a few summer classes being held.

Building Name	Weekday/Weekend	Operating Schedule
Thomas Jefferson Elementary Staff	Weekday	6:30 AM - 10:00 PM
	Weekend	No
Thomas Jefferson Elementary Classes	Weekday	8:30 AM - 3:15 PM
	Weekend	No

Building Occupancy Schedule

2.3 Building Envelope

The walls are made of brick over structural steel with a painted CMU interior finish. The flat roof is supported by steel trusses, metal deck, and built-up aggregate roof with a gravel pebble finish. The roof encloses a plenum area with conditioned space below a drop ceiling.

Most windows are single paned with wood frames. The older windows, particularly, are single-pane, and some have translucent panels. Infiltration was observed through these older windows, which is a concern. The seals between the glass and frames are in fair condition. The operable window weather seals are also in fair condition and show no signs of excessive wear. Exterior doors are mostly made from FRP composite material with aluminum frames; however, there are some wooden doors with wood frames. Doors are in fair condition with undamaged door seals. Degraded window and door seals can lead to increased drafts and outside air infiltration.

Typical Building Envelope

Typical Building Windows

Translucent Window

Typical Building Envelope

Building Door

Building Door

Typical Building Roof

2.4 Lighting Systems

The primary interior lighting system uses LED linear T8 equivalent tubes. Fixture types include 1-lamp, 2-lamp, 3-lampm and 4-lamp, 4-foot-long recessed and surface-mounted troffer fixtures with linear tube lamps. Additionally, compact fluorescent lamps (CFL), incandescent lamps, and LED lamps are installed in some offices, corridors, gymnasium, kitchen, restrooms, classrooms, storage rooms, and theater. Some of the classrooms, custodian rooms, gymnasium, and restrooms also use 32-Watt linear fluorescent T8 lamps. These fixtures include 2-lamp, 4-foot-long recessed and surface-mounted troffer fixtures with linear tube and U-bend tube lamps. Typically, T8 fluorescent lamps use electronic ballasts. Gymnasium fixtures have high-bay LED lamps that are manually controlled. All exit signs are LED.

Most fixtures are in fair condition. Interior lighting levels are generally sufficient. Most lighting fixtures in most spaces are controlled by wall switches.

Typical T8 Fluorescent Fixture

CFL

Gymnasium High Bay LED Fixtures

CFL - Kitchen

LED Lamp

HID Lamp

Typical LED Linear tube Fixtures

Typical LED Linear tube Fixtures

Exterior building mounted fixtures include wall packs and canopy lights, which use a mix of high-intensity discharge (HID), incandescent lamps, CFLs, and LED fixtures. The pole mounted flood fixtures incorporate high intensity discharge (HID) lamps.

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

Exterior LED Wall Pack

Exterior HID Pole Light

Exterior HID Wall Packs

Exterior LED Fixtures

2.5 Air Handling Systems

Unit Ventilators

Various classrooms and offices are heated and ventilated using with unit ventilators. They have supply fan motors and pneumatically controlled outside air dampers and are connected to the steam distribution heating system. Overall, the system appears to be in fair operating condition and original to the building.

Typical Unit Ventilator

Unitary Electric HVAC Equipment

Some classrooms, library, main office, and nurse's office are cooled by window air conditioning (AC) units. These units have capacities ranging from 6,000 Btu to 25,000 Btu and are in good condition. Most units are still within their useful life, in fair condition, and of standard efficiency. The newer systems are operated using remote controls located within the space while the older window air conditioners have manual controls with rotary knobs to adjust the temperature and fan speed.

The main office has a Fujitsu ceiling cassette-style, ductless mini-split heat pump with a cooling capacity of 1.5 tons. The unit is in fair condition and operates at standard efficiency. It is locally controlled by a thermostat located in the area. The main office also has a Berko wall electric resistance heater rated at 0.75 kW. This unit is in fair condition and is controlled by a manual dial thermostat.

Window AC

Window AC

Heat Pump- Outdoor Unit

Window AC

Electric Resistance Heater

Ceiling Cassette Indoor Unit

Packaged Units

The staff dining room, some storage rooms, music room, one classroom, and counselor room are served by two packaged air conditioning units controlled by local thermostats. The York unit has a capacity of 2 tons. The Aaon unit has a capacity of 4 tons and incorporates gas-fired heating rated at 75 MBh. Both units are standard efficiency, are operating beyond their useful life, and are in fair condition. These units are being evaluated for replacement. They are equipped with economizers, which are also in fair condition.

Refer to Appendix A for detailed information about each unit.

Package Unit

Package Unit

Air Handling Units (AHUs)

The school has two air handling units used for heating and air exchange: one serves the gymnasium and the other serves the auditorium. Each unit includes a supply fan motor and steam heating coil. The supply fan motors are estimated to be 0.75 hp. Both units operate at a constant speed with standard efficiency motors. The motors run continuously according to facility personnel. These units can be controlled using a local programmable thermostat. During the audit, the set temperatures for occupied and unoccupied heating were 70°F and 65°F, respectively.

Several fractional hp exhaust fans on the rooftop serve various areas, including classrooms, hallways, bathrooms, and kitchen hood. Additionally, there are three, 2-hp exhaust fans in the rooftop mechanical room serving the auditorium, bathrooms, and classrooms. The fan motors have standard efficiency ratings and are in fair condition. Most of them operate during school hours and are controlled remotely by Energy for America, managing both occupied and unoccupied schedules.

The heating coil is supplied by a steam boiler which is discussed in Section 2.6.

Air Handling Unit- Auditorium

Air Handling Unit- Gymnasium

Exhaust Fan

Typical Rooftop Exhaust Fans

2.6 Heating Steam Systems

Two Smith boilers with capacities of 2,249 MBH and 2,513 MBH, and one HB Smith boiler with a capacity of 1,611 MBH, serve the building's heating load. The burners are fully modulating, and the boilers are configured in a lead-lag control scheme. Multiple boilers are required under high-load conditions. The two Smith boilers are new and were recently installed, while the (HB) Smith boiler was manufactured in 1988. They are well maintained and in good condition. The facility regularly tests the air-fuel ratio with combustion tests and tunes the boilers for maximum efficiency.

The building's heating terminals are served by a steam distribution system that includes radiant heaters and unit ventilators. The mechanical room contains two boiler feed pumps, each with a 0.75 hp capacity. There are also two condensate return pumps, each with a 1 hp capacity. Most of the insulation for the steam supply and condensate return is in good condition, and the steam traps are repaired and replaced as needed. The controls for heating the classrooms and other areas are pneumatic.

Energy for America is the energy management company that remotely manages the HVAC system, controlling the boilers and the set point temperature for occupied and unoccupied times.

Steam Boilers

Boiler Nameplate-Boiler 1

2.7 Building Automation System (BAS)

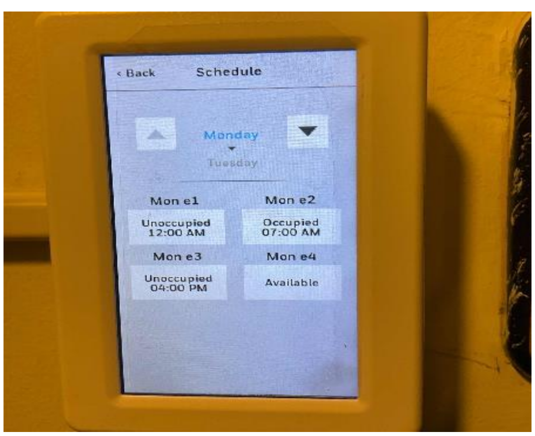
The HVAC system is remotely managed by a third party, Energy for America. Energy for America controls occupied and unoccupied temperature setpoints, as well as equipment operating times (including boilers, unit ventilators and AHUs). Classrooms and similar spaces are scheduled based upon occupancy, while areas including the library, gymnasium and auditorium room are scheduled based upon both typical occupancy and events. The air handling units serving the gymnasium and auditorium are controlled using programmable thermostats. According to staff, Energy for Americas' control functions are not accessible to local staff.

A 1 hp air compressor was observed for use serving the pneumatic controls for the HVAC system, with a storage tank set at around 75 PSI. No leaks were found, and the equipment was in fair condition.

The site staff are interested in expanding the control provided by the BAS. Retro-commissioning of the BAS system has been evaluated and is recommended because the facility's EUI is higher than the national average. Whether or not to replace remaining pneumatic controls with solid state systems should be considered. System upgrade planning and retro-commissioning activities should be coordinated among the various stakeholder parties.

Pneumatic System with Refrigerant Dryer

Air Compressor- Pneumatic System



Programmable Thermostat- Auditorium

Programmable Thermostat- Gymnasium

Boiler Control System

2.8 Domestic Hot Water

Hot water is produced by an A.O. Smith 230-gallon, 199.9 MBh gas-fired storage water heater. The hot water is then stored in an A.O. Smith 200-gallon tank. The system is operating within its life, is of standard efficiency, and is in fair condition.

At the time of the site visit, the domestic water heaters were set at 120°F. Two fractional horsepower circulation pumps, operating continuously, circulate the water to the end users from the mechanical room. The domestic hot water pipes are insulated, and the insulation is in fair condition.

Domestic Hot Water Heater

Domestic Hot Water Heater- Setpoint

DHW Storage Tank

DHW Circulation Pump

2.9 Food Service Equipment

The kitchen has a combination of gas and electric appliances used for preparing breakfast and lunch for students. Most of the cooking is done using a gas-fired oven and an electric convection oven. The equipment is in fair condition and not high efficiency.

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

Cooktop/Oven

Convection Oven- Full Size

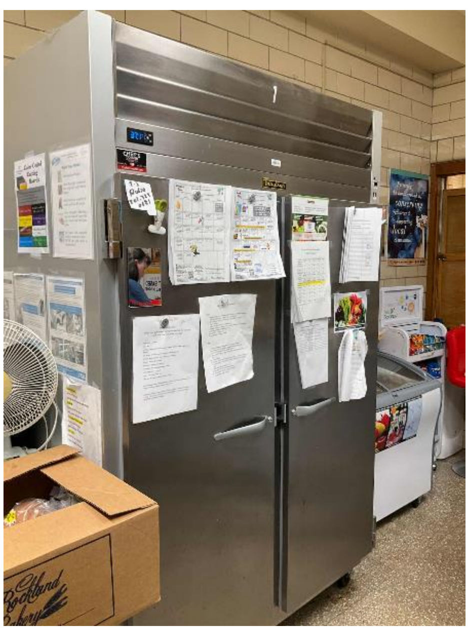
2.10 Refrigeration

The kitchen is equipped with several stand-up refrigerators and freezers featuring solid doors, along with a refrigerated milk cooler, and freezer chest. Some of the equipment is ENERGY STAR-rated and is in fair condition. This report makes additional suggestions for ECMs in this area as well as energy efficient best practices.

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

Standup Solid Door Freezer

Refrigerator- Milk Cooler



Standup Solid Door Refrigerator

Standup Solid Door Refrigerator

2.11 Plug Load

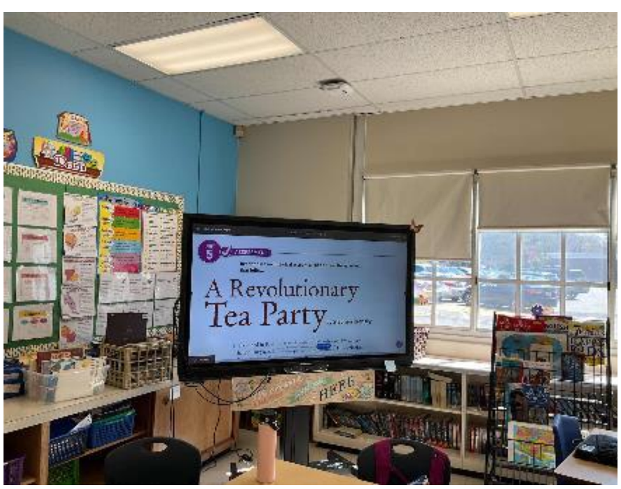
The location is doing a great job managing the electrical plug loads. This report makes additional suggestions for ECMs in this area and provides energy-efficient best practices.

There are 361 Chromebooks being used by the students and staff, along with a few computer workstations spread throughout the facility. Plug loads include general cafe, office, and classroom equipment. Typical loads include printer/copiers, microwaves, and projectors. All classrooms have Promethean smartboards and Medify brand air purifiers.

There are also a few residential-style refrigerators throughout the building that store food. These vary in condition and efficiency. The art classroom also has a Skutt electric kiln.

Kiln

Residential-style Refrigerator



Smartboard

Serving Table

Typical Air Purifier

Copier/Printer

2.12 Water-Using Systems

Water is provided by the Southeast Morris County Municipal Utilities Authority. Water is mainly used for drinking, cleaning, cooking, building conditioning, landscaping, and sanitary fixtures. Water leaks were not observed.

EPA WaterSense® has set maximum flow rates for sanitary fixtures. They are: 1.28 gallons per flush (gpf) for toilets, 0.5 gpf for urinals, 1.5 gallons per minute (gpm) for lavatory faucets, and 2.0 gpm for showerheads. There are few restrooms with toilets, urinals, and sinks. Faucet flow rates are 2.2 gpm or higher.

Kitchen Faucet

Restroom Faucet

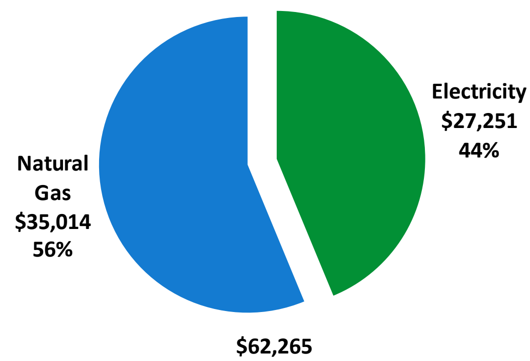
Restroom Faucet

Restroom Faucet

3 Energy and Water Use and Costs

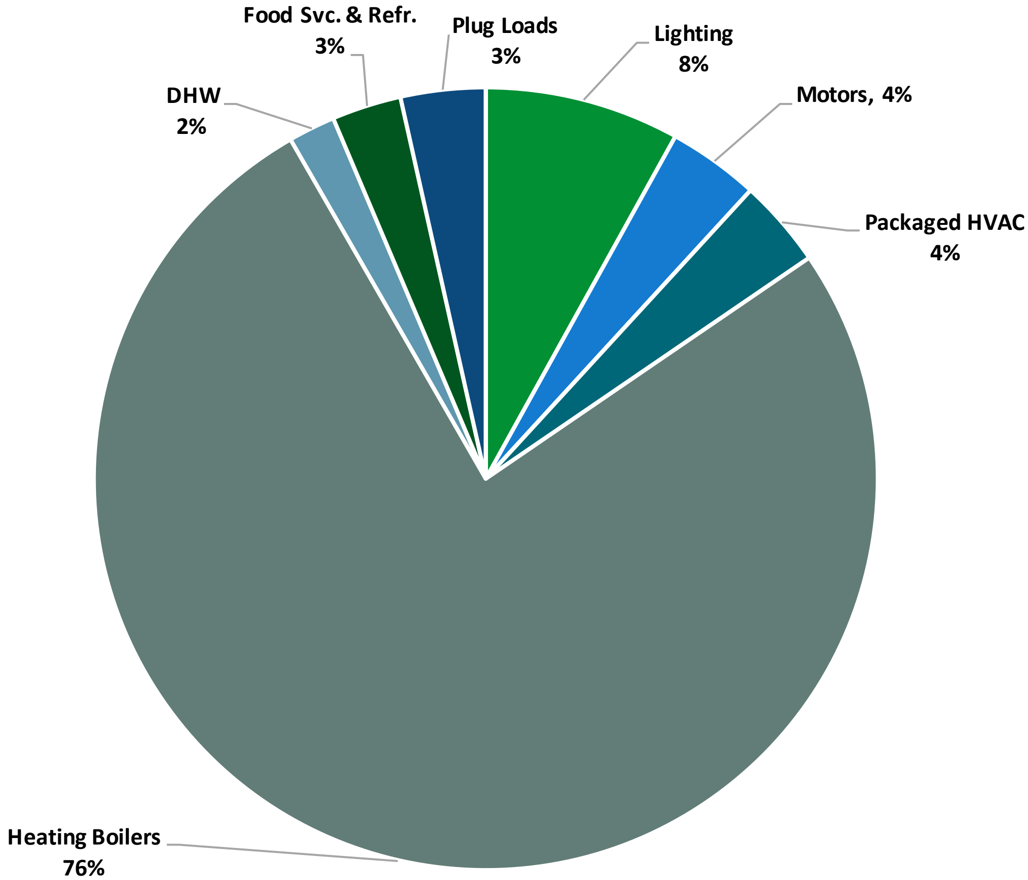
Twelve months of utility billing data are used to develop annual energy consumption and cost data. This information creates a profile of the annual energy consumption and energy costs.

Utility Summary		
Fuel	**Usage**	**Cost**
Electricity	197,060 kWh	$27,251
Natural Gas	28,016 Therms	$35,014
Total		**$62,265**



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.

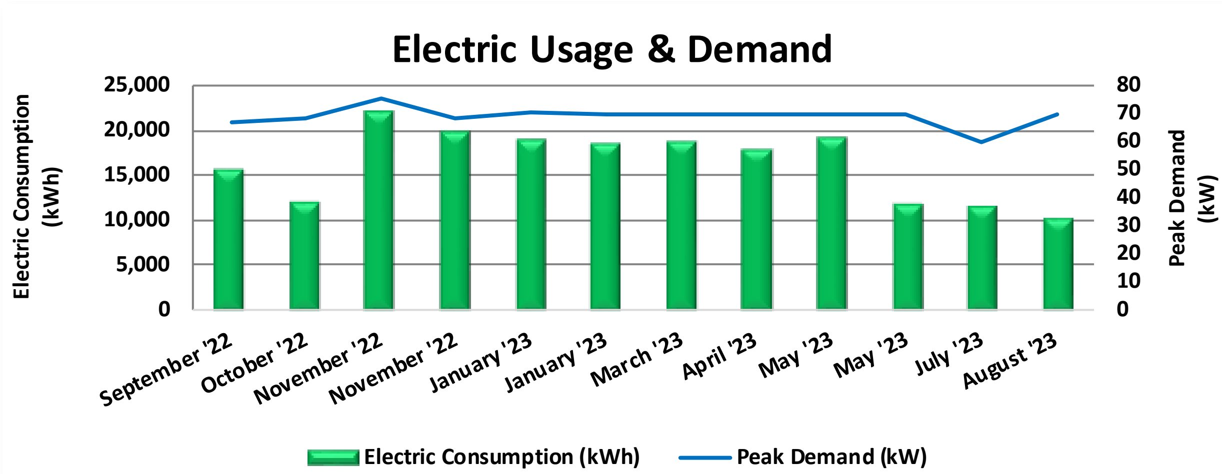
The energy auditor collects information regarding equipment operating hours, capacity, efficiency, and other operational parameters from facility staff, drawings, and on-site observations. This information is used as the inputs to calculate the existing conditions energy use for the site. The calculated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



Energy Balance by System

3.1 Electricity

JCP&L delivers electricity under rate class General Service Secondary 3 Phase JC_GS3_01D, with electric production provided by Direct Energy, a third-party supplier.



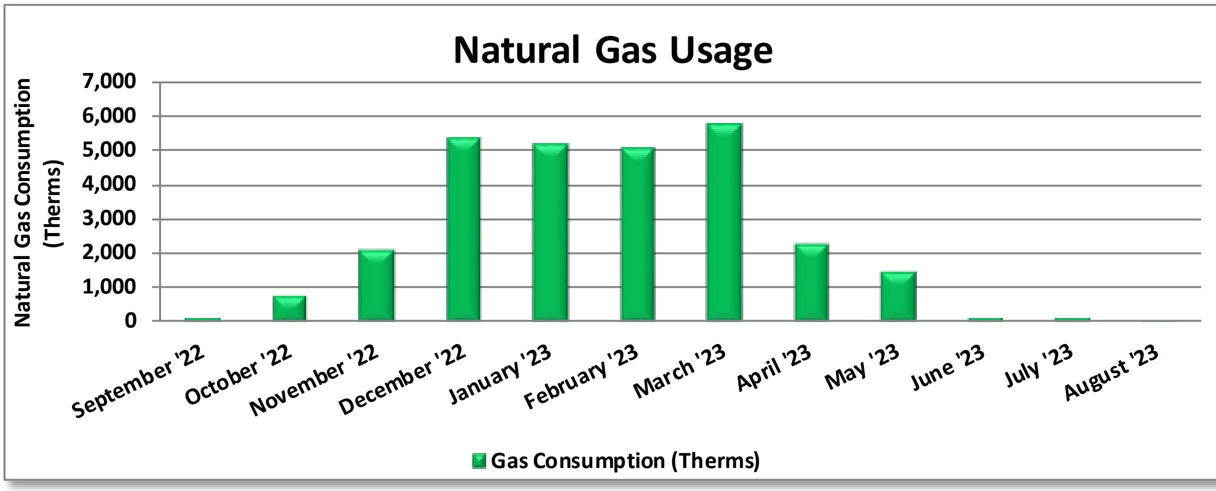
Electric Billing Data					
Period Ending	**Days in Period**	**Electric Usage (kWh)**	**Demand (kW)**	**Demand Cost**	**Total Electric Cost**
9/19/22	32	15,680	67	$454	$2,146
10/18/22	29	12,160	68	$431	$1,789
11/16/22	29	22,000	76	$486	$2,893
12/5/22	19	19,760	68	$431	$2,589
1/18/23	44	18,960	71	$447	$2,513
2/15/23	28	18,560	70	$440	$2,466
3/16/23	29	18,640	70	$444	$2,498
4/17/23	32	17,840	70	$443	$2,426
5/16/23	29	19,200	70	$443	$2,565
6/15/23	30	11,840	70	$475	$1,819
7/18/23	33	11,560	60	$394	$1,815
8/17/23	30	10,320	70	$475	$1,657
Totals	**364**	**196,520**	**76**	**$5,362**	**$27,177**
Annual	**365**	**197,060**	**76**	**$5,376**	**$27,251**

Notes:

- Peak demand of 76 kW occurred in November '22.
- Average demand over the past 12 months was 69 kW.
- The average electric cost over the past 12 months was $0.138/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 Large Volume Gas (LVG), with natural gas supply provided by Direct energy, a third-party supplier.



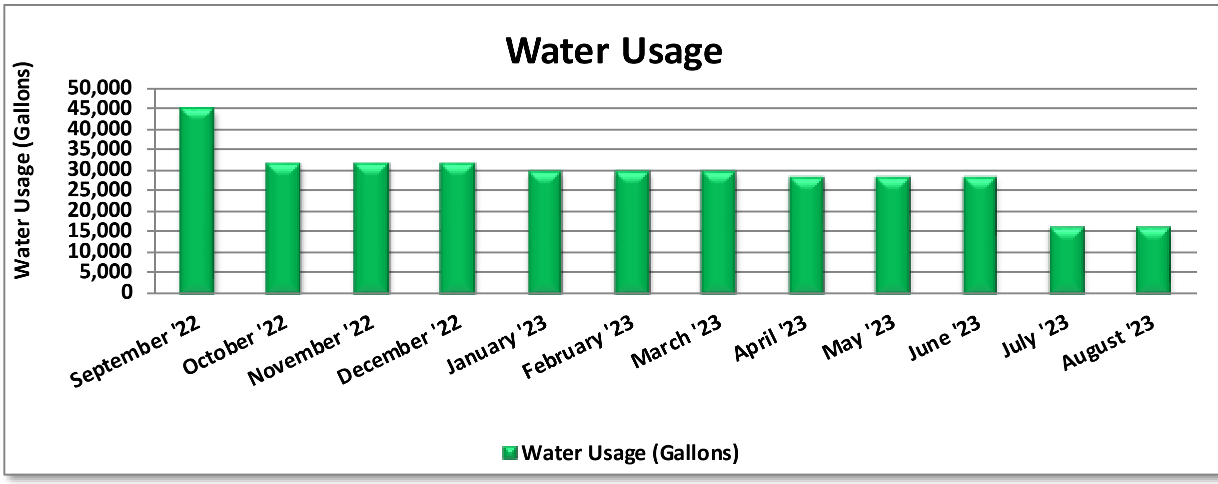
Gas Billing Data			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
9/19/22	31	90	$317
10/18/22	29	738	$1,033
11/16/22	29	2,086	$3,525
12/19/22	33	5,329	$7,106
1/20/23	32	5,159	$6,922
2/17/23	28	5,047	$5,960
3/21/23	32	5,748	$6,326
4/20/23	30	2,249	$2,002
5/22/23	32	1,464	$1,297
6/21/23	30	121	$260
7/20/23	29	75	$232
8/21/23	32	64	$224
Totals	**367**	**28,170**	**$35,206**
Annual	**365**	**28,016**	**$35,014**

Notes:

- The average gas cost for the past 12 months is $1.250/therm, which is the blended rate used throughout the analysis.

3.3 Water

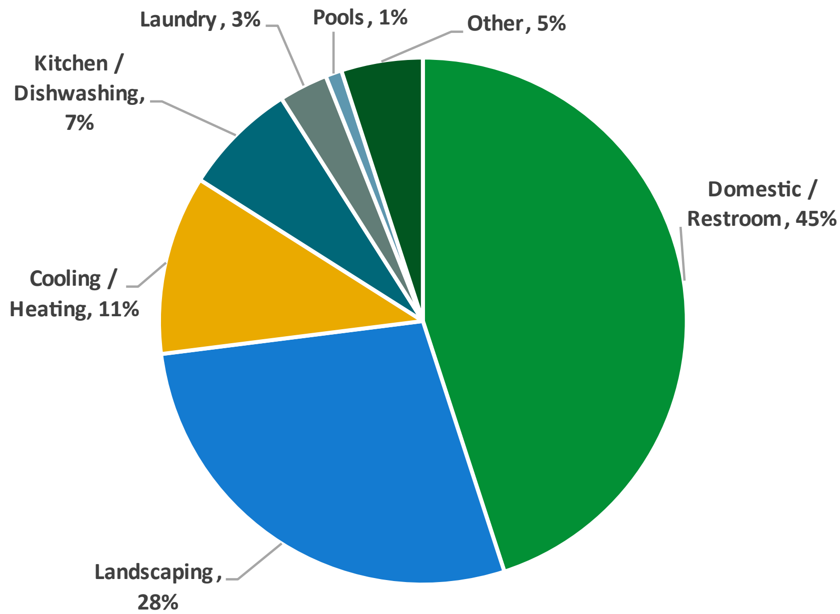
Southeast Morris County Municipal Utilities Authority delivers water to the project site.



Water Billing Data			
Period Ending	**Days in Period**	**Water Usage (gallons)**	**Water Cost**
9/26/22	31	44,883	$646
10/26/22	30	31,668	$342
11/26/22	31	31,668	$342
12/26/22	30	31,668	$342
1/26/23	31	29,673	$359
2/26/23	31	29,673	$359
3/26/23	28	29,673	$359
4/26/23	31	28,177	$346
5/26/23	30	28,177	$346
6/26/23	31	28,177	$346
7/26/23	30	16,457	$381
8/26/23	31	16,457	$381
Totals	**365**	**346,348**	**$4,549**
Annual	**365**	**346,348**	**$4,549**

Notes:

- The average cost of water for the past 12 months is $0.0131/gal.



Typical Education Water End Use[4]

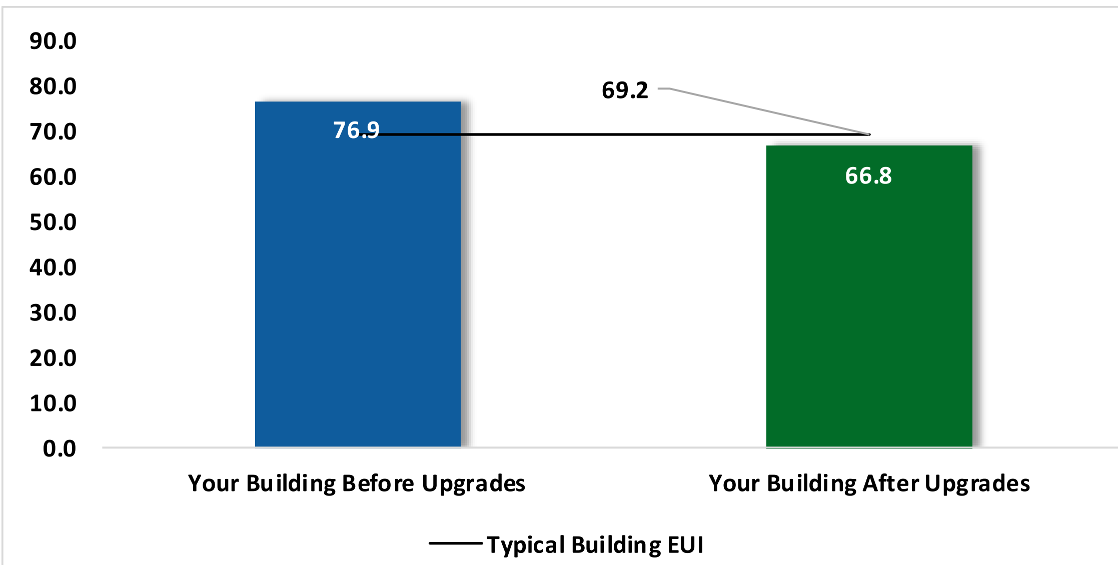
[4] Chart is of typical water end use and not specific to the facility.

3.4 Benchmarking

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

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

Benchmarking Score	38



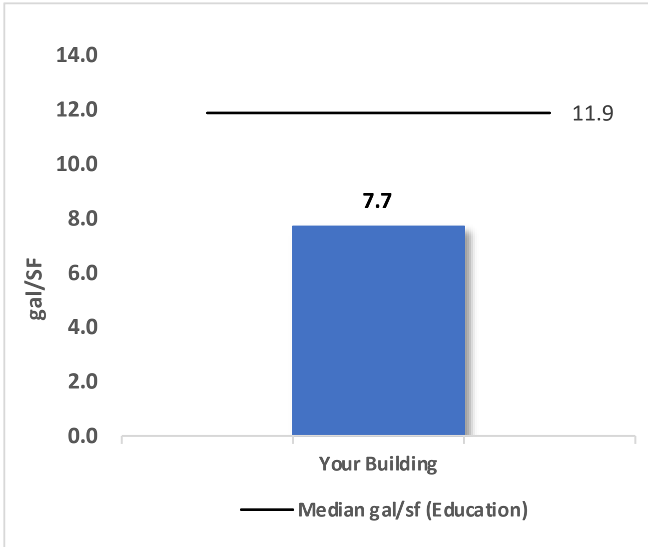
Energy Use Intensity Comparison[5]

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

[5] Based on all evaluated ECMs

Water Benchmarking



A benchmark is provided for your building's water use based on the annual water use in gallons per square foot of building area (gal/sf-yr.). Your building is compared to other similar buildings based on average water usage as available from the 2012 Commercial Buildings Energy Consumption Survey (CBECS) and from the EPA ENERGY STAR DataTrends Water Use Tracking database. Kitchens and sanitary fixtures may use varying amounts of water.

Tracking your Energy Performance

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

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

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

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

3.5 Understanding Your Utility Bills

The State of New Jersey Department of the Public Advocate provides detailed information on how to read natural gas and electric bills. Your bills contain important information including account numbers, meter numbers, rate schedules, meter readings, and the supply and delivery charges. Gas and electric bills both provide comparisons of current energy consumption with prior usage.

Sample bills, with annotation, may be viewed at:
https://www.nj.gov/rpa/docs/Understanding_Electric_Bill.pdf
https://www.nj.gov/rpa/docs/Understanding_Gas_Bill.pdf

Why Utility Bills Vary

Utility bills vary from one month to another for many reasons. For this reason, assessing the effects of your energy savings efforts can be difficult.

Billing periods vary, typically ranging between 28 and 33 days. Electric bills provide the kilowatt-hours (kWh) used per month while gas bills provide therms (or hundreds of cubic feet - CCF) per month consumption information. Monthly consumption information can be helpful as a tool to assess your efforts to reduce energy, particularly when compared to monthly usage from a similar calendar period in a prior year.

Bills typically vary seasonally, often with more gas consumed in the winter for heating, and more electricity used in the summer when air conditioning is used. Facilities with electric heating may experience higher electricity use in the winter. Seasonal variance will be impacted by the type of heating and cooling systems used. Normal seasonal fluctuations are further impacted by the weather. Extremely cold or hot weathers causes HVAC equipment to run longer, increasing usage. Other monthly fluctuations in usage can be caused by changes in building occupancy. Utility bills provide a comparison of usage between the current period and comparable billing month period of the prior year. Year-to-year monthly use comparisons can point to trends with energy savings for measures/projects that were implemented within the timeframe, but these comparisons do not account for changing weather of occupancy patterns.

The price of fuel and purchased power used to produce and delivery electricity and gas fluctuates. Any increase or decrease in these costs will be reflected in your monthly bill. Additionally, billing rates occasionally change after justification and approval of the NJBPU. For this reason, it is more useful to review energy use rather than cost when assessing energy use trends or the impact of energy conservation measures implemented.

4 Energy Conservation Measures

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

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

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

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

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

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**25,313**	**3.9**	**-4**	**$3,450**	**$12,510**	**$700**	**$11,810**	**3.4**	**25,016**
ECM 1	Install LED Fixtures	Yes	6,539	0.0	0	$904	$6,250	$350	$5,900	6.5	6,585
ECM 2	Retrofit Fixtures with LED Lamps	Yes	18,773	3.9	-4	$2,546	$6,260	$350	$5,910	2.3	18,431
Lighting Control Measures			**14,866**	**3.2**	**-3**	**$2,013**	**$22,060**	**$5,100**	**$16,960**	**8.4**	**14,570**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	10,418	2.6	-2	$1,411	$17,830	$2,090	$15,740	11.2	10,210
ECM 4	Install High/Low Lighting Controls	Yes	4,448	0.6	-1	$602	$4,230	$3,010	$1,220	2.0	4,360
Motor Upgrades			**649**	**0.2**	**0**	**$90**	**$2,100**	**$0**	**$2,100**	**23.4**	**654**
ECM 5	Premium Efficiency Motors	No	649	0.2	0	$90	$2,100	$0	$2,100	23.4	654
Unitary HVAC Measures			**2,621**	**3.3**	**2**	**$387**	**$25,900**	**$600**	**$25,300**	**65.5**	**2,865**
ECM 6	Install High Efficiency Air Conditioning Units	No	2,621	3.3	2	$387	$25,900	$600	$25,300	65.5	2,865
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**26**	**$320**	**$53,100**	**$1,900**	**$51,200**	**159.9**	**3,000**
ECM 7	Install High Efficiency Steam Boilers	No	0	0.0	26	$320	$53,100	$1,900	$51,200	159.9	3,000
HVAC System Improvements			**0**	**0.0**	**12**	**$149**	**$3,000**	**$0**	**$3,000**	**20.2**	**1,392**
ECM 8	Implement Demand Control Ventilation (DCV)	No	0	0.0	12	$149	$3,000	$0	$3,000	20.2	1,392
Domestic Water Heating Upgrade			**0**	**0.0**	**7**	**$87**	**$210**	**$100**	**$110**	**1.3**	**820**
ECM 9	Install Low-Flow DHW Devices	Yes	0	0.0	7	$87	$210	$100	$110	1.3	820
Food Service & Refrigeration Measures			**6,538**	**0.7**	**0**	**$904**	**$8,400**	**$300**	**$8,100**	**9.0**	**6,584**
ECM 10	Replace Refrigeration Equipment	Yes	6,538	0.7	0	$904	$8,400	$300	$8,100	9.0	6,584
Custom Measures			**-3,176**	**0.0**	**256**	**$2,758**	**$35,900**	**$0**	**$35,900**	**13.0**	**26,754**
ECM 11	Retro-Commissioning Study	Yes	3,061	0.0	189	$2,783	$26,300	$0	$26,300	9.5	25,190
ECM 12	Replace Gas Fired Water Heater with Heat Pump Water Heater	No	-6,237	0.0	67	-$25	$9,600	$0	$9,600	-384.0	1,564
TOTALS			**46,812**	**11.4**	**295**	**$10,158**	**$163,180**	**$8,700**	**$154,480**	**15.2**	**81,653**

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

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

*** - Negative payback explained in section 4.9

All Evaluated ECMs

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**25,313**	**3.9**	**-4**	**$3,450**	**$12,510**	**$700**	**$11,810**	**3.4**	**25,016**
ECM 1	Install LED Fixtures	6,539	0.0	0	$904	$6,250	$350	$5,900	6.5	6,585
ECM 2	Retrofit Fixtures with LED Lamps	18,773	3.9	-4	$2,546	$6,260	$350	$5,910	2.3	18,431
Lighting Control Measures		**14,866**	**3.2**	**-3**	**$2,013**	**$22,060**	**$5,100**	**$16,960**	**8.4**	**14,570**
ECM 3	Install Occupancy Sensor Lighting Controls	10,418	2.6	-2	$1,411	$17,830	$2,090	$15,740	11.2	10,210
ECM 4	Install High/Low Lighting Controls	4,448	0.6	-1	$602	$4,230	$3,010	$1,220	2.0	4,360
Domestic Water Heating Upgrade		**0**	**0.0**	**7**	**$87**	**$210**	**$100**	**$110**	**1.3**	**820**
ECM 9	Install Low-Flow DHW Devices	0	0.0	7	$87	$210	$100	$110	1.3	820
Food Service & Refrigeration Measures		**6,538**	**0.7**	**0**	**$904**	**$8,400**	**$300**	**$8,100**	**9.0**	**6,584**
ECM 10	Replace Refrigeration Equipment	6,538	0.7	0	$904	$8,400	$300	$8,100	9.0	6,584
Custom Measures		**3,061**	**0.0**	**189**	**$2,783**	**$26,300**	**$0**	**$26,300**	**9.5**	**25,190**
ECM 11	Retro-Commissioning Study	3,061	0.0	189	$2,783	$26,300	$0	$26,300	9.5	25,190
TOTALS		**49,778**	**7.9**	**188**	**$9,238**	**$69,480**	**$6,200**	**$63,280**	**6.9**	**72,178**

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

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

Cost Effective ECMs

4.1 Lighting

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**25,313**	**3.9**	**-4**	**$3,450**	**$12,510**	**$700**	**$11,810**	**3.4**	**25,016**
ECM 1	Install LED Fixtures	6,539	0.0	0	$904	$6,250	$350	$5,900	6.5	6,585
ECM 2	Retrofit Fixtures with LED Lamps	18,773	3.9	-4	$2,546	$6,260	$350	$5,910	2.3	18,431

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

ECM 1: Install LED Fixtures

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

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

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

Affected Building Areas: exterior fixtures

ECM 2: Retrofit Fixtures with LED Lamps

Replace fluorescent, or incandescent lamps with LED lamps. Many LED tubes are direct replacements for existing fluorescent tubes and can be installed while leaving the fluorescent fixture ballast in place. LED lamps can be used in existing fixtures as a direct replacement for most other lighting technologies. Be sure to specify replacement lamps that are compatible with existing dimming controls, where applicable. In some circumstances, you may need to upgrade your dimming system for optimum performance.

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

Affected Building Areas: all areas with fluorescent fixtures with T8 tubes; incandescent lamps: auditorium, custodian, gymnasium, kitchen, office, restrooms, storage closet, and theatre; CFLs: auditorium, classrooms, exterior, roof mechanical space, kitchen, and restroom

4.2 Lighting Controls

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**14,866**	**3.2**	**-3**	**$2,013**	**$22,060**	**$5,100**	**$16,960**	**8.4**	**14,570**
ECM 3	Install Occupancy Sensor Lighting Controls	10,418	2.6	-2	$1,411	$17,830	$2,090	$15,740	11.2	10,210
ECM 4	Install High/Low Lighting Controls	4,448	0.6	-1	$602	$4,230	$3,010	$1,220	2.0	4,360

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

ECM 3: Install Occupancy Sensor Lighting Controls

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

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

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

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

Affected Building Areas: offices, kitchen, classrooms, library, gymnasium, restrooms, and auditorium

ECM 4: Install High/Low Lighting Controls

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

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

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

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

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

Affected Building Areas: hallways

4.3 Motors

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades		**649**	**0.2**	**0**	**$90**	**$2,100**	**$0**	**$2,100**	**23.4**	**654**
ECM 5	Premium Efficiency Motors	649	0.2	0	$90	$2,100	$0	$2,100	23.4	654

ECM 5: Premium Efficiency Motors

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

Affected Motors:

Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Additional Motor Description
Exterior Hatch-Mechanical	Bathroom Exhaust	1	Exhaust Fan	2.0	
Exterior Hatch-Mechanical	Auditroium Exhaust	1	Exhaust Fan	2.0	
Exterior Hatch-Mechanical	Old Classroom Exhaust	1	Exhaust Fan	2.0	

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

4.4 Unitary HVAC

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Unitary HVAC Measures		**2,621**	**3.3**	**2**	**$387**	**$25,900**	**$600**	**$25,300**	**65.5**	**2,865**
ECM 6	Install High Efficiency Air Conditioning Units	2,621	3.3	2	$387	$25,900	$600	$25,300	65.5	2,865

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

ECM 6: Install High Efficiency Air Conditioning Units

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

Affected Units: window AC: classroom 13, classroom 3, classroom D, library and nurse's office; rooftop package units

4.5 Gas-Fired Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**26**	**$320**	**$53,100**	**$1,900**	**$51,200**	**159.9**	**3,000**
ECM 7	Install High Efficiency Steam Boilers	0	0.0	26	$320	$53,100	$1,900	$51,200	159.9	3,000

ECM 7: Install High Efficiency Steam Boilers

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

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

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

4.6 HVAC Improvements

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
HVAC System Improvements		**0**	**0.0**	**12**	**$149**	**$3,000**	**$0**	**$3,000**	**20.2**	**1,392**
ECM 8	Implement Demand Control Ventilation (DCV)	0	0.0	12	$149	$3,000	$0	$3,000	20.2	1,392

ECM 8: Implement Demand Control Ventilation (DCV)

Demand control ventilation (DCV) is a control strategy that monitors the indoor air's carbon dioxide (CO2) content to measure room occupancy. This data is used to regulate the amount of outdoor air provided to the space for ventilation.

Standard ventilation systems often provide outside air based on a space's estimated maximum occupancy but not actual occupancy. During low occupancy periods, the space may then be over ventilated. This wastes energy through heating and cooling the excess outside air flow. DCV reduces unnecessary outdoor air intake by regulating ventilation based on actual occupancy levels. DCV is most suited for facilities where occupancy levels vary significantly from hour to hour and day to day.

Energy savings associated with DCV are based on hours of operation, space occupancy, outside air reduction, and other factors. Energy savings results from eliminating unnecessary ventilation and space conditioning. Implementation of this measure is dependent upon having a building automation system (BAS) or other smart building control system connected to the space conditioning equipment serving the noted areas.

Affected Building Areas: We evaluated DCV for multipurpose room and auditorium.

4.7 Domestic Water Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**7**	**$87**	**$210**	**$100**	**$110**	**1.3**	**820**
ECM 9	Install Low-Flow DHW Devices	0	0.0	7	$87	$210	$100	$110	1.3	820

ECM 9: Install Low-Flow DHW Devices

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

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

Low-flow devices reduce the overall water flow from the fixture, while still providing adequate pressure for washing.

4.8 Food Service and Refrigeration Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Food Service & Refrigeration Measures		**6,538**	**0.7**	**0**	**$904**	**$8,400**	**$300**	**$8,100**	**9.0**	**6,584**
ECM 10	Replace Refrigeration Equipment	6,538	0.7	0	$904	$8,400	$300	$8,100	9.0	6,584

ECM 10: Replace Refrigeration Equipment

Replace existing commercial freezers, freezer chest and refrigerator milk cooler with new ENERGY STAR rated equipment. The energy savings associated with this measure come from reduced energy usage, due to more efficient technology, and reduced run times.

Affected Units: Avanti freezer chest, Powers refrigerator chest, True stand-up freezer

4.9 Custom Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Custom Measures		**-3,176**	**0.0**	**256**	**$2,758**	**$35,900**	**$0**	**$35,900**	**13.0**	**26,754**
ECM 11	Retro-Commissioning Study	3,061	0.0	189	$2,783	$26,300	$0	$26,300	9.5	25,190
ECM 12	Replace Gas Fired Water Heater with Heat Pump Water Heater***	-6,237	0.0	67	-$25	$9,600	$0	$9,600	-384.0	1,564

ECM 11: Retro-Commissioning Study

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

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

Note that this process may involve identifying additional control opportunities that require further investment, such as replacing dedicated pneumatic controls, installing a local BAS system at the facility, and adding more control points to the BAS system. Additional control or monitoring points will likely increase the cost beyond the amount estimated for retro-commissioning. Retro-commissioning is especially important for your facility because it has a low energy benchmarking score. Adjustments to setpoints and schedules for air handling units, boilers, ventilation fans, and pumps will likely be necessary to optimize your building operations.

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

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

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

A high-level evaluation of potential savings and costs is provided for demonstration purposes only. It is a screening evaluation for the potential in HVAC control improvements. Based on industry standards and previous project experience, the potential energy savings may be up to 15% of existing HVAC energy use. We estimate the cost of retro-commissioning studies and control improvements of $0.50 per square foot. Actual savings and costs will need to be outlined by the specific contractor engaged to perform the study. For the purposes of this report, we have conservatively estimated savings to be 7.9% of the HVAC energy consumption baseline.

ECM 12: Replace Gas Fired Water Heater with Heat Pump Water Heater

We evaluated replacing existing the gas water heater with a heat pump water heater (HPWH).

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

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

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

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

** Note: Uniform Energy Factor (UEF): The newest measure of water heater overall efficiency. The higher the UEF value is, the more efficient the water heater. UEF is determined by the Department of Energy's test method outlined in 10 CFR Part 430, Subpart B, Appendix E.*[6]

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

HPWH reject cold air. As such, they need to be installed in an unconditioned space of about 750 cubic feet with good ventilation[7]. Ideal locations are garages, large enclosed, unconditioned storage areas, or areas with excess heat such as a furnace or boiler room. The HPWH will also produce condensate so accommodations for draining the condensate need to be provided.

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

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

Switching from a gas fired water heater to a HPWH has the potential to reduce the sites overall greenhouse gas emissions. If the electricity for the HPWH is provided by an on-site photovoltaic (PV) system then there are essentially no greenhouse gas (GHG) emissions. A 2016 study conducted at Cornell[8] calculated the kg of methane (CH_4) and carbon dioxide (CO_2) produced per GJ of water heated. The study compared HPWH to gas and electric fired, storage and tankless water heaters. The study also considered electricity produced from natural gas and coal fired electric plants. In all cases the study found that HPWHs produced less methane than all of the other water heaters. The study also found that HPWH produced less carbon dioxide than electric resistance water heaters but more carbon dioxide than tankless gas water heaters and about the same amount of carbon dioxide as storage gas water heaters. The summary tables provide the reduction in CO2 equivalent emissions based on the typical New Jersey electric utility.

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

Affected Units: Gas fired storage tank heater.

4.10 Measures for Future Consideration

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

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

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

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

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

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

Heating System Conversion from Steam to Hot Water

This type of system upgrade/conversion has significant up-front capital costs. However, there are benefits with modular hot water boiler system designs with advanced control strategies. Advantages associated with configuring a boiler plant around several modular boilers include the better system performance at low load conditions, and the modular boilers will often take less space than multiple old large boilers.

Steam and condensate return piping will need to be capped off, removed, or replaced in most cases. If distribution systems are mainly hydronic, replacing a steam boiler will likely be more cost effective than for situations where steam is supplied to the end uses, for instance, where steam coils or fin tube radiators are used. In such cases, end use distribution points will need to be modified to accommodate the circulation of hot water.

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

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

Upgrade to a Heat Pump System

Electric resistance heating units work by passing an electric current through wires to heat them. The system is 100% efficient since for every unit of electricity consumed, one unit of heat is produced.

But there is a way to convert electricity to create heat at better than a 1:1 ratio. Heat pumps operate on a more efficient principle, the refrigeration cycle. Instead of directly converting electricity to heat, electricity does the work, via a compressor, of moving refrigerant through a system that transfers heat from a cooler place to a warmer place. That system can move three to five as much energy as is available using electric resistance heating methods. Heat pumps work in a similar manner to an air conditioner, except they reverse the cooling process to circulate warm air instead of cold air. Also, heat pumps are generally capable of dispensing refrigerated air as they can typically be operated in air conditioning mode.

An electric furnace or boiler has no flue loss through a chimney. The AFUE rating for an all-electric furnace or boiler is between 95% and 100%. The lower values are for units installed outdoors because they have greater jacket heat loss. However, despite their high efficiency, the higher cost of electricity in most parts of the country makes all-electric furnaces or boilers an uneconomic choice. If you are interested in electric heating, consider installing a heat pump system.

Electric resistance heat, including electric furnaces and baseboard heaters, can be inexpensive to install but often expensive to run. Facilities with these systems can save substantial energy at a moderate cost by installing a heat pump when they replace a central air conditioner.

Even in buildings without central air-conditioning, there are opportunities to save energy when an existing electric furnace needs to be replaced, as well as opportunities to install ductless electric heat pumps in buildings with baseboard electric heaters and electric fan coils. Unit ventilators with built-in electric resistance heaters can be replaced with unit ventilators with integrated heat pumps.

Electric heat pumps have high coefficient of performance (COP) ratings and are substantially more efficient than traditional electric heating systems. Further investigation is required to determine whether installing a heat pump system is a cost-effective solution when replacing existing electrical heating systems.

Window Replacements

Energy efficient windows are an important consideration when improving the building envelope. The heat transfer through the glass panes is responsible for a significant portion of the facility's heating and cooling energy consumption. We recommend replacing single-pane windows with double-pane windows, and we recommend models that are gas-filled with low-e coatings to reduce heat loss. Windows should be selected with low U-factors to maximize energy savings. The U-factor is the rate at which the window conducts non-solar heat flow and is a key indicator of performance. The lower the U-factor, the higher the efficiency of the window. Window frames and sashes should be efficient as well. If metal frames are specified or required by code, the frame extrusions should have a thermal break to reduce conduction through the frame. As part of the installation, the window frames should be properly sealed with caulk materials to ensure the mitigation of air infiltration. Building envelopes that limit air infiltration and that have adequate fenestrations play a key role in optimizing heating and cooling efficiency, controlling moisture, and providing occupant comfort. Window system replacement is an expensive upgrade that generally involves architectural elements. We recommend this as a measure for further study.

5 Energy Efficient Best Practices

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

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

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

Energy Tracking with ENERGY STAR Portfolio Manager

You've heard it before—you cannot manage what you do not measure. ENERGY STAR Portfolio Manager is an online tool that you can use to measure and track energy and water consumption, as well as greenhouse gas emissions[9]. Your account has already been established. Now you can continue to keep tabs on your energy performance every month.

Weatherization

Caulk or weather strip leaky doors and windows to reduce drafts and loss of heated or cooled air. Sealing cracks and openings can reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. Materials used may include caulk, polyurethane foam, and other weather-stripping materials. There is an energy savings opportunity by reducing the uncontrolled air exchange between the outside and inside of the building. Blower door assisted comprehensive building air sealing will reduce the amount of air exchange, which will in turn reduce the load on the buildings heating and cooling equipment, providing energy savings and increased occupant comfort.

Doors and Windows

Close exterior doors and windows in heated and cooled areas. Leaving doors and windows open leads to a loss of heat during the winter and chilled air during the summer. Reducing air changes per hour can lead to increased occupant comfort as well as heating and cooling savings, especially when combined with proper HVAC controls and adequate ventilation.

Window Treatments/Coverings

Use high-reflectivity films or cover windows with shades or shutters to reduce solar heat gain and reduce the load on cooling and heating systems. Older, single-pane windows and east- or west-facing windows are especially prone to solar heat gain. In addition, use shades or shutters at night during cold weather to reduce heat loss.

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

Lighting Maintenance

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

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

Motor Controls

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

Motor Maintenance

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

Thermostat Schedules and Temperature Resets

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

Economizer Maintenance

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

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

AC System Evaporator/Condenser Coil Cleaning

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

HVAC Filter Cleaning and Replacement

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

Steam Trap Repair and Replacement

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

Boiler Maintenance

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

Optimize HVAC Equipment Schedules

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

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

Water Heater Maintenance

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

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

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

Compressed Air System Maintenance

Compressed air systems require periodic maintenance to operate at peak efficiency. A maintenance plan for compressed air systems should include:

- Inspection, cleaning, and replacement of inlet filter cartridges.
- Cleaning of drain traps.
- Daily inspection of lubricant levels to reduce unwanted friction.
- Inspection of belt condition and tension.
- Check for leaks and adjust loose connections.
- Overall system cleaning.
- Reduce pressure setting to minimum needed for air operated equipment.
- Turn off compressor if not routinely needed.
- Use low pressure blower air rather than high pressure compressed air.

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

Refrigeration Equipment Maintenance

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

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

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

Procurement Strategies

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

6 Water Best Practices

Getting Started

The commercial and institutional sector is the second largest consumer of publicly supplied water in the United States, accounting for 17% of the withdrawals from public water supplies[10]. In New Jersey, excluding water used for power generation, approximately 80% of total water use was attributed to potable supply during the period of 2009 to 2018. Water withdrawals for potable supply have not changed noticeably during the period from 1990 to 2018[11].

Water management planning serves as the foundation for any successful water reduction effort. It is the first step a commercial or institutional facility owner or manager should take to achieve and sustain long-term water savings. Understanding how water is used within a facility is critical for the water management planning process. A water assessment provides a comprehensive account of all known water uses at the facility. It allows the water management team to establish a baseline from which progress and program success can be measured. It also enables the water management team to set achievable goals and identify and prioritize specific projects based on the relative savings opportunities and project cost-effectiveness.

Water conservation devices may significantly reduce your water and sewer usage costs. Any reduction in water use reduces grid-level electricity use since a significant amount of electricity is used to treat and deliver water from reservoirs to end users.

For more information regarding water conservation or additional details regarding the practices shown below go to the EPA's WaterSense website[12] or download a copy of EPA's "WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities"[13] to get ideas for creating a water management plan and best practices for a wide range of water using systems.

Leak Detection and Repair

Identifying and repairing leaks and other water use anomalies within a facility's water distribution system or from processes or equipment can keep a facility from wasting significant quantities of water. Examples of common leaks include leaking toilets and faucets, drip irrigation malfunctions, stuck float valves, and broken distribution lines. Reading meters, installing failure abatement technologies, and conducting visual and auditory inspections are important best practices to detect leaks. Train building occupants, employees, and visitors to report any leaks that they detect. To reduce unnecessary water loss, detected leaks should be repaired quickly. Repairing leaks in water distribution that is pressurized by on-site pumps or in heated or chilled water piping will also reduce energy use.

Toilets and Urinals

Toilets and urinals are considered sanitary fixtures and are found in most facilities. High efficiency fixtures are at least 20% more efficient than available standard products. Leaking or damaged equipment is a substantial source of water waste. Train users to report continuously flushing, leaking, or otherwise improperly operating equipment to the appropriate personnel. Depending on the age of the equipment

---

10 Estimated from analyzing data in: Solley, Wayne B,. et al, "Estimated Use of Water in the United States in 1995", U.S Geological Survey Circular 1200, (1998)

11 https://dep.nj.gov/wp-content/uploads/dsr/trends-water-supply.pdf

12 https://www.epa.gov/watersense

13 https://www.epa.gov/watersense/watersense-work-0

and the frequency of use, it may be cost effective to replace older inefficient fixtures with current generation WaterSense labeled equipment.

Commercial facilities typically use tank toilets or wall-mount flushometers. Educate and inform users with restroom signage and other means to avoid flushing inappropriate objects. For tank toilets, periodically check to ensure fill valves are working properly and that water level is set correctly. Annually test toilets to ensure the flappers are not worn or allowing water to seep from the tank into the bowl and down the sewer. Control stops and piston valves on flushometer toilets should be checked at least annually.

Most urinals use water to flush liquid. These standard single-user fixtures are present in most facilities. Non-water urinals use a specially designed trap that allows liquid waste to drain out of the fixture through a trap seal, and into the drainage system. Flushing urinals should be inspected at least annually for proper valve and sensor operation. For non-water urinals, follow maintenance practices as directed by the manufacturer to ensure products perform as expected. Non-water urinals can be considered during urinal replacement, however, review the condition and design of the existing plumbing system and the expected usage patterns to ensure that these products will provide the anticipated performance.

Faucets and Showerheads

Faucets and showerheads are sanitary fixtures that generally dispense heated water. Reducing water use by these fixtures translates into a reduction of site fuel or electric use depending on how water is heated. High efficiency fixtures are at least 20% more efficient than available standard products. Leaking or damaged equipment is a substantial source of water waste. Train users to report continuously dripping, leaking, or otherwise improperly operating equipment to the appropriate personnel. Depending on the age of the equipment and the frequency of use, it may be cost effective to replace older fixtures with current generation WaterSense labeled equipment.

Faucets are used for a variety of purposes, and standard flow rates are dictated by the intended use. Public use lavatory faucets and kitchen faucets are subject to maximum flow rates while service sinks are not. Periodically inspect faucet aerators for scale buildup to ensure flow is not being restricted. Clean or replace the aerator or other spout end device as needed. Check and adjust automatic sensors (where installed) to ensure they are operating properly to avoid faucets running longer than necessary. Post materials in restrooms and kitchens to ensure user awareness of the facility's water-efficiency goals. Remind users to turn off the tap when they are done and to consider turning the tap off during sanitation activities when it is not being used. Consider installing lavatory and kitchen faucet fixtures with reduced flow. Federal standards limit kitchen and restroom faucet flows to 2.2 gpm. To qualify for a WaterSense label a faucet cannot exceed 1.5 gpm.

Effective in 1992, the maximum allowable flow rate for all showerheads sold in the United States is 2.5 gpm. Since this standard was enacted, many showerheads have been designed to use even less water. WaterSense labeled equipment is designed to use 2.0 gpm, or less. For optimum showerhead efficiency, the system pressure should be tested to make sure that it is between 20 and 80 pounds per square inch (PSI). Verify that plumbing lines are routed through a shower valve to prevent water pressure fluctuations. Periodically inspect showerheads for scale buildup to ensure flow is not being restricted. In general, replace showerheads with 2.5 gpm flow rates or higher with WaterSense labeled models. Note: Use of poor performing replacement reduced flow showerheads may result in increased use if the duration of use is increased to compensate for reduced performance. WaterSense labeled showerheads are independently certified to meet or exceed minimum performance requirements for spray coverage and force.

7 On-Site Generation

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

Preliminary screenings were performed to determine if an on-site generation measure could be a cost-effective solution for your facility. Before deciding to install an on-site generation system, we recommend conducting a feasibility study to analyze existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

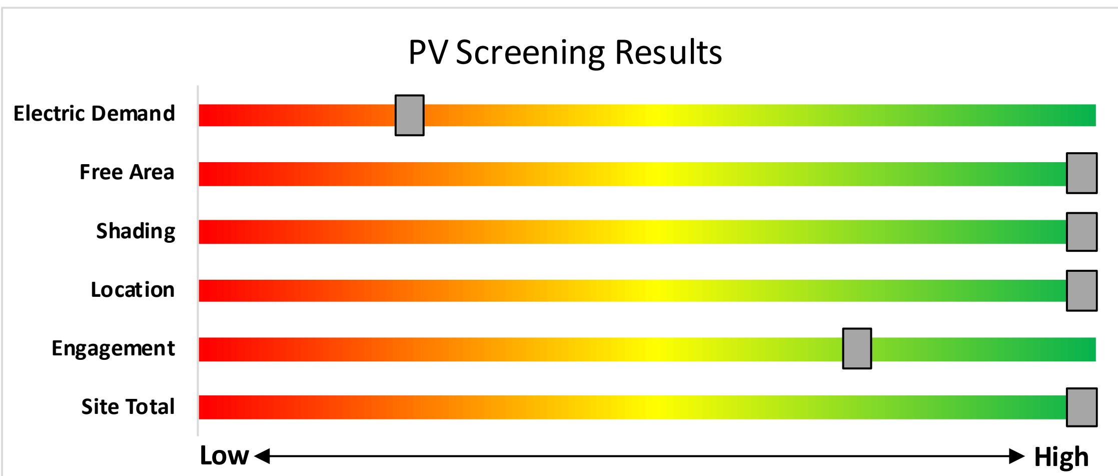
7.1 Solar Photovoltaic

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

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

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

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



Potential	High	
System Potential	69	kW DC STC
Electric Generation	82,204	kWh/yr
Displaced Cost	$11,370	/yr
Installed Cost	$179,400	

Photovoltaic Screening

Successor Solar Incentive Program (SuSI)

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

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

- **Successor Solar Incentive Program (SuSI):** https://www.njcleanenergy.com/renewable-energy/programs/susi-program
- **Basic Info on Solar PV in NJ**: http://www.njcleanenergy.com/whysolar
- **NJ Solar Market FAQs**: ww.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs
- **Approved Solar Installers in the NJ Market**: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/?id=60&start=1

7.2 Combined Heat and Power

Combined heat and power (CHP) generates electricity at the facility and puts waste heat energy to good use. Common types of CHP systems are reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines.

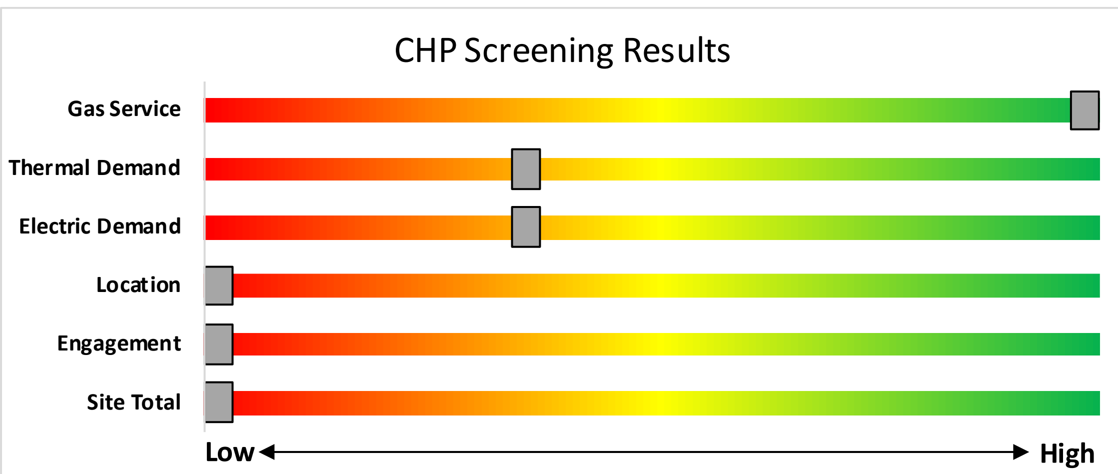
CHP systems typically produce a portion of the electric power used on-site, with the balance of electric power needs supplied by the local utility company. The heat is used to supplement (or replace) existing boilers and provide space heating and/or domestic hot water heating. Waste heat can also be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

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

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

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

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



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/

8 ELECTRIC VEHICLES

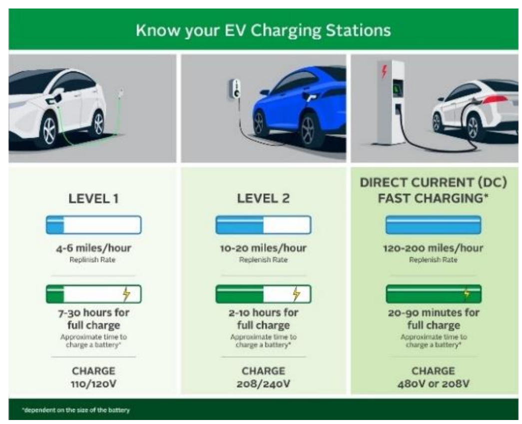
All electric vehicles (EVs) have an electric motor instead of an internal combustion engine. EVs function by plugging into a charge point, taking electricity from the grid, and then storing it in rechargeable batteries. Although electricity production may contribute to air pollution, the U.S. EPA categorizes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

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

8.1 EV Charging

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

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



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

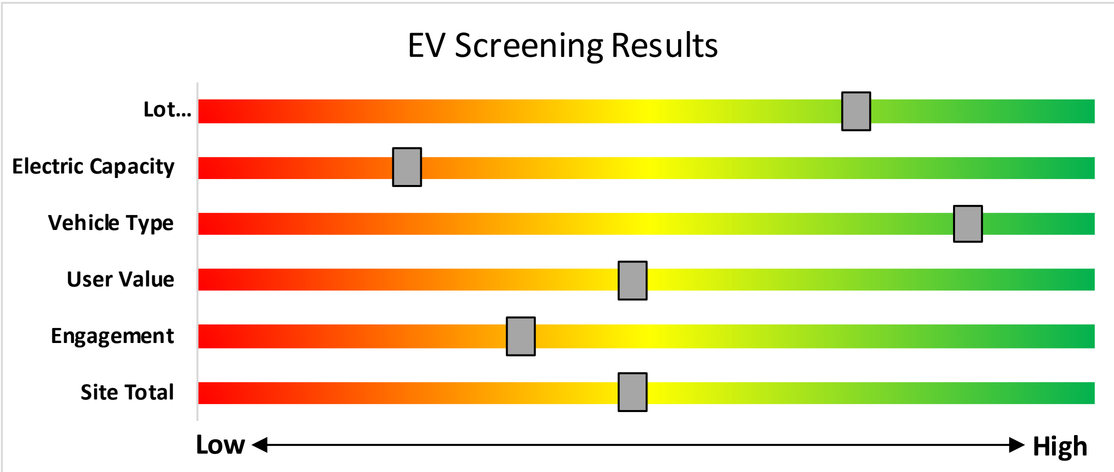
The primary costs associated with installing EV charging are the charger hardware and the cost to extend power from the facility to parking spaces. This may include upgrades to electric panels to serve increased loads.

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

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

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

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



EV Charger Screening

Electric Vehicle Programs Available

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

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

EV Charging incentive information is available from Atlantic City Electric, PSE&G and JCP&L.For more information and to keep up to date on all EV programs please visit https://www.njcleanenergy.com/commercial-industrial/programs/electric-vehicle-programs

9 Project Funding and Incentives

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

NJBPU and NJCEP Administered Programs

- New Construction (residential, commercial, industrial, government)
- Large Energy Users
- Energy Savings Improvement Program (financing)
- State Facilities Initiative*
- Local Government Energy Audits
- Combined Heat & Power & Fuel Cells

*State facilities are also eligible for utility programs

Utility Administered Programs

- Existing buildings (residential, commercial, industrial, government)
- Efficient Products
  - Lighting & Marketplace
  - HVAC
  - Appliance Rebates
  - Appliance Recycling

9.1 New Jersey's Clean Energy Program

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

Large Energy Users

The Large Energy Users Program (LEUP) is designed to foster self-directed investment in energy projects. This program is offered to New Jersey's largest energy customers. To qualify entities must have incurred at least $5 million in total energy costs in the prior fiscal year.

Incentives

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

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

How to Participate

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

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

Combined Heat and Power

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

Incentives[14]

Eligible Technology	Size (Installed Rated Capacity)	Incentive ($/Watt)[5]	% of Total Cost Cap per Project	$ Cap per Project
CHPs powered by non-renewable or renewable fuel source, or a combination:[4] - Gas Internal Combustion Engine - Gas Combustion Turbine - Microturbine Fuel Cells ≥60%	≤500 kW[1]	$2.00	30-40%[2]	$2 million
	>500 kW - 1 MW[1]	$1.00		
	> 1 MW - 3 MW[1]	$0.55	30%	$3 million
	>3 MW[1]	$0.35		
Fuel Cells ≥40%	Same as above[1]	Applicable amount above	30%	$1 million
Waste Heat to Power (WHP)[3] Powered by non-renewable fuel source. Heat recovery or other mechanical recovery from existing equipment utilizing new electric generation equipment (e.g. steam turbine)	≤1MW[1]	$1.00	30%	$2 million
	> 1MW[1]	$.50	30%	$3 million

14

[1] Incentives are tiered, which means the incentive levels vary based upon the installed rated capacity, as listed in the chart above. For example, a 4 MW CHP system would receive $2.00/watt for the first 500 kW, $1.00/watt for the second 500 kW, $0.55/watt for the next 2 MW and $0.35/watt for the last 1 MW (up to the caps listed).
[2] The maximum incentive will be limited to 30% of total project. For CHP projects up to 1 MW, this cap will be increased to 40% where a cooling application is used or included with the CHP system (e.g. absorption chiller).
[3] Projects will be eligible for incentives shown above, not to exceed the lesser of % of total project cost per project cap or maximum $ per project cap. Projects installing CHP or FC with WHP will be eligible for incentive shown above, not to exceed the lesser caps of the CHP or FC incentive. Minimum efficiency will be calculated based on annual total electricity generated, utilized waste heat at the host site (i.e. not lost/rejected), and energy input.
[4] Systems fueled by a Class 1 Renewable Fuel Source, as defined by N.J.A.C. 14:8-2.5, are eligible for a 30% incentive bonus. If the fuel is mixed, the bonus will be prorated accordingly. For example, if the mix is 60/40 (60% being a Class 1 renewable), the bonus will be 18%. This bonus will be included in the final performance incentive payment, based on system performance and fuel mix consumption data. Total incentive, inclusive of bonus, shall not exceed above stipulated caps.
[5] CHP-FC systems located at Critical Facility and incorporating blackstart and islanding technology are eligible for a 25% incentive bonus. This bonus incentive will be paid with the second/Installation incentive payment. Total incentive, inclusive of bonus, shall not exceed above stipulated caps.

How to Participate

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

Successor Solar Incentive Program (SuSI)

The SuSI program replaces the SREC Registration Program (SRP) and the Transition Incentive (TI) program. The program is used to register and certify solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects must register their projects prior to the start of construction to establish the project's eligibility to earn SREC-IIs (Solar Renewable Energy Certificates-II). SuSI consists of two sub-programs. The Administratively Determined Incentive (ADI) Program and the Competitive Solar Incentive (CSI) Program.

Administratively Determined Incentive (ADI) Program

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

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

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

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

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

The ADI Program online portal is now open to new registrations.

Competitive Solar Incentive (CSI) Program

The CSI Program opened on April 15, 2023, and will serve as the permanent program within the SuSI Program providing incentives to larger solar facilities. The CSI Program is open to qualifying grid supply solar facilities, non-residential net metered solar installations with a capacity greater than five (5) megawatts ("MW"), and to eligible grid supply solar facilities installed in combination with energy storage.

CSI eligible facilities will only be allowed to register in the CSI program upon award of a bid pursuant to N.J.A.C. 14:8-11.10.

The CSI program structure has separate categories, or tranches, to ensure that a range of solar project types, including those on preferred sites, are able to participate despite potentially different project cost profiles. The Board has approved four tranches for grid supply and large net metered solar and an additional fifth tranche for storage in combination with grid supply solar. The following table lists procurement targets for the first solicitation:

Tranche	Project Type	MW (dc) Targets
Tranche 1.	Basic Grid Supply	140
Tranche 2.	Grid Supply on the Built Environment	80
Tranche 3.	Grid Supply on Contaminated Sites and Landfills	40
Tranche 4.	Net Metered Non- Residential	40
Tranche 5.	*Storage Paired with Grid	160 MWh

*The storage tranche of 160 MWh corresponds to a 4-hour storage pairing of 40 MW of solar

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

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

Energy Savings Improvement Program

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

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

How to Participate

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

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

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

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

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

Demand Response (DR) Energy Aggregator

Demand Response Energy Aggregator is a program designed to reduce the electric load when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Grid operators call upon curtailment service providers and commercial facilities to reduce electric usage during times of peak demand, making the grid more reliable and reducing transmission costs for all ratepayers. Curtailment service providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary, and participants receive payments whether or not their facility is called upon to curtail its electric usage.

Typically, an electric customer must be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with greater capability to quickly curtail their demand during peak hours receive higher payments. Customers with back-up generators on site may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in DR programs often find it to be a valuable source of revenue for their facility, because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature setpoints on thermostats (so that air conditioning units run less frequently) or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a DR activity in most situations.

The first step toward participation in a DR program is to contact a curtailment service provider. A list of these providers is available on the website of the independent system operator, PJM, and it includes contact information for each company, as well as the states where they have active business[15]. PJM also posts training materials for program members interested in specific rules and requirements regarding DR activity along with a variety of other DR program information[16].

Curtailment service providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities, and they may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

[15] http://www.pjm.com/markets-and-operations/demand-response.aspx.

[16] http://www.pjm.com/training/training-events.aspx.

9.2 Utility Energy Efficiency Programs

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

Prescriptive and Custom

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

Equipment Examples

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

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

Direct Install

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

Incentives

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

How to Participate

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

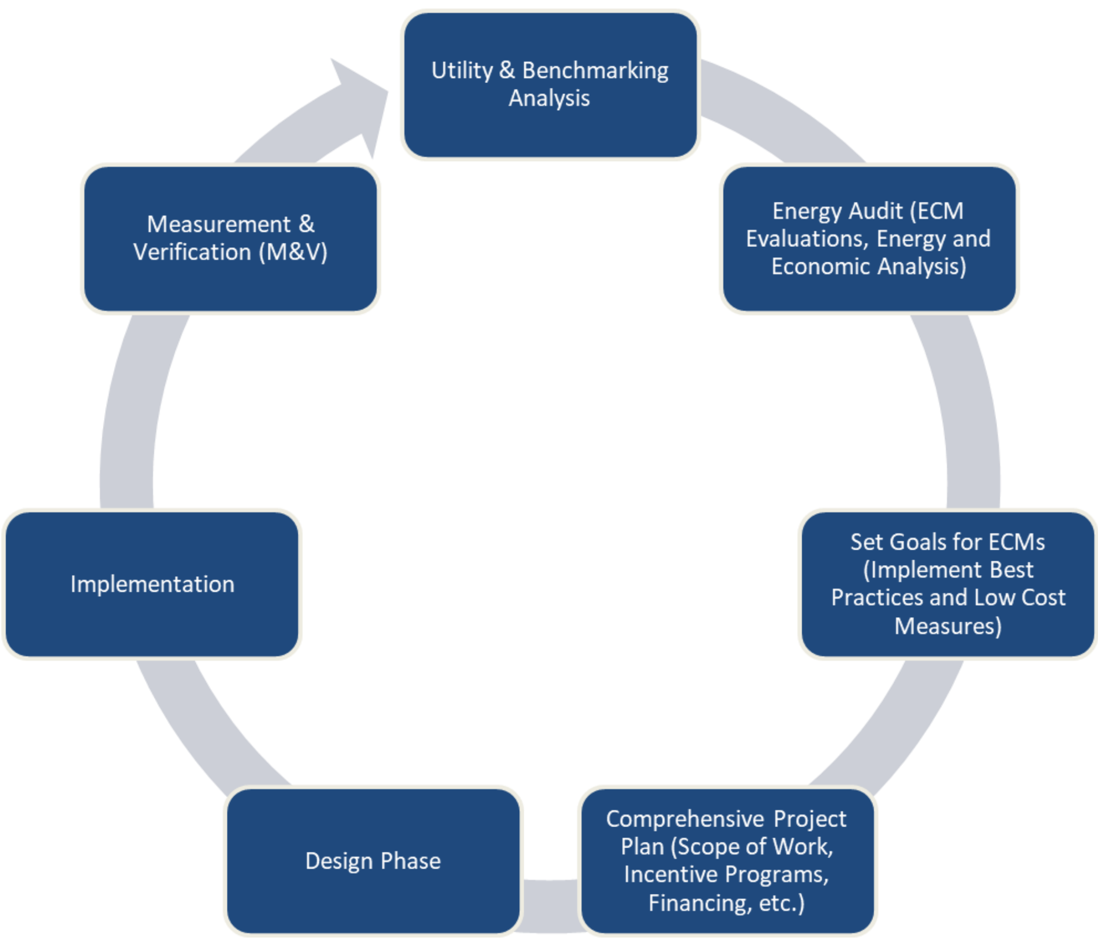
Engineered Solutions

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

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

10 Project Development

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



Project Development Cycle

11 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

11.1 Retail Electric Supply Options

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

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

A list of licensed third-party electric suppliers is available at the NJBPU website[17].

11.2 Retail Natural Gas Supply Options

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

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

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

A list of licensed third-party natural gas suppliers is available at the NJBPU website[18].

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

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

Appendix A: Equipment Inventory & Recommendations

Lighting Inventory & Recommendations

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Auditorium	1	Compact Fluorescent: (1) 26W A19 Screw-In Lamp	Wall Switch	S	26	2,250	2	Relamp	No	1	LED Lamps: LED Lamp	Wall Switch	19	2,250	0.0	16	0	$2	$30	$0	14.1
Auditorium	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
Auditorium	120	Halogen Incandescent: (1) 40W A19 Screw-In Lamp	Wall Switch	S	40	2,250	2, 3	Relamp	Yes	120	LED Lamps: LED Lamp	Occupancy Sensor	6	1,553	2.2	9,682	-2	$1,311	$5,680	$400	4.0
Auditorium	3	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	2,250	2, 3	Relamp	Yes	3	LED Lamps: LED Lamp	Occupancy Sensor	9	1,553	0.1	363	0	$49	$410	$40	7.5
Band room	6	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,250	3	None	Yes	6	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,553	0.0	182	0	$25	$330	$40	11.8
Classroom 1	9	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	231	0	$31	$330	$40	9.3
Classroom 10	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 11	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 12	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 13	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 14	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 15	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 16	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 17	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 18	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 19	9	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	1,900	3	None	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 2	9	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	231	0	$31	$330	$40	9.3
Classroom 20	6	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	1,900	3	None	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,311	0.1	205	0	$28	$330	$40	10.4
Classroom 21	3	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	1,900	2, 3	Relamp	Yes	3	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,311	0.1	224	0	$30	$600	$70	17.5
Classroom 22 Art Room	4	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	1,900	2, 3	Relamp	Yes	4	LED Lamps: LED Lamp	Occupancy Sensor	9	1,311	0.1	409	0	$55	$100	$0	1.8
Classroom 22 Art Room	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,900	3	None	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,311	0.0	51	0	$7	$0	$0	0.0
Classroom 22 Art Room	8	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	1,900	3	None	Yes	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,311	0.1	273	0	$37	$330	$40	7.8
Classroom 23	5	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	1,900	3	None	Yes	5	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,311	0.0	171	0	$23	$330	$40	12.5
Classroom 24	6	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	6	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.0	154	0	$21	$330	$40	13.9
Classroom 3	9	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	231	0	$31	$330	$40	9.3

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Classroom 4	9	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	231	0	$31	$330	$40	9.3
Classroom 5	9	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	231	0	$31	$330	$40	9.3
Classroom 6	9	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	231	0	$31	$330	$40	9.3
Classroom 7	9	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	231	0	$31	$330	$40	9.3
Classroom 8	9	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	9	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	231	0	$31	$330	$40	9.3
Classroom 9	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom 9A	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	307	0	$42	$330	$40	7.0
Classroom D	1	Compact Fluorescent: (1) 26W A19 Screw-In Lamp	Wall Switch	S	26	1,900	2, 3	Relamp	Yes	1	LED Lamps: LED Lamp	Occupancy Sensor	19	1,311	0.0	24	0	$3	$30	$0	9.0
Classroom D	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	1,900	3	None	Yes	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Occupancy Sensor	13	1,311	0.0	8	0	$1	$0	$0	0.0
Classroom D	4	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.0	102	0	$14	$330	$40	20.9
Corridor	11	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	11	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Corridor	3	Halogen Incandescent: (1) 90W A19 Screw-In Lamp	Wall Switch	S	90	3,600	2, 4	Relamp	Yes	3	LED Lamps: LED Lamp	High/Low Control	14	2,484	0.1	868	0	$117	$80	$0	0.7
Corridor	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,600	4	None	Yes	1	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,484	0.0	32	0	$4	$0	$0	0.0
Corridor	86	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	3,600	4	None	Yes	86	LED - Linear Tubes: (3) 4' Lamps	High/Low Control	44	2,484	0.6	4,175	-1	$565	$4,230	$3,010	2.2
Corridor	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,600	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,484	0.0	194	0	$26	$0	$0	0.0
Custodian	1	Halogen Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	4,000	2	Relamp	No	1	LED Lamps: LED Lamp	Wall Switch	9	4,000	0.0	204	0	$28	$30	$0	1.1
Custodian	3	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	4,000	2, 3	Relamp	Yes	3	LED Lamps: LED Lamp	Occupancy Sensor	9	2,760	0.1	645	0	$87	$410	$40	4.2
Custodian	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	4,000		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	4,000	0.0	0	0	$0	$0	$0	0.0
Custodian	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	4,000	2, 3	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,760	0.1	504	0	$68	$480	$70	6.0
Custodian	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	4,000	2	Relamp	No	1	LED Lamps: LED Lamp	Wall Switch	9	4,000	0.0	204	0	$28	$30	$0	1.1
Exterior	2	Compact Fluorescent: (1) 26W Plug-In Lamp	Photocell		26	4,380	2	Relamp	No	2	LED Lamps: LED Lamp	Photocell	19	4,380	0.0	61	0	$8	$50	$0	5.9
Exterior	4	Halogen Incandescent: (1) 75W A19 Screw-In Lamp	Timeclock		75	4,380	2	Relamp	No	4	LED Lamps: LED Lamp	Timeclock	12	4,380	0.0	1,104	0	$153	$100	$0	0.7
Exterior	12	LED Lamps: (1) 13W Plug-In Lamp	Photocell		13	4,380		None	No	12	LED Lamps: (1) 13W Plug-In Lamp	Photocell	13	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior	3	LED - Fixtures: Wall Pack	Photocell		120	4,380		None	No	3	LED - Fixtures: Wall Pack	Photocell	120	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior	1	LED - Fixtures: Wall Pack	Photocell		35	4,380		None	No	1	LED - Fixtures: Wall Pack	Photocell	35	4,380	0.0	0	0	$0	$0	$0	0.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis							
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Exterior	1	High-Pressure Sodium: (1) 35W Lamp	Photocell		46	4,380	1	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	11	4,380	0.0	153	0	$21	$180	$50	6.1
Exterior	6	Metal Halide: (1) 100W Lamp	Photocell		128	4,380	1	Fixture Replacement	No	6	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	30	4,380	0.0	2,575	0	$356	$1,970	$300	4.7
Exterior	6	Metal Halide: (1) 150W Lamp	Photocell		190	4,380	1	Fixture Replacement	No	6	LED - Fixtures: Large Pole/Arm-Mounted Area/Roadway Fixture	Photocell	45	4,380	0.0	3,811	0	$527	$4,100	$0	7.8
Exterior Hatch-Mechanical	1	Compact Fluorescent: (1) 26W A19 Screw-In Lamp	Wall Switch	S	26	1,000	2	Relamp	No	1	LED Lamps: LED Lamp	Wall Switch	19	1,000	0.0	7	0	$1	$30	$0	31.6
Exterior Hatch-Mechanical	4	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	1,000	2	Relamp	No	4	LED Lamps: LED Lamp	Wall Switch	9	1,000	0.1	204	0	$28	$100	$0	3.6
Exterior Hatch-Mechanical	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	1,000		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	1,000	0.0	0	0	$0	$0	$0	0.0
Gymnasium	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
Gymnasium	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	2,250	2	Relamp	No	1	LED Lamps: LED Lamp	Wall Switch	9	2,250	0.0	115	0	$16	$30	$0	1.9
Gymnasium	4	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,250	3	None	Yes	4	LED Lamps: (1) 13W A19 Screw-In Lamp	Occupancy Sensor	13	1,553	0.0	36	0	$5	$0	$0	0.0
Gymnasium	6	LED - Fixtures: Ceiling Mount	Wall Switch	S	20	2,250	3	None	Yes	6	LED - Fixtures: Ceiling Mount	Occupancy Sensor	20	1,553	0.0	84	0	$11	$0	$0	0.0
Gymnasium	16	LED - Fixtures: High-Bay	Wall Switch	S	105	2,250	3	None	Yes	16	LED - Fixtures: High-Bay	Occupancy Sensor	105	1,553	0.3	1,172	0	$159	$660	$70	3.7
Gymnasium	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,250	2, 3	Relamp	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,553	0.0	94	0	$13	$50	$10	3.1
Kitchen	4	Compact Fluorescent: (1) 26W A19 Screw-In Lamp	Wall Switch	S	26	2,520	2, 3	Relamp	Yes	4	LED Lamps: LED Lamp	Occupancy Sensor	19	1,739	0.0	130	0	$18	$100	$0	5.7
Kitchen	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	2,520	2, 3	Relamp	Yes	1	LED Lamps: LED Lamp	Occupancy Sensor	9	1,739	0.0	136	0	$18	$30	$0	1.6
Kitchen	5	LED Lamps: (1) 18.5W Plug-In Lamp	Wall Switch	S	19	2,520	3	None	Yes	5	LED Lamps: (1) 18.5W Plug-In Lamp	Occupancy Sensor	19	1,739	0.0	72	0	$10	$330	$40	29.6
Kitchen	1	LED - Fixtures: Ceiling Mount	Wall Switch	S	28	2,520	3	None	Yes	1	LED - Fixtures: Ceiling Mount	Occupancy Sensor	28	1,739	0.0	22	0	$3	$0	$0	0.0
Kitchen	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	2,520	3	None	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,739	0.0	45	0	$6	$330	$40	47.3
Library	3	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	1,900	3	None	Yes	3	LED Lamps: (1) 13W A19 Screw-In Lamp	Occupancy Sensor	13	1,311	0.0	23	0	$3	$0	$0	0.0
Library	19	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,900	3	None	Yes	19	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,311	0.1	487	0	$66	$660	$70	9.0
Library	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,900		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,900	0.0	0	0	$0	$0	$0	0.0
Mechanical 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
Mechanical Room	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	4,000		None	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,000	0.0	0	0	$0	$0	$0	0.0
Mechanical Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	4,000	2	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	4,000	0.1	528	0	$71	$200	$40	2.2
Office - Counsel E	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,025		None	No	1	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,025	0.0	0	0	$0	$0	$0	0.0
Office - Facility Dining	2	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	2,025	2, 3	Relamp	Yes	2	LED Lamps: LED Lamp	Occupancy Sensor	9	1,397	0.1	218	0	$30	$380	$40	11.5

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Office - Facility Dining	4	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,025	3	None	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,397	0.0	109	0	$15	$330	$40	19.6
Office - Facility Dining	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,025		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,025	0.0	0	0	$0	$0	$0	0.0
Office - Main	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,025		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	2,025	0.0	0	0	$0	$0	$0	0.0
Office - Main	6	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	2,025	3	None	Yes	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,397	0.1	218	0	$30	$330	$40	9.8
Office - Nurse	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,025	3	None	Yes	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Occupancy Sensor	13	1,397	0.0	16	0	$2	$0	$0	0.0
Office - Nurse	3	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,025	3	None	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,397	0.0	82	0	$11	$0	$0	0.0
Restroom - Female	5	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	1,520	2, 3	Relamp	Yes	5	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,049	0.1	298	0	$40	$770	$90	16.8
Restroom - Female	7	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	S	15	1,049		None	No	7	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,049	0.0	0	0	$0	$0	$0	0.0
Restroom - Male	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
Restroom - Male	7	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	S	15	1,049		None	No	7	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,049	0.0	0	0	$0	$0	$0	0.0
Restroom - Male	5	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	1,520	2, 3	Relamp	Yes	5	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,049	0.1	298	0	$40	$770	$90	16.8
Restroom - Unisex	2	Compact Fluorescent: (1) 26W A19 Screw-In Lamp	Wall Switch	S	26	1,520	2	Relamp	No	2	LED Lamps: LED Lamp	Wall Switch	19	1,520	0.0	21	0	$3	$50	$0	17.4
Restroom - Unisex	2	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	1,520	2, 3	Relamp	Yes	2	LED Lamps: LED Lamp	Occupancy Sensor	9	1,049	0.1	164	0	$22	$380	$40	15.4
Restroom - Unisex	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	1,520		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	1,520	0.0	0	0	$0	$0	$0	0.0
Restroom - Unisex	2	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	1,520	2, 3	Relamp	Yes	2	LED Lamps: LED Lamp	Occupancy Sensor	9	1,049	0.1	164	0	$22	$380	$40	15.4
Restroom - Unisex	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	1,520		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	1,520	0.0	0	0	$0	$0	$0	0.0
Restroom - Unisex	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	1,520		None	No	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	1,520	0.0	0	0	$0	$0	$0	0.0
Server Room	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,025		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,025	0.0	0	0	$0	$0	$0	0.0
Storage	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	400	2	Relamp	No	1	LED Lamps: LED Lamp	Wall Switch	9	400	0.0	20	0	$3	$30	$0	10.9
Storage	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	400		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	400	0.0	0	0	$0	$0	$0	0.0
Storage	1	LED Lamps: (2) 13W A19 Screw-In Lamps	Wall Switch	S	26	400		None	No	1	LED Lamps: (2) 13W A19 Screw-In Lamps	Wall Switch	26	400	0.0	0	0	$0	$0	$0	0.0
Storage closet	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	400	2	Relamp	No	1	LED Lamps: LED Lamp	Wall Switch	9	400	0.0	20	0	$3	$30	$0	10.9
Storage Closets	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	400	2	Relamp	No	1	LED Lamps: LED Lamp	Wall Switch	9	400	0.0	20	0	$3	$30	$0	10.9
Storage F block	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	400	2	Relamp	No	1	LED Lamps: LED Lamp	Wall Switch	9	400	0.0	20	0	$3	$30	$0	10.9
Theater	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Theater	18	Halogen Incandescent: (1) 90W A19 Screw-In Lamp	Wall Switch	S	90	2,250	2, 3	Relamp	Yes	18	LED Lamps: LED Lamp	Occupancy Sensor	14	1,553	0.7	3,254	-1	$441	$1,120	$90	2.3
Theater	7	LED - Fixtures: High-Bay	Wall Switch	S	35	2,250	3	None	Yes	7	LED - Fixtures: High-Bay	Occupancy Sensor	35	1,553	0.0	171	0	$23	$330	$40	12.5

Motor Inventory & Recommendations

		Existing Conditions									Proposed Conditions					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Manufacturer	Model	Remaining Useful Life	Annual Operating Hours	ECM #	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Domestic Hot Water System	1	DHW Circulation Pump	0.08	65.0%	No		QD48S17D1048W	W	8,760		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	HVAC Pneumatic System	1	Air Compressor	1.00	85.5%	No	Dayton	2NKX3	W	100		No	85.5%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	HVAC Pneumatic System	1	Air Compressor	1.00	82.5%	No	Marathon	E715	W	100		No	82.5%	No		0.0	0	0	$0	$0	$0	0.0
Custodian	Boiler Feed Water Pump	2	Boiler Feed Water Pump	0.75	76.2%	No	Worldwide Electric Corp	NATJ34-36-56-JB	W	1,922		No	76.2%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Condensate Return Pump	2	Condensate Pump	1.00	82.0%	No			W	1,922		No	82.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Domestic Hot Water System	2	DHW Circulation Pump	0.08	65.0%	No	Bell & Gossett		W	8,760		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Kitchen	Kitchen Hood Exhaust Fan	1	Kitchen Hood Exhaust Fan	0.50	70.0%	No			W	2,625		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom 22 Art Room	Wall Exhaust Fan	1	Exhaust Fan	0.20	65.0%	No			W	2,059		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Kitchen Exhaust Fan-EF #6	1	Kitchen Hood Exhaust Fan	0.17	65.0%	No			W	2,625		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Bathroom Exhaust	4	Exhaust Fan	0.17	65.0%	No			W	2,059		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Bathroom Exhaust	1	Exhaust Fan	0.33	65.0%	No			W	2,059		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Hall and Classroom EF #3	1	Exhaust Fan	1.00	75.0%	No			W	2,059		No	75.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Classroom Exhaust EF #8	1	Exhaust Fan	0.17	65.0%	No			W	2,059		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Dining Room Exhaust	1	Exhaust Fan	0.17	65.0%	No			W	2,059		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Gymnasium	Unit Heater	1	Supply Fan	0.25	65.0%	No			W	2,059		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Kitchen	Unit Heater	1	Supply Fan	0.25	65.0%	No			W	2,059		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Staff dining, Music and Counselor	1	Supply Fan	0.75	75.0%	No			B	2,059		No	75.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	School- Cooling RTU	1	Supply Fan	0.50	70.0%	No			B	2,059		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Hatch-Mechanical	Bathroom Exhaust	1	Exhaust Fan	2.00	80.0%	No	Century	SC-224-NGC6-5	B	2,059	5	Yes	86.5%	No		0.1	216	0	$30	$700	$0	23.4
Exterior Hatch-Mechanical	Auditroium Exhaust	1	Exhaust Fan	2.00	80.0%	No	Century	SC-224-NGC6-5	B	2,059	5	Yes	86.5%	No		0.1	216	0	$30	$700	$0	23.4

		Existing Conditions									Proposed Conditions					Energy Impact & Financial Analysis						
Location	**Area(s)/System(s) Served**	**Motor Quantity**	**Motor Application**	**HP Per Motor**	**Full Load Efficiency**	**VFD Control?**	**Manufacturer**	**Model**	**Remaining Useful Life**	**Annual Operating Hours**	**ECM #**	**Install High Efficiency Motors?**	**Full Load Efficiency**	**Install VFDs?**	**Number of VFDs**	**Total Peak kW Savings**	**Total Annual kWh Savings**	**Total Annual MMBtu Savings**	**Total Annual Energy Cost Savings**	**Estimated M&L Cost ($)**	**Total Incentives**	**Simple Payback w/ Incentives in Years**
Exterior Hatch-Mechanical	Old Classroom Exhaust	1	Exhaust Fan	2.00	80.0%	No	Century	SC-224-NGC6-5	B	2,059	5	Yes	86.5%	No		0.1	216	0	$30	$700	$0	23.4
Office Main	Ceiling Cassette	1	Supply Fan	0.25	65.0%	No	Fujitsu		W	2,059		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Hatch-Mechanical	Air Handling Unit-Gymnsaium	1	Supply Fan	0.75	70.0%	No			W	2,059		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Hatch-Mechanical	Air Handling Unit-Auditorium	1	Supply Fan	0.75	70.0%	No			W	2,059		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Various Classrooms and Offices	Unit Ventilator	25	Supply Fan	0.25	65.0%	No			W	2,059		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0

Packaged HVAC Inventory & Recommendations

		Existing Conditions									Proposed Conditions								Energy Impact & Financial Analysis						
Location	**Area(s)/System(s) Served**	**System Quantity**	**System Type**	**Cooling Capacity per Unit (Tons)**	**Heating Capacity per Unit (MBh)**	**Cooling Mode Efficiency (SEER/IEER/EER)**	**Heating Mode Efficiency**	**Manufacturer**	**Model**	**Remaining Useful Life**	**ECM #**	**Install High Efficiency System?**	**System Quantity**	**System Type**	**Cooling Capacity per Unit (Tons)**	**Heating Capacity per Unit (MBh)**	**Cooling Mode Efficiency (SEER/IEER/EER)**	**Heating Mode Efficiency**	**Total Peak kW Savings**	**Total Annual kWh Savings**	**Total Annual MMBtu Savings**	**Total Annual Energy Cost Savings**	**Estimated M&L Cost ($)**	**Total Incentives**	**Simple Payback w/ Incentives in Years**
Classroom 13	Classroom 13 - Cooling	1	Window AC	1.00		10.02		Electrolux	FAC125P1A	B	6	Yes	1	Window AC	1.00		12.00		0.1	78	0	$11	$1,000	$0	92.8
Classroom 13	Classroom 13 - Cooling	1	Window AC	1.00		9.28		White Westinghouse		B	6	Yes	1	Window AC	1.00		12.00		0.1	116	0	$16	$1,000	$0	62.5
Classroom 2	Classroom 2 - Cooling	1	Window AC	2.00		10.40		Friedrich	KCL24A30B-A	W		No							0.0	0	0	$0	$0	$0	0.0
Classroom 21	Classroom 21 - Cooling	1	Window AC	0.50		10.00				W		No							0.0	0	0	$0	$0	$0	0.0
Classroom 3	Classroom 3 - Cooling	1	Window AC	1.50		9.28		Frigidaire		B	6	Yes	1	Window AC	1.50		12.00		0.2	174	0	$24	$1,200	$0	50.0
Classroom 3	Classroom 3 - Cooling	1	Window AC	1.50		10.00				W		No							0.0	0	0	$0	$0	$0	0.0
Classroom D	Classroom D - Cooling	1	Window AC	1.50		9.28		Carrier		B	6	Yes	1	Window AC	1.50		12.00		0.2	174	0	$24	$1,200	$0	50.0
Library	Library - Cooling	2	Window AC	2.08		8.35		Friedrich	KL25J30A-3	B	6	Yes	2	Window AC	2.08		12.00		0.9	718	0	$99	$3,600	$0	36.2
Office - Main	Office - Main - Cooling	1	Window AC	0.50		9.28				W		No							0.0	0	0	$0	$0	$0	0.0
Office - Nurse	Office - Nurse - Cooling	1	Window AC	0.67		9.28		Friedrich		B	6	Yes	1	Window AC	0.67		12.00		0.1	77	0	$11	$900	$0	84.4
Office- Main	Unit Heater	1	Unit Heater		2.56		1 COP	Berko				No							0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	School- Cooling RTU	1	Package Unit	2.00		9.28		York	DCYP-F024N070B	B	6	Yes	1	Package Unit	2.00		16.00		0.5	428	0	$59	$5,700	$200	92.8
Exterior Rooftop	Staff dining, Music and Counselor	1	Package Unit	4.00	75.00	9.28	0.8 AFUE	Aaon	HB-004-B-H-BA02-232	B	6	Yes	1	Package Unit	4.00	75.00	16.00	0.82 AFUE	1.1	857	2	$143	$11,300	$400	76.5
Exterior Rooftop	Main Office	1	Ductless Mini-Split HP	1.50	22.00	12.50	9.3 HSPF	Fujitsu	AOU18RLX	W		No							0.0	0	0	$0	$0	$0	0.0

Space Heating Boiler Inventory & Recommendations

		Existing Conditions						Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Manufacturer	Model	Remaining Useful Life	ECM #	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Steam Heating System	1	Forced Draft Steam Boiler	2,249	Smith	28HE-9	W		No						0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Steam Heating System	1	Forced Draft Steam Boiler	2,513	Smith	28HE-10	W		No						0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Steam Heating System	1	Forced Draft Steam Boiler	1,611	HB Smith	28-9	B	7	Yes	1	Forced Draft Steam Boiler	1,611	81.00%	Et	0.0	0	26	$320	$53,100	$1,900	159.9

Demand Control Ventilation Recommendations

		Recommendation Inputs					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Affected	ECM #	Number of Zones	Cooling Capacity of Controlled System (Tons)	Electric Heating Capacity of Controlled System (kBtu/hr)	Output Heating Capacity of Controlled System (MBh)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Multipurpose Room	Heating and Ventilation	8	1.00	0.00	0.00	348.00	0.0	0	7	$89	$1,500	$0	16.8
Auditorium	Heating and Ventilation	8	1.00	0.00	0.00	231.00	0.0	0	5	$59	$1,500	$0	25.3

DHW Inventory & Recommendations

		Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Manufacturer	Model	Remaining Useful Life	ECM #	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Domestic Hot Water System	1	Storage Tank Water Heater (> 50 Gal)	A.O. Smith	BTH 199 100	W		No						0.0	0	0	$0	$0	$0	0.0

Low-Flow Device Recommendations

	Recommendation Inputs					Energy Impact & Financial Analysis						
Location	ECM #	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	9	1	Faucet Aerator (Kitchen)	2.50	1.50	0.0	0	0	$2	$10	$0	4.8
Various Classroom and Restroom	9	24	Faucet Aerator (Lavatory)	2.20	0.50	0.0	0	7	$85	$200	$100	1.2

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	Manufacturer	Model	ENERGY STAR Qualified?	ECM #	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Freezer Chest	Avanti		No	10	Yes	0.3	3,026	0	$418	$2,300	$0	5.5
Kitchen	1	Refrigerator Chest	Powers		No	10	Yes	0.1	1,006	0	$139	$2,700	$0	19.4
Kitchen	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	TRUE	T-49F	No	10	Yes	0.3	2,507	0	$347	$3,400	$300	8.9
Kitchen	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	Atosa	MBF8002	Yes		No	0.0	0	0	$0	$0	$0	0.0
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Traulsen	G200100	Yes		No	0.0	0	0	$0	$0	$0	0.0
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Traulsen	G20000	Yes		No	0.0	0	0	$0	$0	$0	0.0

Cooking Equipment Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	Manufacturer	Model	High Efficiency Equipement?	ECM #	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Cooktop/ Oven	Vulcan		No		No	0.0	0	0	$0	$0	$0	0.0
Kitchen	1	Gas Convection Oven (Full Size)	Blodgett	Zephaire	Yes		No	0.0	0	0	$0	$0	$0	0.0

Plug Load Inventory

Location	Existing Conditions					
	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Office - Facility Dining	3	Coffee Machine	800	No		
Office - Main	2	Coffee Machine	800	No		
Classroom 21	1	Desktop	150	No		
Office - Counsel E	1	Desktop	150	No		
Office - Main	3	Desktop	150	No		
Office - Nurse	1	Desktop	150	No		
Classroom 22 Art Room	1	Kiln	11,520	No	Skutt Electric	1027-240
Office - Facility Dining	1	Microwave	1,000	No		
Office - Main	1	Microwave	1,000	No		
Custodian	1	Refrigerator (Mini)	153	No		
Office - Main	1	Refrigerator (Mini)	153	No		
Office - Facility Dining	1	Refrigerator (Residential)	218	No		
Server Room	1	Refrigerator (Residential)	218	No		
Kitchen	1	Serving Table (Chilled/Heated)	1,920	No		
Custodian	1	Toaster Oven	1,200	No		
Office - Facility Dining	1	Toaster Oven	1,200	No		
Various Classroom and Offices	22	Printer (Medium/Small)	200	No		
Various Offices	2	Printer/Copier (Large)	600	Yes		
Various Classroom and Offices	13	Projector	200	No		
Various Classroom and Offices	22	Smart Board	235	Yes	Promethean	
Various Restrooms	3	Hand Dryer	1,200	No		
Various Classroom and Offices	40	Air purifier	120	No	Medify Air	MA-112
Custodian Room	1	Grinder	248	No	Stanley	677
Mechanical Room	1	Refrigerant Dryer	200	No	Speedaire	3YA49A
Various Classroom and Offices	361	Chromebook	45	No		

Custom (High Level) Measure Analysis

Retro-Commissioning Study

Building Square Footage	45,178
Percent of Conditioned Area Impacted	100%
Fuel Utility Rate	$12.498 MMBtu
Blended Electric Utility Rate	$0.138 kWh

Existing Conditions						Proposed Conditions					Energy Impact & Financial Analysis										
Description	Area(s)/System(s) Served	Remaining Useful Life	Total HVAC Motor Usage kWh	Total HVAC Electric Usage kWh	Total HVAC Fuel Usage MMBtu	Description	% Savings HVAC Motor Usage kWh	% Savings HVAC Electric Usage kWh	% Savings HVAC Fuel Usage MMBtu	Estimated Cost per Sqft	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Base Incentives	Enhanced Incentives	Total Incentives	Total Net Cost	Payback w/o Incentives in Years	Simple Payback w/ Incentives in Years
Controls Not Currently Optimized	HVAC Equipment & Systems	3	37,922	13,563	2,697	Retro-Commissioning Study	7%	3%	7%	$0.50	0.00	3,061	189	$2,783	$26,300	$0	$0	$0	$26,300	9.45	9.45

Appendix B: ENERGY STAR Statement of Energy Performance

Energy use intensity (EUI) is presented in terms of site energy and source energy. Site energy is the amount of fuel and electricity consumed by a building as reflected in utility bills. Source energy includes fuel consumed to generate electricity consumed at the site, factoring in electric production and distribution losses for the region. NJCEP uses the EPA's ENERGY STAR Portfolio Manager system to generate baseline energy usage results and comparable building EUIs. Portfolio Manager is specifically designed for benchmarking energy consumption within a building.

LEARN MORE AT energystar.gov

ENERGY STAR® Statement of Energy Performance

38

ENERGY STAR® Score[1]

Thomas Jefferson Elementary

Primary Property Type: K-12 School
Gross Floor Area (ft²): 45,178
Built: 1958

For Year Ending: July 31, 2023
Date Generated: May 06, 2024

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

Property & Contact Information

Property Address	Property Owner	Primary Contact
Thomas Jefferson Elementary 101 James Street Morristown, New Jersey 07960	Morris School District 31 Hazel Street Morristown, NJ 07960 (973) 292-2300	Anthony Lo Franco 31 Hazel Street Morristown, NJ 07960 (973) 292-2300 x2021 Anthony.LoFranco@msdk12.net

Property ID: 32587378

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
77.2 kBtu/ft²

Source EUI
107.1 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	672,473 (19%)
Natural Gas (kBtu)	2,816,293 (81%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	69.2
National Median Source EUI (kBtu/ft²)	96
% Diff from National Median Source EUI	12%

Annual Emissions

Total (Location-Based) GHG Emissions (Metric Tons CO2e/year)	210

Signature & Stamp of Verifying Professional

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

LP Signature: ____________________ Date: __________

Licensed Professional

____ ________
,
(____)____-______
____

Professional Engineer or Registered Architect Stamp
(if applicable)

Appendix C: Glossary

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

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

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