# Local Government Energy Audit Report

Maugham Elementary School

October 14, 2022

| *Prepared for:* | *Prepared by:* |
|---|---|
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# Disclaimer

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

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

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

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

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

# Table of Contents

## Energy Efficiency Incentive & Rebate Transition

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

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

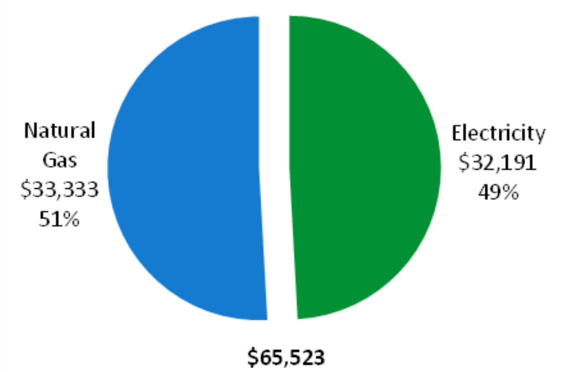
These next generation energy efficiency programs feature new ways of managing and delivering programs historically administered by New Jersey's Clean Energy Program™ (NJCEP). All of the investor-owned gas and electric utility companies will now also offer complementary energy efficiency programs and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

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

# 1 Executive Summary

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

## BUILDING PERFORMANCE REPORT

| | | |
|---|---|---|
| Annual Utilities | Costs: $65,523<br>Electricity: 204,346 kWh<br>Natural Gas: 42,898 Therms |  |
| ENERGY STAR® Benchmarking Score | 36<br>*(1-100 scale)* | This building performs at or below the national average. This report contains suggestions about how to improve building performance and reduce energy costs. |

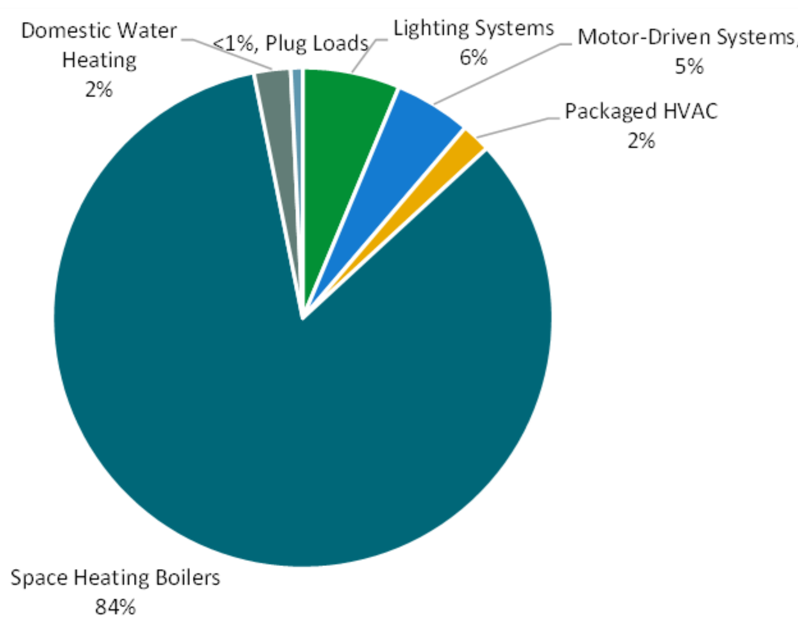


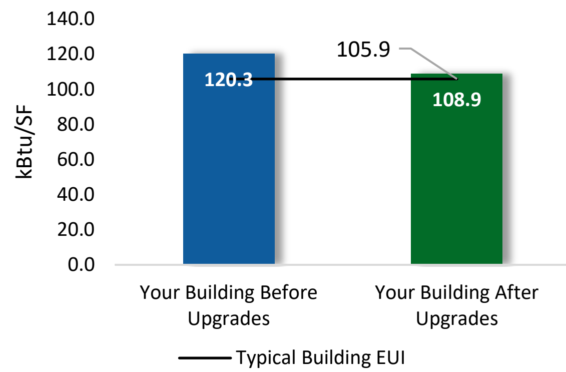

***Figure 1 - Energy Use by System***

## POTENTIAL IMPROVEMENTS

This energy audit considered a range of potential energy improvements in your building. Costs and savings will vary between improvements. Presented below are two potential scopes of work for your consideration.

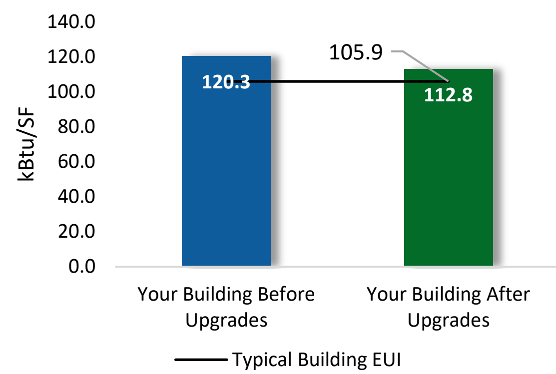
### Scenario 1: Full Package (All Evaluated Measures)

| | |
|---|---|
| Installation Cost | $196,026 |
| Potential Rebates & Incentives[1] | $20,654 |
| Annual Cost Savings | $15,612 |
| Annual Energy Savings | Electricity: 91,140 kWh<br>Natural Gas: 1,614 Therms |
| Greenhouse Gas Emission Savings | 55 Tons |
| Simple Payback | 11.2 Years |
| Site Energy Savings (All Utilities) | 9% |




### Scenario 2: Cost Effective Package[2]

| | |
|---|---|
| Installation Cost | $68,748 |
| Potential Rebates & Incentives | $14,141 |
| Annual Cost Savings | $14,114 |
| Annual Energy Savings | Electricity: 89,324 kWh<br>Natural Gas: 55 Therms |
| Greenhouse Gas Emission Savings | 45 Tons |
| Simple Payback | 3.9 Years |
| Site Energy Savings (all utilities) | 6% |




### 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** | | | **51,991** | **15.1** | **-11** | **$8,106** | **$27,658** | **$6,323** | **$21,335** | **2.6** | **51,082** |
| ECM 1 | Install LED Fixtures | Yes | 7,362 | 2.2 | -2 | $1,148 | $4,432 | $450 | $3,982 | 3.5 | 7,233 |
| ECM 2 | Retrofit Fixtures with LED Lamps | Yes | 44,629 | 12.9 | -9 | $6,958 | $23,226 | $5,873 | $17,353 | 2.5 | 43,849 |
| **Lighting Control Measures** | | | **14,034** | **4.0** | **-3** | **$2,188** | **$17,071** | **$4,490** | **$12,581** | **5.8** | **13,789** |
| ECM 3 | Install Occupancy Sensor Lighting Controls | Yes | 10,654 | 3.2 | -2 | $1,661 | $13,246 | $1,830 | $11,416 | 6.9 | 10,468 |
| ECM 4 | Install High/Low Lighting Controls | Yes | 3,380 | 0.8 | -1 | $527 | $3,825 | $2,660 | $1,165 | 2.2 | 3,321 |
| **Variable Frequency Drive (VFD) Measures** | | | **19,447** | **6.6** | **0** | **$3,063** | **$21,716** | **$3,200** | **$18,516** | **6.0** | **19,583** |
| ECM 5 | Install VFDs on Constant Volume (CV) Fans | Yes | 12,382 | 5.6 | 0 | $1,951 | $13,563 | $1,400 | $12,163 | 6.2 | 12,469 |
| ECM 6 | Install VFDs on Heating Water Pumps | Yes | 7,064 | 1.0 | 0 | $1,113 | $8,152 | $1,800 | $6,352 | 5.7 | 7,114 |
| **Unitary HVAC Measures** | | | **1,817** | **2.6** | **0** | **$286** | **$23,826** | **$948** | **$22,879** | **80.0** | **1,829** |
| ECM 7 | Install High Efficiency Air Conditioning Units | No | 1,817 | 2.6 | 0 | $286 | $23,826 | $948 | $22,879 | 80.0 | 1,829 |
| **Gas Heating (HVAC/Process) Replacement** | | | **0** | **0.0** | **156** | **$1,212** | **$103,451** | **$5,566** | **$97,885** | **80.8** | **18,258** |
| ECM 8 | Install High Efficiency Steam Boilers | No | 0 | 0.0 | 156 | $1,212 | $103,451 | $5,566 | $97,885 | 80.8 | 18,258 |
| **HVAC System Improvements** | | | **0** | **0.0** | **10** | **$80** | **$150** | **$24** | **$126** | **1.6** | **1,203** |
| ECM 9 | Install Pipe Insulation | Yes | 0 | 0.0 | 10 | $80 | $150 | $24 | $126 | 1.6 | 1,203 |
| **Domestic Water Heating Upgrade** | | | **1,390** | **0.0** | **9** | **$289** | **$208** | **$104** | **$104** | **0.4** | **2,455** |
| ECM 10 | Install Low-Flow DHW Devices | Yes | 1,390 | 0.0 | 9 | $289 | $208 | $104 | $104 | 0.4 | 2,455 |
| **Custom Measures** | | | **2,462** | **0.0** | **0** | **$388** | **$1,945** | **$0** | **$1,945** | **5.0** | **2,479** |
| ECM 11 | Install Heat Pump Water Heater | Yes | 2,462 | 0.0 | 0 | $388 | $1,945 | $0 | $1,945 | 5.0 | 2,479 |
| **TOTALS (COST EFFECTIVE MEASURES)** | | | **89,324** | **25.7** | **5** | **$14,114** | **$68,748** | **$14,141** | **$54,607** | **3.9** | **90,591** |
| **TOTALS (ALL MEASURES)** | | | **91,140** | **28.3** | **161** | **$15,612** | **$196,026** | **$20,654** | **$175,372** | **11.2** | **110,678** |

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

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

*Figure 2 – Evaluated Energy Improvements*

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

## 1.1 Planning Your Project

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

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

### Pick Your Installation Approach

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

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

## Options from Around the State

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

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

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

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

*Successor Solar Incentive Program (SuSI)*

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

*Ongoing Electric Savings with Demand Response*

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

*Large Energy User Program (LEUP)*

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

# 2 Existing Conditions

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

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

## 2.1 Site Overview

On July 5, 2022, TRC performed an energy audit at Maugham Elementary School located in Tenafly, New Jersey. TRC met with Mario Cofini to review the facility operations and help focus our investigation on specific energy-using systems.

Maugham Elementary School is a two-story, 41,450 square foot building built in 1928. Spaces include classrooms, offices, gymnasium, library, corridors, stairwells, restrooms, storage rooms, electrical and mechanical space.

Lighting for the facility is provided mainly by linear fluorescent T8 fixtures. Window air conditioning units and boilers provide cooling and heating to most spaces. There is one passenger elevator located in the facility.

## 2.2 Building Occupancy

The facility is occupied from September to July, with the school year ending for students in July and restarting in September. The building has limited use on the weekends, and the facility closes at 11:30 PM on weekdays. During a typical day, the facility is occupied by 66 staff and 366 students.

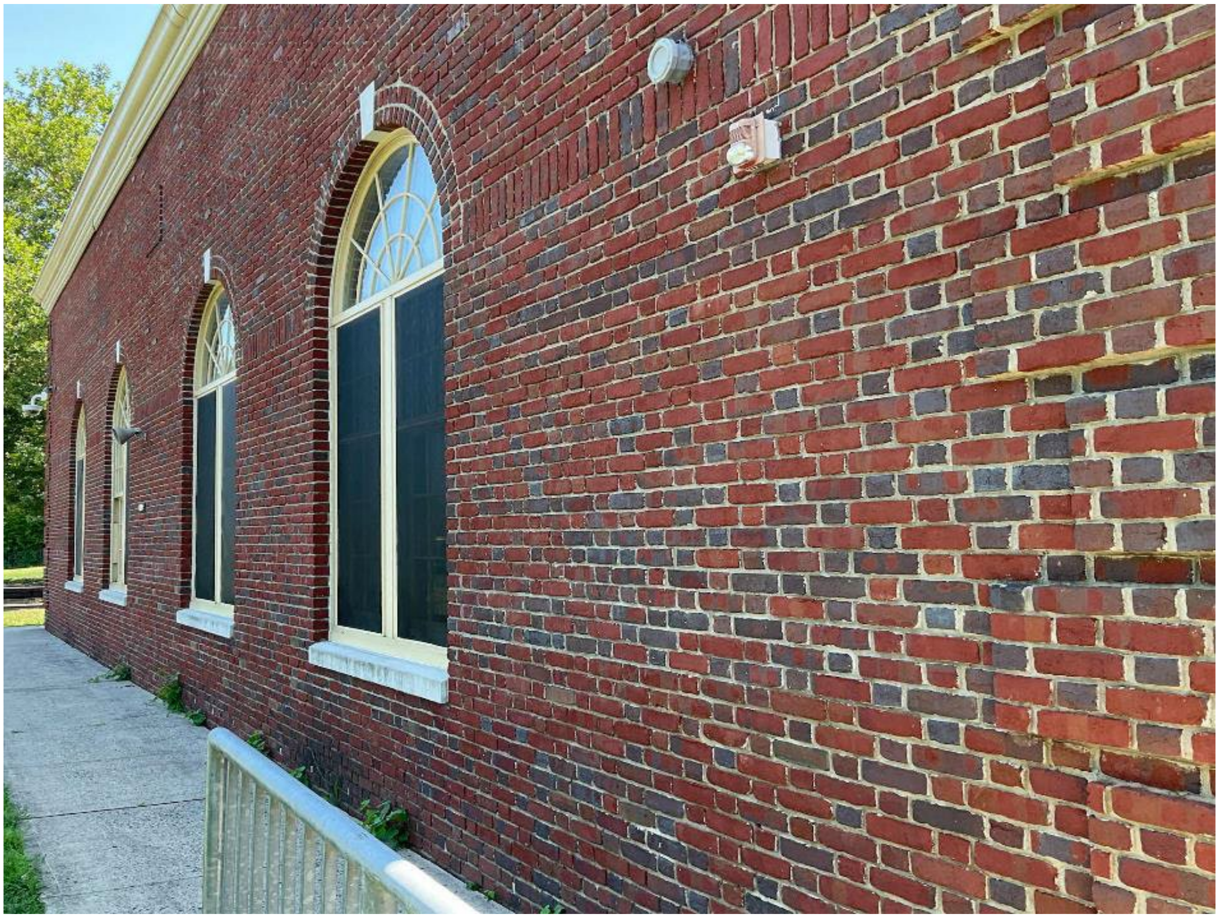
| Building Name | Weekday/Weekend | Operating Schedule |
|---|---|---|
| Maugham Elementary School - General Operating Hours | Weekday | 6:30 AM - 11:30 PM |
| | Weekend | Limited Use |
| Maugham Elementary School - Classes Hours | Weekday | 8:30 AM - 3:10 PM |
| | Weekend | Closed |

***Figure 3 - Building Occupancy Schedule***

## 2.3 Building Envelope

Building walls are concrete block over structural steel with a brick facade. The roof is primarily pitched with slate shingles, having some flat sections partially covered with pebbles over a gray membrane. The roof is in fair condition.

The windows are double glazed and have aluminum frames with thermal breaks. The glass-to-frame seals are in fair condition. The operable window weather seals are in fair condition, showing little evidence of excessive wear. Exterior doors have wooden frames and are in fair condition with worn door seals. Degraded window and door seals increase drafts and outside air infiltration. Overall, the building envelope appears in fair condition.


*Building Walls and Windows*


*Building Windows*


*Entrance Door*

*Exit Doors*

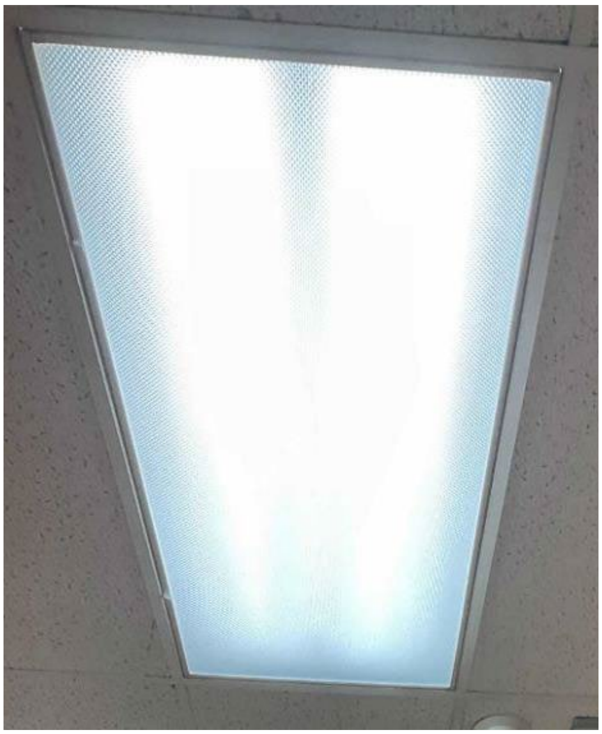
*Roof*

## 2.4 Lighting Systems

The primary interior lighting system uses 32-Watt fluorescent T8 lamps. Fixture types include 2-lamp, 3-lamp, and 4-lamp, 2-foot and 4-foot long recessed, surface mounted, and pendent fixtures with linear and U-bend tube lamps. Typically, T8 fluorescent lamps use electronic ballasts.

Additionally, compact fluorescent lamps (CFL), halogen, incandescent, metal halide (MH) and LED lamps are used in some spaces. Typically, CFLs at this site use between 23-Watts or 42-Watts, halogen lamps draw 100-Watts, incandescent "A" lamps are rated at 60-Watts, and metal halide lamps require 400-Watts. Gymnasium fixtures have manually controlled high-bay MH lamps. Exit signs use LED sources.

Interior light fixtures are primarily controlled by manual wall switches, with some restrooms equipped with occupancy sensors. All light fixtures are in good condition. Interior lighting levels were generally sufficient. Exterior fixtures use LED lamps and are photocell controlled.



*Fluorescent T8 Fixtures*

*Fluorescent T8 Fixtures*

*Gymnasium MH Fixtures*

*Gymnasium MH Fixtures*

*Exterior LED Fixtures*

*Exterior LED Fixtures*

## 2.5 Air Handling Systems

**Unit Ventilators**

Unit ventilators (UV) provide heating to the classrooms. Each UV is equipped with hot water heating coils, supply fan motors, and pneumatically controlled outside air dampers. Some of the units can be monitored and controlled through the onsite building energy management system (EMS), with the rest controlled locally.

*Unit Ventilator*

**Unitary Electric HVAC Equipment**

Various areas of the building are conditioned using window air conditioning (AC) units, one mini-split AC unit, and one split AC system. They range in cooling capacity from 1-ton to 1.5-tons with estimated efficiencies of 10 EER to 11 EER. The units are in fair to good condition. Some are recommended for replacement.

*Split System*

*Window AC Unit*

*Unitary Heating Equipment*

The teachers prep office is heated by an electric forced air furnace with an estimated heating capacity of 8 kW. The unit is equipped with a fractional hp supply fan. Installed in 2003, the unit is in fair condition and is locally controlled.

*Electric Furnace*

## Air Handling Units (AHUs) & Rooftop Units (RTUs)

The library and gymnasium are each conditioned by a rooftop unit (RTU). The library unit is equipped with DX cooling coils. The library unit has a 10-ton cooling capacity with an efficiency of 9.7 EER and is equipped with a 2 hp constant speed supply fan motor. The gymnasium unit is equipped with a 15 hp constant speed supply fan motor and provides ventilation only. The units are in fair condition and are controlled and monitored by the onsite EMS.

Additionally, two air handling units (AHUs) located in the mechanical space are used to condition areas of the building. Each AHU is equipped with hot water heating coils and an estimated 3 hp constant speed supply fan. The units are in fair condition and are controlled using thermostats.


*Rooftop Unit – Library*


*Rooftop Unit - Gymnasium*

## 2.6 Heating Steam Systems

The building heating system consists of two gas-fired steam boilers with output capacities of 2,766 MBh and 2,800 MBh. The burners are fully modulating with a nominal efficiency of 78%. The boilers are configured in a lead/lag control scheme and controlled by the facility's energy management system (EMS). Both boilers are required under high load conditions. The boilers are in fair condition and operating beyond their normal useful life. There is a service contract in place.

Steam produced by the boilers is supplied to a shell and tube heat exchanger that serves a hydronic hot water loop. The hydronic loop is configured in a constant flow primary distribution with two, 5 hp constant speed hot water pumps (HWP-1 and HWP-2) operating in a lead/lag control scheme. The hydronic system provides heating hot water to air handling units and unit ventilators. There are two, 1 hp and one, 5 hp condensate pumps and one, 1 hp boiler feed water pump in the boiler room.

*Steam Boiler*

*Condensate System*

*Heating Hot Water Pumps*

## 2.7 Building Energy Management Systems (EMS)

A Johnson Controls Metasys EMS controls the HVAC equipment, boilers, and some unit ventilators. The EMS provides equipment scheduling control and monitors and controls space temperatures, supply air temperatures, humidity, and heating water loop temperatures. The site staff expressed an interest in expanding the level of control provided by the EMS, as it currently only operates for the new wing.

## 2.8 Domestic Hot Water

Hot water is produced by a 75.1 MBh, gas-fired storage water heater with a 75-gallon capacity and a 4.5 kW electric storage water heater with a 36-gallon capacity. The units are in good condition. One fractional circulation pump distributes water to end uses. The circulation pump operates continuously. The domestic hot water pipes are insulated, and the insulation is in good condition.

*Water Heater*


*Circulation Pump*

## 2.9 Plug Load and Vending Machines

The location is doing a great job managing their electrical plug loads. This report makes additional suggestions for ECMs in this area as well as energy efficient best practices.

Plug loads throughout the building include general cafe and office equipment. There are classroom typical loads such as smart boards and projectors, and typical office loads such as computers, copiers, printers, microwaves, and coffee machines.

There are two residential-style refrigerators located throughout the building that are used to store food and drinks. These vary in condition and efficiency.

*Copier*

## 2.10 Water-Using Systems

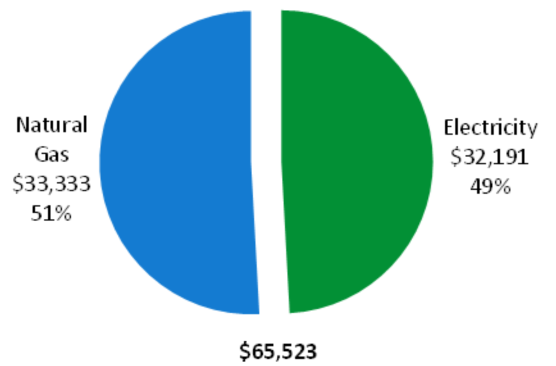
There are 14 restrooms with toilets, urinals, and sinks. Faucet flow rates are at 2.2 gallons per minute (gpm) or higher.

*Typical Restroom Sink*

# 3 Energy Use and Costs

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

| Utility Summary | | |
|---|---|---|
| **Fuel** | **Usage** | **Cost** |
| Electricity | 204,346 kWh | $32,191 |
| Natural Gas | 42,898 Therms | $33,333 |
| **Total** | | **$65,523** |




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

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

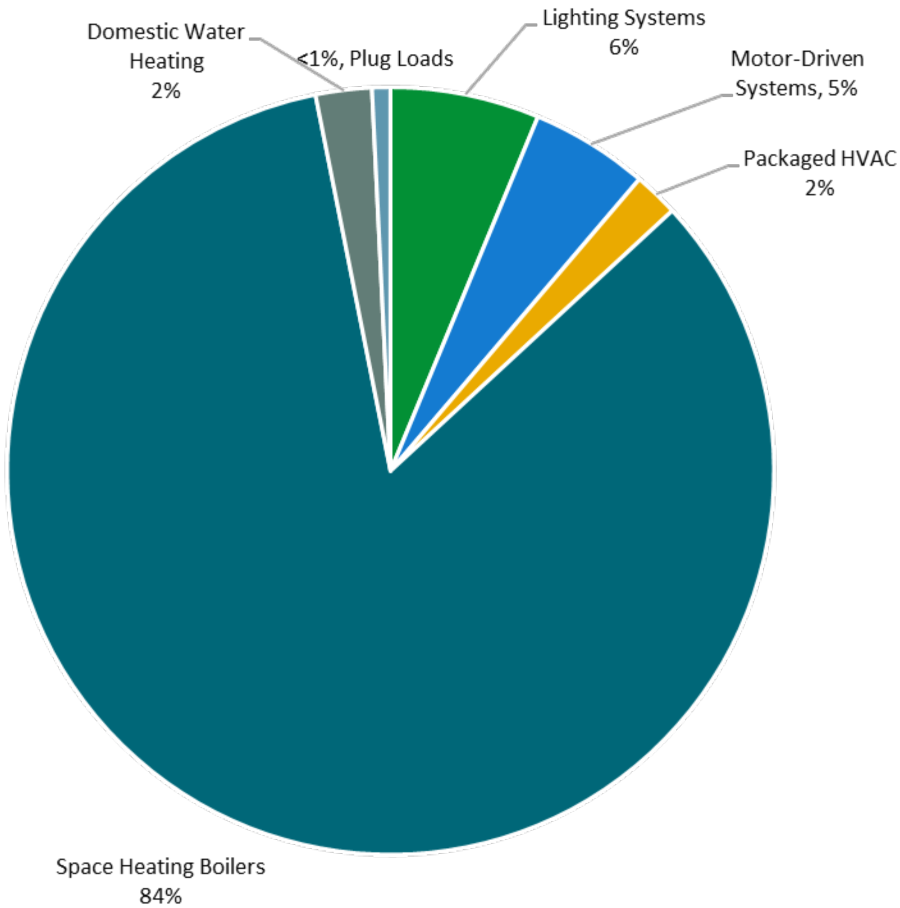
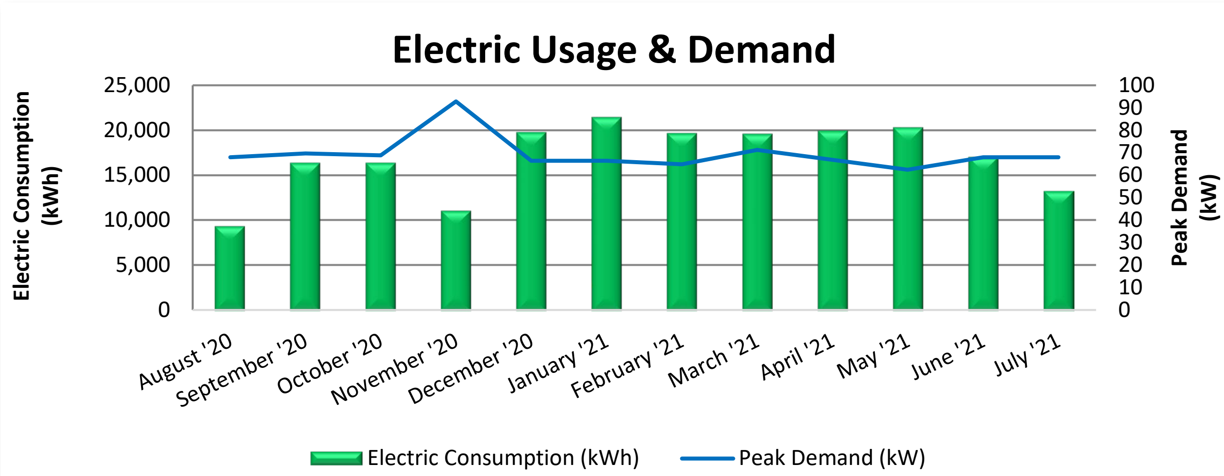



***Figure 4 - Energy Balance***

## 3.1 Electricity

PSE&G delivers electricity under rate class General Lighting & Power (GLP), with electric production provided by Constellation Energy, a third-party supplier.



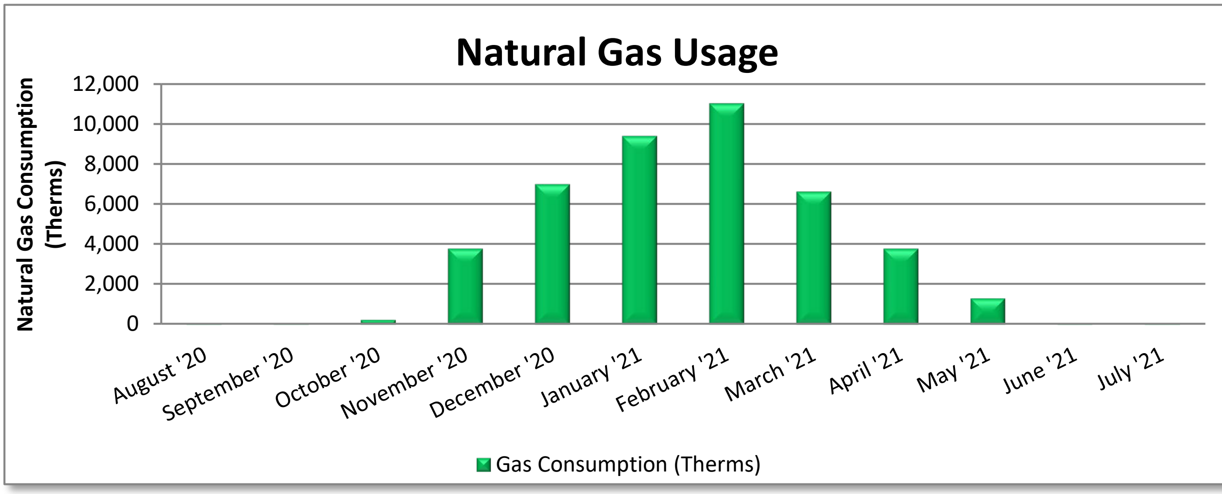

| Electric Billing Data | | | | | |
|---|---|---|---|---|---|
| Period Ending | Days in Period | Electric Usage (kWh) | Demand (kW) | Demand Cost | Total Electric Cost |
| 8/18/20 | 28 | 9,360 | 68 | $939 | $2,596 |
| 9/17/20 | 30 | 16,400 | 70 | $961 | $3,047 |
| 10/16/20 | 29 | 16,400 | 69 | $271 | $2,396 |
| 11/16/20 | 31 | 11,106 | 93 | $365 | $1,523 |
| 12/18/20 | 32 | 19,760 | 66 | $261 | $2,709 |
| 1/20/21 | 33 | 21,440 | 66 | $261 | $2,915 |
| 2/18/21 | 29 | 19,680 | 65 | $255 | $2,673 |
| 3/19/21 | 29 | 19,600 | 71 | $280 | $2,697 |
| 4/20/21 | 32 | 19,960 | 67 | $261 | $2,794 |
| 5/19/21 | 29 | 20,320 | 62 | $246 | $2,715 |
| 6/18/21 | 30 | 17,040 | 68 | $944 | $3,130 |
| 7/21/21 | 33 | 13,280 | 68 | $944 | $2,995 |
| **Totals** | **365** | **204,346** | **93** | **$5,990** | **$32,191** |
| **Annual** | **365** | **204,346** | **93** | **$5,990** | **$32,191** |

Notes:

- Peak demand of 93 kW occurred in November 2020.
- Average demand over the past 12 months was 69 kW.
- The average electric cost over the past 12 months was $0.158/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 UGI Energy, a third-party supplier.




| Gas Billing Data | | | |
|---|---|---|---|
| Period Ending | Days in Period | Natural Gas Usage (Therms) | Natural Gas Cost |
| 8/18/20 | 31 | 2 | $149 |
| 9/17/20 | 30 | 41 | $168 |
| 10/16/20 | 29 | 242 | $288 |
| 11/16/20 | 31 | 3,793 | $3,484 |
| 12/18/20 | 32 | 6,997 | $5,334 |
| 1/20/21 | 33 | 9,394 | $6,708 |
| 2/18/21 | 29 | 11,024 | $7,644 |
| 3/19/21 | 29 | 6,616 | $5,094 |
| 4/20/21 | 32 | 3,793 | $3,484 |
| 5/19/21 | 29 | 1,319 | $926 |
| 6/18/21 | 30 | 18 | $164 |
| 7/21/21 | 33 | 11 | $163 |
| **Totals** | **368** | **43,250** | **$33,607** |
| **Annual** | **365** | **42,898** | **$33,333** |

Notes:

- The average gas cost for the past 12 months is $0.777/therm, which is the blended rate used throughout the analysis.

## 3.3 Benchmarking

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

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

| Benchmarking Score | 36 |
|---|---|

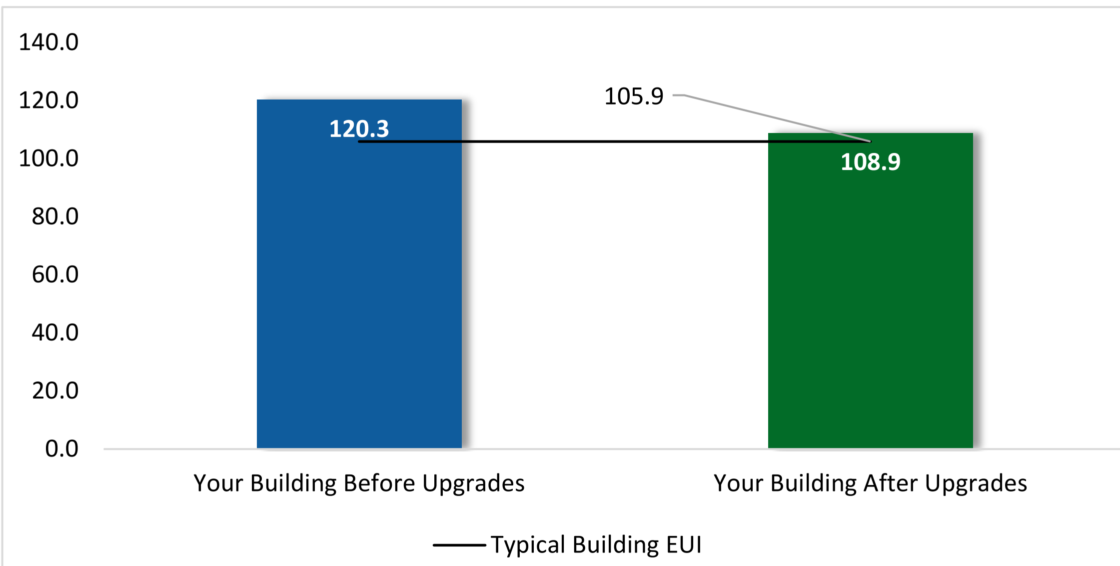



***Figure 5 - Energy Use Intensity Comparison[3]***

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.

[3] Based on all evaluated ECMs

## Tracking Your Energy Performance

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

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

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

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

# 4 Energy Conservation Measures

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

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

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

Financial incentives are based on previously run state rebate programs. New utility programs are expected to start rolling out in the spring and summer of 2021. Keep up to date with developments by visiting the NJCEP website. Some measures and proposed upgrades may be eligible for higher incentives than those shown below.

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

| # | Energy Conservation Measure | Cost Effective? | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Upgrades** | | | **51,991** | **15.1** | **-11** | **$8,106** | **$27,658** | **$6,323** | **$21,335** | **2.6** | **51,082** |
| ECM 1 | Install LED Fixtures | Yes | 7,362 | 2.2 | -2 | $1,148 | $4,432 | $450 | $3,982 | 3.5 | 7,233 |
| ECM 2 | Retrofit Fixtures with LED Lamps | Yes | 44,629 | 12.9 | -9 | $6,958 | $23,226 | $5,873 | $17,353 | 2.5 | 43,849 |
| **Lighting Control Measures** | | | **14,034** | **4.0** | **-3** | **$2,188** | **$17,071** | **$4,490** | **$12,581** | **5.8** | **13,789** |
| ECM 3 | Install Occupancy Sensor Lighting Controls | Yes | 10,654 | 3.2 | -2 | $1,661 | $13,246 | $1,830 | $11,416 | 6.9 | 10,468 |
| ECM 4 | Install High/Low Lighting Controls | Yes | 3,380 | 0.8 | -1 | $527 | $3,825 | $2,660 | $1,165 | 2.2 | 3,321 |
| **Variable Frequency Drive (VFD) Measures** | | | **19,447** | **6.6** | **0** | **$3,063** | **$21,716** | **$3,200** | **$18,516** | **6.0** | **19,583** |
| ECM 5 | Install VFDs on Constant Volume (CV) Fans | Yes | 12,382 | 5.6 | 0 | $1,951 | $13,563 | $1,400 | $12,163 | 6.2 | 12,469 |
| ECM 6 | Install VFDs on Heating Water Pumps | Yes | 7,064 | 1.0 | 0 | $1,113 | $8,152 | $1,800 | $6,352 | 5.7 | 7,114 |
| **Unitary HVAC Measures** | | | **1,817** | **2.6** | **0** | **$286** | **$23,826** | **$948** | **$22,879** | **80.0** | **1,829** |
| ECM 7 | Install High Efficiency Air Conditioning Units | No | 1,817 | 2.6 | 0 | $286 | $23,826 | $948 | $22,879 | 80.0 | 1,829 |
| **Gas Heating (HVAC/Process) Replacement** | | | **0** | **0.0** | **156** | **$1,212** | **$103,451** | **$5,566** | **$97,885** | **80.8** | **18,258** |
| ECM 8 | Install High Efficiency Steam Boilers | No | 0 | 0.0 | 156 | $1,212 | $103,451 | $5,566 | $97,885 | 80.8 | 18,258 |
| **HVAC System Improvements** | | | **0** | **0.0** | **10** | **$80** | **$150** | **$24** | **$126** | **1.6** | **1,203** |
| ECM 9 | Install Pipe Insulation | Yes | 0 | 0.0 | 10 | $80 | $150 | $24 | $126 | 1.6 | 1,203 |
| **Domestic Water Heating Upgrade** | | | **1,390** | **0.0** | **9** | **$289** | **$208** | **$104** | **$104** | **0.4** | **2,455** |
| ECM 10 | Install Low-Flow DHW Devices | Yes | 1,390 | 0.0 | 9 | $289 | $208 | $104 | $104 | 0.4 | 2,455 |
| **Custom Measures** | | | **2,462** | **0.0** | **0** | **$388** | **$1,945** | **$0** | **$1,945** | **5.0** | **2,479** |
| ECM 11 | Install Heat Pump Water Heater | Yes | 2,462 | 0.0 | 0 | $388 | $1,945 | $0 | $1,945 | 5.0 | 2,479 |
| **TOTALS** | | | **91,140** | **28.3** | **161** | **$15,612** | **$196,026** | **$20,654** | **$175,372** | **11.2** | **110,678** |

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

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

*Figure 6 – All Evaluated ECMs*

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Upgrades** | | **51,991** | **15.1** | **-11** | **$8,106** | **$27,658** | **$6,323** | **$21,335** | **2.6** | **51,082** |
| ECM 1 | Install LED Fixtures | 7,362 | 2.2 | -2 | $1,148 | $4,432 | $450 | $3,982 | 3.5 | 7,233 |
| ECM 2 | Retrofit Fixtures with LED Lamps | 44,629 | 12.9 | -9 | $6,958 | $23,226 | $5,873 | $17,353 | 2.5 | 43,849 |
| **Lighting Control Measures** | | **14,034** | **4.0** | **-3** | **$2,188** | **$17,071** | **$4,490** | **$12,581** | **5.8** | **13,789** |
| ECM 3 | Install Occupancy Sensor Lighting Controls | 10,654 | 3.2 | -2 | $1,661 | $13,246 | $1,830 | $11,416 | 6.9 | 10,468 |
| ECM 4 | Install High/Low Lighting Controls | 3,380 | 0.8 | -1 | $527 | $3,825 | $2,660 | $1,165 | 2.2 | 3,321 |
| **Variable Frequency Drive (VFD) Measures** | | **19,447** | **6.6** | **0** | **$3,063** | **$21,716** | **$3,200** | **$18,516** | **6.0** | **19,583** |
| ECM 5 | Install VFDs on Constant Volume (CV) Fans | 12,382 | 5.6 | 0 | $1,951 | $13,563 | $1,400 | $12,163 | 6.2 | 12,469 |
| ECM 6 | Install VFDs on Heating Water Pumps | 7,064 | 1.0 | 0 | $1,113 | $8,152 | $1,800 | $6,352 | 5.7 | 7,114 |
| **HVAC System Improvements** | | **0** | **0.0** | **10** | **$80** | **$150** | **$24** | **$126** | **1.6** | **1,203** |
| ECM 9 | Install Pipe Insulation | 0 | 0.0 | 10 | $80 | $150 | $24 | $126 | 1.6 | 1,203 |
| **Domestic Water Heating Upgrade** | | **1,390** | **0.0** | **9** | **$289** | **$208** | **$104** | **$104** | **0.4** | **2,455** |
| ECM 10 | Install Low-Flow DHW Devices | 1,390 | 0.0 | 9 | $289 | $208 | $104 | $104 | 0.4 | 2,455 |
| **Custom Measures** | | **2,462** | **0.0** | **0** | **$388** | **$1,945** | **$0** | **$1,945** | **5.0** | **2,479** |
| ECM 11 | Install Heat Pump Water Heater | 2,462 | 0.0 | 0 | $388 | $1,945 | $0 | $1,945 | 5.0 | 2,479 |
| **TOTALS** | | **89,324** | **25.7** | **5** | **$14,114** | **$68,748** | **$14,141** | **$54,607** | **3.9** | **90,591** |

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

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

*Figure 7 – Cost Effective ECMs*

## 4.1 Lighting

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Upgrades** | | **51,991** | **15.1** | **-11** | **$8,106** | **$27,658** | **$6,323** | **$21,335** | **2.6** | **51,082** |
| ECM 1 | Install LED Fixtures | 7,362 | 2.2 | -2 | $1,148 | $4,432 | $450 | $3,982 | 3.5 | 7,233 |
| ECM 2 | Retrofit Fixtures with LED Lamps | 44,629 | 12.9 | -9 | $6,958 | $23,226 | $5,873 | $17,353 | 2.5 | 43,849 |

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

### ECM 1: Install LED Fixtures

Replace existing fixtures containing high-intensity discharge (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:** gymnasium MH fixtures.

### ECM 2: Retrofit Fixtures with LED Lamps

Replace fluorescent, CFL, and halogen 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 CFL or incandescent lamps, and fluorescent fixtures with T8 tubes.

## 4.2 Lighting Controls

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Control Measures** | | **14,034** | **4.0** | **-3** | **$2,188** | **$17,071** | **$4,490** | **$12,581** | **5.8** | **13,789** |
| ECM 3 | Install Occupancy Sensor Lighting Controls | 10,654 | 3.2 | -2 | $1,661 | $13,246 | $1,830 | $11,416 | 6.9 | 10,468 |
| ECM 4 | Install High/Low Lighting Controls | 3,380 | 0.8 | -1 | $527 | $3,825 | $2,660 | $1,165 | 2.2 | 3,321 |

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:** classrooms, offices, gymnasium, library, restrooms, and storage rooms.

**ECM 4: Install High/Low Lighting Controls**

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

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

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

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

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

**Affected Building Areas**: hallways and stairwells.

## 4.3 Variable Frequency Drives (VFD)

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Variable Frequency Drive (VFD) Measures** | | **19,447** | **6.6** | **0** | **$3,063** | **$21,716** | **$3,200** | **$18,516** | **6.0** | **19,583** |
| ECM 5 | Install VFDs on Constant Volume (CV) Fans | 12,382 | 5.6 | 0 | $1,951 | $13,563 | $1,400 | $12,163 | 6.2 | 12,469 |
| ECM 6 | Install VFDs on Heating Water Pumps | 7,064 | 1.0 | 0 | $1,113 | $8,152 | $1,800 | $6,352 | 5.7 | 7,114 |

Variable frequency drives control motors for fans, pumps, and process equipment based on the actual output required of the driven equipment. Energy savings result from more efficient control of motor energy usage when equipment operates at partial load. The magnitude of energy savings depends on the estimated amount of time that the motor would operate at partial load. For equipment with proposed VFDs, we have included replacing the controlled motor with a new inverter duty rated motor to conservatively account for the cost of an inverter duty rated motor.

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

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

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

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

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

**Affected Air Handlers:** gymnasium and library RTU supply fans; exhaust fan serving the gymnasium.

## ECM 6: Install VFDs on Heating Water Pumps

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

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

**Affected Pumps:** HWP-1 and HWP-2.

## 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** | | **1,817** | **2.6** | **0** | **$286** | **$23,826** | **$948** | **$22,879** | **80.0** | **1,829** |
| ECM 7 | Install High Efficiency Air Conditioning Units | 1,817 | 2.6 | 0 | $286 | $23,826 | $948 | $22,879 | 80.0 | 1,829 |

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 window air conditioning (AC) unit, mini-split AC unit, split-system, and package unit are eventually replaced, consider purchasing equipment that exceeds the minimum efficiency required by building codes.

### ECM 7: Install High Efficiency Air Conditioning Units

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

**Affected Units:** mini-split AC unit, split-system, package unit, and the main office window AC unit.

## 4.5 Gas-Fired Heating

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Gas Heating (HVAC/Process) Replacement** | | **0** | **0.0** | **156** | **$1,212** | **$103,451** | **$5,566** | **$97,885** | **80.8** | **18,258** |
| ECM 8 | Install High Efficiency Steam Boilers | 0 | 0.0 | 156 | $1,212 | $103,451 | $5,566 | $97,885 | 80.8 | 18,258 |

### ECM 8: 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 boilers have reached the end of their normal useful life. Typically, the marginal cost of purchasing high-efficiency boilers can be justified by the marginal savings from the improved efficiency. When the boiler is eventually replaced, consider purchasing boilers that exceed the minimum efficiency required by building codes.

Section 4.9 discusses converting your space heating system from steam to hot water as a potential item for future consideration.

## 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** | **10** | **$80** | **$150** | **$24** | **$126** | **1.6** | **1,203** |
| ECM 9 | Install Pipe Insulation | 0 | 0.0 | 10 | $80 | $150 | $24 | $126 | 1.6 | 1,203 |

### ECM 9: Install Pipe Insulation

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

**Affected Systems:** steam system piping.

## 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** | | **1,390** | **0.0** | **9** | **$289** | **$208** | **$104** | **$104** | **0.4** | **2,455** |
| ECM 10 | Install Low-Flow DHW Devices | 1,390 | 0.0 | 9 | $289 | $208 | $104 | $104 | 0.4 | 2,455 |

### ECM 10: Install Low-Flow DHW Devices

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

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

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

## 4.8 Custom Measures

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Custom Measures** | | **2,462** | **0.0** | **0** | **$388** | **$1,945** | **$0** | **$1,945** | **5.0** | **2,479** |
| ECM 11 | Install Heat Pump Water Heater | 2,462 | 0.0 | 0 | $388 | $1,945 | $0 | $1,945 | 5.0 | 2,479 |

### ECM 11: Install Heat Pump Water Heater

A typical electric water heater uses electric resistance coils to heat water at a coefficient of performance (COP) of 1. Heat pump water heaters (HPWH) use a refrigeration cycle to transfer heat from the air to the domestic water. The typical average COP for a HPWH is about 2.5, so they require significantly less electricity to produce the same amount of hot water as a traditional electric water heater. HPWH also reject cold air. As such, they need to be in an unconditioned space with good ventilation. Ideal locations are garages or large enclosed, unconditioned storage areas.

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 recommended electric resistance heating element, if enabled, may be energized to maintain set point, thus reducing the overall efficiency of the unit. It is recommended that a careful analysis of the hot water demand be conducted to determine if the application makes economic sense, and the HPWH heating capacity and storage are properly sized.

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

## 4.9 Measures for Future Consideration

There are additional opportunities for improvement that Tenafly Public Schools 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.

Tenafly Public Schools 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.

**Upgrade/Replace Energy Management System**

Based on our site survey and on conversations with facility staff, it appears that the existing energy management system (EMS) is substantially limited in its capabilities, means of control, monitoring/ reporting function, or condition relative to new systems available in the marketplace. A substantial upgrade to your site's EMS could increase the efficiency of your building HVAC system operation.

The current generation EMS typically provides building systems with a network of temperature and pressure sensors that obtain feedback about field conditions and provide signals to control systems to adjust system operation for optimal functioning. Thirty years ago, most control systems were pneumatic systems driven by compressed air, with pneumatic thermostats and air driven actuators for valves and dampers. Pneumatics controls have largely been replaced by direct digital control (DDC) systems, but many pneumatic systems remain. Contemporary DDC systems afford tighter controls and enhanced monitoring and trending capabilities as compared to the older systems.

A controls upgrade would enable automated equipment start and stop times, temperature setpoints, and lockouts and deadbands to be programmed remotely using a graphic interface. Controls can be configured to optimize ventilation and outside air intake by adjusting economizer position, damper function, and fan speed. Existing chilled and hot water distribution system controls are typically tied in, including associated pumps and valves. Coordinated control of HVAC systems is dependent on a network of sensors and status points. A comprehensive building control system provides monitoring and control for all HVAC systems, so operators can adjust system programming for optimal comfort and energy savings.

It is recommended that an HVAC engineer or contractor who specializes in EMS be contacted for a detailed evaluation and implementation costs. A controls expert will be able to tell you to what extent an existing system can be refurbished or expanded, what sensors should be replaced, what additional HVAC systems could be controlled, and what monitoring and graphic capabilities can be added. For the purposes of this report, the potential energy savings and measure costs were estimated based on industry standards and previous project experience. Further analysis should be conducted for the feasibility of this measure. This is not an investment grade analysis, nor should be used as a basis for design and construction.

## Heating System Conversion from Steam to Hot Water

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

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

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

# 5 Energy Efficient Best Practices

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

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

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

## Energy Tracking with ENERGY STAR® Portfolio Manager®

You've heard it before—you cannot manage what you do not measure. ENERGY STAR® Portfolio Manager® is an online tool that you can use to measure and track energy and water consumption, as well as greenhouse gas emissions[4]. 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.

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[4] 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.

## Lighting Controls

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

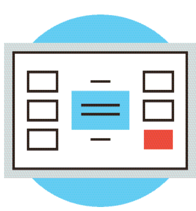
## Motor Maintenance

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.

## Fans to Reduce Cooling Load

Install ceiling fans to supplement your cooling system. Thermostat settings can typically be increased by 4°F with no change in overall occupant comfort due to the wind chill effect of moving air.

## 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.

## Ductwork Maintenance

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

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

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

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

## Steam Trap Repair and Replacement

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

## Boiler Maintenance

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

## Furnace Maintenance

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

## Label HVAC Equipment

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

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

## Optimize HVAC Equipment Schedules

Energy management systems (EMS) typically provide advanced controls for building HVAC systems, including chillers, boilers, air handling units, rooftop units and exhaust fans. The EMS 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 EMS features, when in proper adjustment, can improve comfort for building occupants and save substantial energy.

Know your EMS scheduling capabilities. Regularly monitor HVAC equipment operating schedules and match them to building operating hours in order 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 EMS (if available) to optimize the building warmup sequence. Most EMS 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.

## Water Conservation

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

For more information regarding water conservation go to the EPA's WaterSense™ website[5] or download a copy of EPA's "WaterSense™ at Work: Best Management Practices for Commercial and Institutional Facilities"[6] to get ideas for creating a water management plan and best practices for a wide range of water using systems.

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

If the facility has detached buildings with a master water meter for the entire campus, check for unnatural wet areas in the lawn or water seeping in the foundation at water pipe penetrations through the foundation. Periodically check overnight meter readings when the facility is unoccupied, and there is no other scheduled water usage.

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

## Procurement Strategies

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

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

[6] https://www.epa.gov/watersense/watersense-work-0.

# 6 On-site Generation

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

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

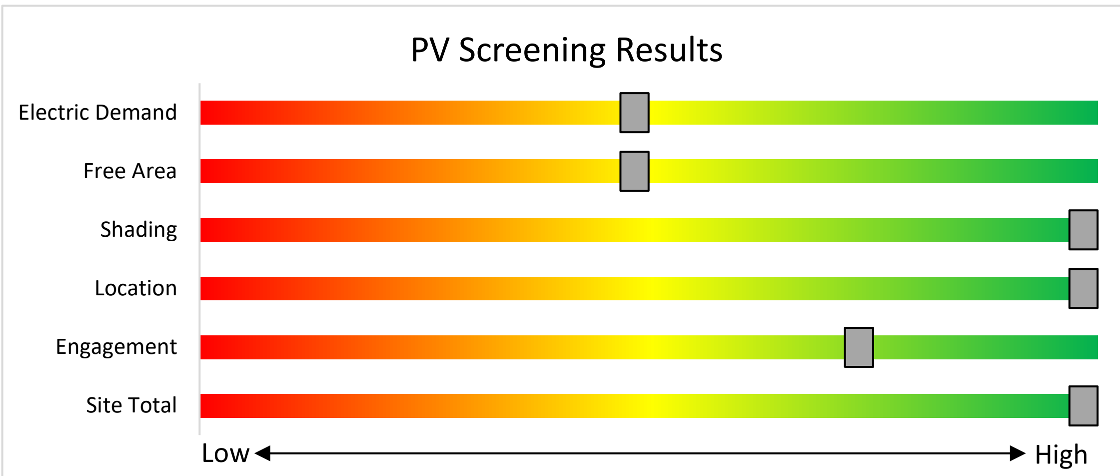
## 6.1 Solar Photovoltaic

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

A preliminary screening based on the facility's electric demand, size and location of free area, and shading elements shows that the facility has 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** | $12,950 | /yr |
| **Installed Cost** | $179,400 | |

*Figure 8 - Photovoltaic Screening*

**Successor Solar Incentive Program (SuSI)**

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

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

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

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

## 6.2 Combined Heat and Power

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

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

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

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

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

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

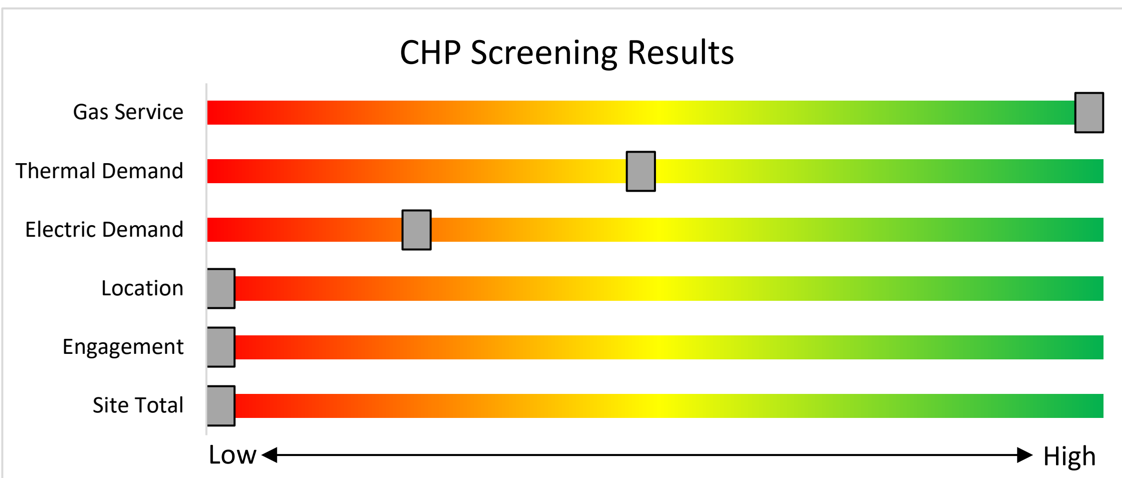



*Figure 9 - Combined Heat and Power Screening*

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

# 7 Project Funding and Incentives

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

## 7.1 Utility Energy Efficiency Programs

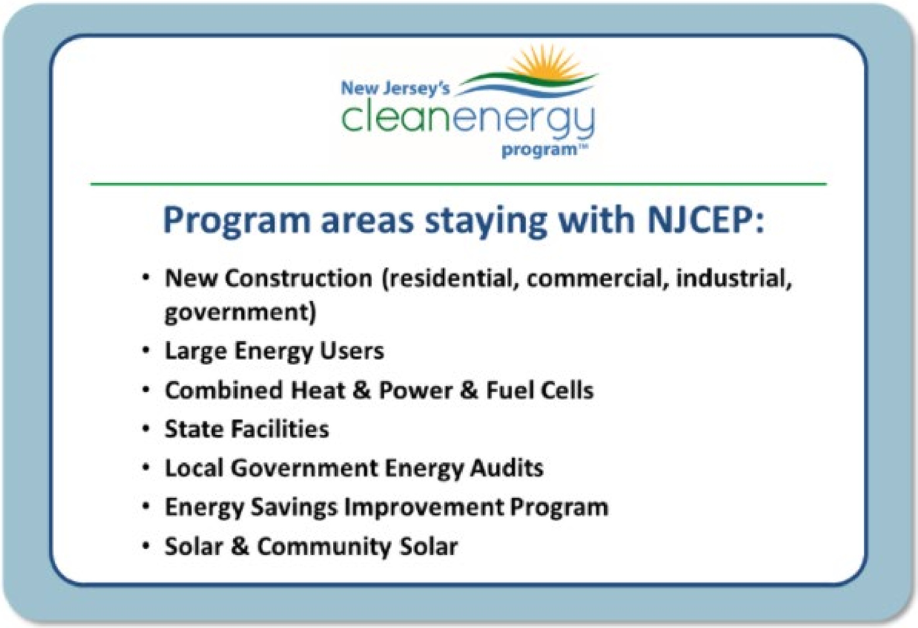
The Clean Energy Act, signed into law by Governor Murphy in 2018, requires New Jersey's investor-owned gas and electric utilities to reduce their customers' use by set percentages over time. To help reach these targets the New Jersey Board of Public Utilities approved a comprehensive suite of energy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


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

https://www.njcleanenergy.com/transition

# 8 New Jersey's Clean Energy Programs

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



## 8.1 Large Energy Users

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

**Incentives**

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

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

**How to Participate**

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

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

## 8.2 Combined Heat and Power

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

**Incentives**

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

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

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

**How to Participate**

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

## 8.3 Successor Solar Incentive Program (SuSI)

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

**Administratively Determined Incentive (ADI) Program**

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

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

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

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

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

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

**Competitive Solar Incentive Program**

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

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

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

## 8.4 Energy Savings Improvement Program

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

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

**How to Participate**

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

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

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

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

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

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

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

# 9 PROJECT DEVELOPMENT

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

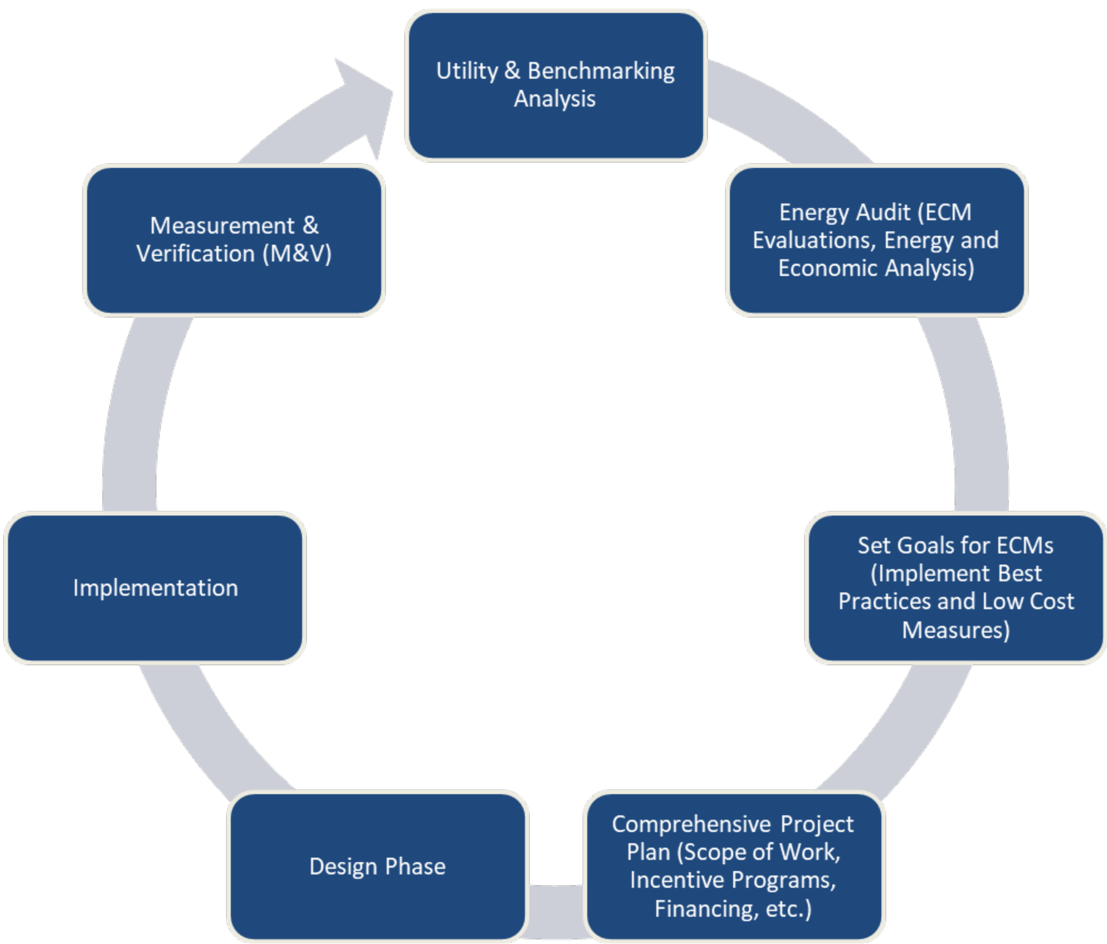



*Figure 3 – Project Development Cycle*

# 10 Energy Purchasing and Procurement Strategies

## 10.1 Retail Electric Supply Options

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

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

A list of licensed third-party electric suppliers is available at the NJBPU website[7].

## 10.2 Retail Natural Gas Supply Options

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

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

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

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

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

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

# APPENDIX A: EQUIPMENT INVENTORY & RECOMMENDATIONS

**Lighting Inventory & Recommendations**

| | Existing Conditions | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Fixture Quantity | Fixture Description | Control System | Light Level | Watts per Fixture | Annual Operating Hours | ECM # | Fixture Recommendation | Add Controls? | Fixture Quantity | Fixture Description | Control System | Watts per Fixture | Annual Operating Hours | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Boiler Room - New Wing | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 440 | 2 | Relamp | No | 3 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 440 | 0.1 | 48 | 0 | $7 | $110 | $30 | 10.6 |
| Boiler Room - Old Building | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 440 | 2 | Relamp | No | 3 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 440 | 0.1 | 48 | 0 | $7 | $110 | $30 | 10.6 |
| Boiler Room - Old Building | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 440 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 440 | 0.0 | 16 | 0 | $2 | $37 | $10 | 10.6 |
| Boiler Room - Old Building | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 440 | 2 | Relamp | No | 3 | LED - Linear Tubes: (4) 4' Lamps | Wall Switch | 58 | 440 | 0.1 | 81 | 0 | $13 | $219 | $60 | 12.5 |
| Classroom 100 | 15 | Linear Fluorescent - T8: 4' T8 (32W) - 3L | Wall Switch | S | 93 | 2,200 | 2, 3 | Relamp | Yes | 15 | LED - Linear Tubes: (3) 4' Lamps | Occupancy Sensor | 44 | 1,518 | 0.7 | 2,286 | 0 | $356 | $1,092 | $260 | 2.3 |
| Classroom 100 | 3 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 1,518 | 0.1 | 285 | 0 | $44 | $487 | $65 | 9.5 |
| Classroom 101 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 3L | Wall Switch | S | 93 | 2,200 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (3) 4' Lamps | Occupancy Sensor | 44 | 1,518 | 0.5 | 1,829 | 0 | $285 | $927 | $215 | 2.5 |
| Classroom 102 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 3L | Wall Switch | S | 93 | 2,200 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (3) 4' Lamps | Occupancy Sensor | 44 | 1,518 | 0.5 | 1,829 | 0 | $285 | $927 | $215 | 2.5 |
| Classroom 103 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 203 | 0 | $32 | $189 | $40 | 4.7 |
| Classroom 103 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 104 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 3L | Wall Switch | S | 93 | 2,200 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (3) 4' Lamps | Occupancy Sensor | 44 | 1,518 | 0.5 | 1,829 | 0 | $285 | $927 | $215 | 2.5 |
| Classroom 105 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 3L | Wall Switch | S | 93 | 2,200 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (3) 4' Lamps | Occupancy Sensor | 44 | 1,518 | 0.5 | 1,829 | 0 | $285 | $927 | $215 | 2.5 |
| Classroom 109 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 111 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 113 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 115 | 2 | Compact Fluorescent: (3) 32W Biaxial Plug-In Lamps | Wall Switch | S | 96 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED Lamps: GX23 (Plug-In) Lamps | Occupancy Sensor | 68 | 1,518 | 0.1 | 238 | 0 | $37 | $191 | $26 | 4.5 |
| Classroom 117 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 3L | Wall Switch | S | 93 | 2,200 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (3) 4' Lamps | Occupancy Sensor | 44 | 1,518 | 0.1 | 457 | 0 | $71 | $434 | $80 | 5.0 |
| Classroom 119 Music | 4 | Linear Fluorescent - T8: 4' T8 (32W) - 3L | Wall Switch | S | 93 | 2,200 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (3) 4' Lamps | Occupancy Sensor | 44 | 1,518 | 0.2 | 610 | 0 | $95 | $489 | $95 | 4.1 |
| Classroom 120 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 203 | 0 | $32 | $189 | $40 | 4.7 |
| Classroom 120 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 121 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 3L | Wall Switch | S | 93 | 2,200 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (3) 4' Lamps | Occupancy Sensor | 44 | 1,518 | 0.1 | 457 | 0 | $71 | $434 | $80 | 5.0 |
| Classroom 122 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 203 | 0 | $32 | $189 | $40 | 4.7 |
| Classroom 122 | 4 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.2 | 716 | 0 | $112 | $562 | $115 | 4.0 |
| Classroom 123 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 203 | 0 | $32 | $189 | $40 | 4.7 |
| Classroom 123 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |

| | 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 124 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.2 | 537 | 0 | $84 | $489 | $95 | 4.7 |
| Classroom 201 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 203 | 0 | $32 | $189 | $40 | 4.7 |
| Classroom 201 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 203 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 203 | 0 | $32 | $189 | $40 | 4.7 |
| Classroom 203 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 206 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 208 | 1 | Compact Fluorescent: (1) 42W Triple Biaxial Plug-In Lamp | Wall Switch | S | 42 | 2,200 | 2, 3 | Relamp | Yes | 1 | LED Lamps: PL-L (Biax) Lamps | Occupancy Sensor | 30 | 1,518 | 0.0 | 52 | 0 | $8 | $14 | $1 | 1.6 |
| Classroom 208 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 209 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 211 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 212 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 203 | 0 | $32 | $189 | $40 | 4.7 |
| Classroom 212 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom 213 | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Classroom Speech | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 4L | Wall Switch | S | 63 | 2,200 | 2 | Relamp | No | 1 | LED - Linear Tubes: (4) 2' Lamps | Wall Switch | 34 | 2,200 | 0.0 | 70 | 0 | $11 | $65 | $12 | 4.8 |
| Classroom Speech | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2 | Relamp | No | 1 | LED - Linear Tubes: (4) 4' Lamps | Wall Switch | 58 | 2,200 | 0.0 | 136 | 0 | $21 | $73 | $20 | 2.5 |
| Corridor - 1st Floor | 10 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 10 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Corridor - 1st Floor | 25 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,800 | 2, 4 | Relamp | Yes | 25 | LED - Linear Tubes: (4) 4' Lamps | High/Low Control | 58 | 1,932 | 1.3 | 5,696 | -1 | $888 | $2,951 | $1,375 | 1.8 |
| Corridor - 1st Floor | 21 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,800 | 2, 4 | Relamp | Yes | 21 | LED - Linear Tubes: (2) U-Lamp | High/Low Control | 33 | 1,932 | 0.6 | 2,537 | -1 | $396 | $2,422 | $945 | 3.7 |
| Corridor - 2nd Floor | 8 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 8 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Corridor - 2nd Floor | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,800 | 2, 4 | Relamp | Yes | 3 | LED - Linear Tubes: (2) 4' Lamps | High/Low Control | 29 | 1,932 | 0.1 | 388 | 0 | $60 | $335 | $135 | 3.3 |
| Corridor - 2nd Floor | 19 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,800 | 2, 4 | Relamp | Yes | 19 | LED - Linear Tubes: (4) 4' Lamps | High/Low Control | 58 | 1,932 | 1.0 | 4,329 | -1 | $675 | $2,288 | $1,045 | 1.8 |
| Gymnasium | 1 | Compact Fluorescent: (1) 23W Spiral Plug-In Lamp | Wall Switch | S | 23 | 2,200 | 2 | Relamp | No | 1 | LED Lamps: A19 Lamps | Wall Switch | 17 | 2,200 | 0.0 | 15 | 0 | $2 | $17 | $1 | 7.2 |
| Gymnasium | 5 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 5 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Gymnasium | 9 | Metal Halide: (1) 400W Lamp | Wall Switch | S | 458 | 2,200 | 1, 3 | Fixture Replacement | Yes | 9 | LED - Fixtures: High-Bay | Occupancy Sensor | 120 | 1,518 | 2.4 | 8,172 | -2 | $1,274 | $6,412 | $765 | 4.4 |
| Library | 2 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 2 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

| | Existing Conditions | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Fixture Quantity | Fixture Description | Control System | Light Level | Watts per Fixture | Annual Operating Hours | ECM # | Fixture Recommendation | Add Controls? | Fixture Quantity | Fixture Description | Control System | Watts per Fixture | Annual Operating Hours | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Library | 30 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 30 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 1.6 | 5,371 | -1 | $837 | $2,731 | $670 | 2.5 |
| Library | 2 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 1,518 | 0.1 | 190 | 0 | $30 | $261 | $40 | 7.5 |
| Main Office | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 305 | 0 | $48 | $380 | $65 | 6.6 |
| Main Office | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 305 | 0 | $48 | $380 | $65 | 6.6 |
| Main Office | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2 | Relamp | No | 1 | LED - Linear Tubes: (4) 4' Lamps | Wall Switch | 58 | 2,200 | 0.0 | 136 | 0 | $21 | $73 | $20 | 2.5 |
| Main Office | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,200 | 0.0 | 70 | 0 | $11 | $72 | $10 | 5.7 |
| Maintenance Office | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2 | Relamp | No | 1 | LED - Linear Tubes: (4) 4' Lamps | Wall Switch | 58 | 2,200 | 0.0 | 136 | 0 | $21 | $73 | $20 | 2.5 |
| Mechanical - AHU 1 | 2 | Compact Fluorescent: (1) 23W Spiral Plug-In Lamp | Wall Switch | S | 23 | 440 | 2 | Relamp | No | 2 | LED Lamps: A19 Lamps | Wall Switch | 17 | 440 | 0.0 | 6 | 0 | $1 | $34 | $2 | 35.8 |
| Mechanical - AHU 1 | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 440 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 440 | 0.0 | 16 | 0 | $2 | $37 | $10 | 10.6 |
| Mechanical - AHU 2 | 1 | Incandescent: (1) 60W A19 Screw-In Lamp | Wall Switch | S | 60 | 440 | 2 | Relamp | No | 1 | LED Lamps: A21 Lamps | Wall Switch | 9 | 440 | 0.0 | 25 | 0 | $4 | $17 | $1 | 4.2 |
| Nurses Office | 7 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 7 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.4 | 1,253 | 0 | $195 | $781 | $175 | 3.1 |
| Office - ELL 1 | 1 | Incandescent: (1) 60W A19 Screw-In Lamp | Wall Switch | S | 60 | 2,200 | 2, 3 | Relamp | Yes | 1 | LED Lamps: A19 Lamps | Occupancy Sensor | 9 | 1,518 | 0.0 | 130 | 0 | $20 | $17 | $1 | 0.8 |
| Office - ELL 1 | 3 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 1,518 | 0.1 | 285 | 0 | $44 | $487 | $65 | 9.5 |
| Office - Teachers Prep | 2 | Incandescent: (1) 60W A19 Screw-In Lamp | Wall Switch | S | 60 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED Lamps: A19 Lamps | Occupancy Sensor | 9 | 1,518 | 0.1 | 260 | 0 | $41 | $150 | $22 | 3.2 |
| Office - Teachers Prep | 10 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 10 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.5 | 1,790 | 0 | $279 | $1,000 | $235 | 2.7 |
| Office - Teachers Prep | 2 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 1,518 | 0.1 | 190 | 0 | $30 | $261 | $40 | 7.5 |
| Resource Room | 6 | Halogen Incandescent: (1) 100W PAR30 Screw-In Lamp | Wall Switch | S | 100 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED Lamps: PAR30 Lamps | Occupancy Sensor | 15 | 1,518 | 0.4 | 1,302 | 0 | $203 | $409 | $53 | 1.8 |
| Resource Room | 6 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,518 | 0.3 | 1,074 | 0 | $167 | $708 | $155 | 3.3 |
| Resource Room | 6 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 1,518 | 0.2 | 570 | 0 | $89 | $705 | $95 | 6.9 |
| Restroom - Boys #1 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 305 | 0 | $48 | $380 | $65 | 6.6 |
| Restroom - Boys #2 | 5 | LED - Fixtures: Ambient 2x4 Fixture | Occupancy Sensor | S | 23 | 1,800 | | None | No | 5 | LED - Fixtures: Ambient 2x4 Fixture | Occupancy Sensor | 23 | 1,800 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Restroom - Girls #1 | 4 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,518 | 0.1 | 406 | 0 | $63 | $416 | $75 | 5.4 |
| Restroom - Girls #2 | 3 | LED - Fixtures: Ambient 2x4 Fixture | Occupancy Sensor | S | 23 | 1,800 | | None | No | 3 | LED - Fixtures: Ambient 2x4 Fixture | Occupancy Sensor | 23 | 1,800 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Restroom - Staff | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,200 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,200 | 0.0 | 70 | 0 | $11 | $72 | $10 | 5.7 |
| Stair 1 | 1 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 1 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

| | 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 |
| Stair 1 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | | 62 | 2,800 | 2, 4 | Relamp | Yes | 3 | LED - Linear Tubes: (2) 4' Lamps | High/Low Control | 29 | 1,932 | 0.1 | 388 | 0 | $60 | $335 | $135 | 3.3 |
| Stair 2 | 1 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 1 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Stair 2 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | | 62 | 2,800 | 2, 4 | Relamp | Yes | 3 | LED - Linear Tubes: (2) 4' Lamps | High/Low Control | 29 | 1,932 | 0.1 | 388 | 0 | $60 | $335 | $135 | 3.3 |
| Stair 3 to Gym | 2 | Compact Fluorescent: (1) 23W Spiral Plug-In Lamp | Wall Switch | S | 23 | 2,800 | 2, 4 | Relamp | Yes | 2 | LED Lamps: A19 Lamps | High/Low Control | 17 | 1,932 | 0.0 | 69 | 0 | $11 | $259 | $72 | 17.3 |
| Storage #1 | 1 | Compact Fluorescent: (1) 23W Spiral Plug-In Lamp | Wall Switch | S | 23 | 440 | 2 | Relamp | No | 1 | LED Lamps: A19 Lamps | Wall Switch | 17 | 440 | 0.0 | 3 | 0 | $0 | $17 | $1 | 35.8 |
| Storage - Janitor | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 440 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 440 | 0.0 | 14 | 0 | $2 | $72 | $10 | 28.5 |
| Storage - Janitor | 1 | Compact Fluorescent: (1) 23W Spiral Plug-In Lamp | Wall Switch | S | 23 | 440 | 2 | Relamp | No | 1 | LED Lamps: A19 Lamps | Wall Switch | 17 | 440 | 0.0 | 3 | 0 | $0 | $17 | $1 | 35.8 |
| Storage - Janitor | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 440 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 440 | 0.0 | 14 | 0 | $2 | $72 | $10 | 28.5 |
| Exterior - Pole Light | 3 | LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture | Photocell | | 100 | 4,380 | | None | No | 3 | LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture | Photocell | 100 | 4,380 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Exterior - Rear Lighting | 4 | LED Lamps: (1) 14W A19 Screw-In Lamp | Photocell | | 14 | 4,380 | | None | No | 4 | LED Lamps: (1) 14W A19 Screw-In Lamp | Photocell | 14 | 4,380 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

## 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 |
| Boiler Room - Old Building | Air Compressor | 2 | Air Compressor | 0.5 | 70.0% | No | Dayton | | W | 730 | | No | 70.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Boiler Room - Old Building | Condensate System | 2 | Condensate Pump | 1.0 | 82.5% | No | Marathon | | W | 2,000 | | No | 82.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Boiler Room - Old Building | Boiler Feed Water | 1 | Boiler Feed Water Pump | 1.0 | 82.5% | No | | | W | 2,000 | | No | 82.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Boiler Room - Old Building | Condensate System | 1 | Condensate Pump | 5.0 | 89.5% | No | Westinghouse | | B | 2,000 | | No | 89.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Roof | Classrooms | 2 | Exhaust Fan | 0.5 | 82.5% | No | | | W | 2,000 | | No | 82.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Roof | Gymnasium | 1 | Exhaust Fan | 2.0 | 84.0% | No | | | W | 2,000 | 5 | No | 86.5% | Yes | 1 | 0.6 | 1,401 | 0 | $221 | $3,261 | $100 | 14.3 |
| Roof - New Addition | Exhaust System | 5 | Exhaust Fan | 0.3 | 62.5% | No | | | W | 2,000 | | No | 62.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Boiler Room - New Wing | Heating System - HWP-1 | 1 | Heating Hot Water Pump | 5.0 | 89.5% | No | Weg | | W | 2,190 | 6 | No | 89.5% | Yes | 1 | 0.5 | 3,423 | 0 | $539 | $4,076 | $900 | 5.9 |
| Boiler Room - New Wing | Heating System - HWP-2 | 1 | Heating Hot Water Pump | 5.0 | 87.5% | No | Baldor | | W | 2,190 | 6 | No | 89.5% | Yes | 1 | 0.5 | 3,642 | 0 | $574 | $4,076 | $900 | 5.5 |
| Boiler Room - New Wing | DHW | 1 | DHW Circulation Pump | 0.0 | 60.0% | No | Taco | | W | 8,760 | | No | 60.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classrooms | Unit Ventilators | 25 | Supply Fan | 0.3 | 62.5% | No | | | W | 2,000 | | No | 62.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical - AHU1 | School Building | 1 | Supply Fan | 3.0 | 86.5% | No | | | W | 2,000 | | No | 86.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical - AHU2 | School Building | 1 | Supply Fan | 3.0 | 86.5% | No | | | W | 2,000 | | No | 86.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Office - Teachers Prep | Electric Forced Air Furnace | 1 | Supply Fan | 0.3 | 65.0% | No | ICP | | B | 2,000 | | No | 65.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Roof | Gymnasium | 1 | Supply Fan | 15.0 | 91.0% | No | McQuay | | B | 2,000 | 5 | No | 93.0% | Yes | 1 | 4.4 | 9,580 | 0 | $1,509 | $7,041 | $1,200 | 3.9 |
| Roof | Library | 1 | Supply Fan | 2.0 | 84.0% | No | Trane | | B | 2,000 | 5 | No | 86.5% | Yes | 1 | 0.6 | 1,401 | 0 | $221 | $3,261 | $100 | 14.3 |
| Boiler Room - New Wing | Boilers | 2 | Combustion Air Fan | 0.3 | 65.0% | No | | | | 2,000 | | 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 |
| Office - Teachers Prep | Office - Teachers Prep | 1 | Electric Forced Air Furnace | | 27.30 | | 1 COP | ICP | MF08B1500A3 | B | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Exterior HVAC | Resource Room | 1 | Ductless Mini-Split AC | 1.00 | | 10.00 | | | | B | 7 | Yes | 1 | Ductless Mini-Split AC | 1.00 | | 18.00 | | 0.3 | 187 | 0 | $29 | $5,175 | $0 | 176.0 |
| Exterior HVAC | Office - Teachers Prep | 1 | Split-System | 1.50 | | 10.10 | | ICP | CAC218AKA5 | B | 7 | Yes | 1 | Split-System | 1.50 | | 16.00 | | 0.3 | 230 | 0 | $36 | $5,678 | $158 | 152.3 |
| Roof - New Addition | Library | 1 | Package Unit | 10.00 | | 9.70 | | Trane | TCD121C30AAA | B | 7 | Yes | 1 | Package Unit | 10.00 | | 14.00 | | 1.9 | 1,330 | 0 | $209 | $12,271 | $790 | 54.8 |
| Office - ELL 1 | Office - ELL 1 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 100 | Classroom 100 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 101 | Classroom 101 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 102 | Classroom 102 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 103 | Classroom 103 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 104 | Classroom 104 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 105 | Classroom 105 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 109 | Classroom 109 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 111 | Classroom 111 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 113 | Classroom 113 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 115 | Classroom 115 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 117 | Classroom 117 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 120 | Classroom 120 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 121 | Classroom 121 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 122 | Classroom 122 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 123 | Classroom 123 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

| | | 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 (kBtu/hr) | Cooling Mode Efficiency (SEER/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 124 | Classroom 124 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 201 | Classroom 201 | 2 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 203 | Classroom 203 | 2 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 206 | Classroom 206 | 2 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 208 | Classroom 208 | 2 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 209 | Classroom 209 | 2 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 211 | Classroom 211 | 2 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 212 | Classroom 212 | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom 213 | Classroom 213 | 2 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom speech | Classroom - Speech | 1 | Window AC | 1.50 | | 11.00 | | Friedrich | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Office Main | Office Main | 1 | Window AC | 1.00 | | 10.00 | | GE | | B | 7 | Yes | 1 | Window AC | 1.00 | | 12.00 | | 0.1 | 70 | 0 | $11 | $703 | $0 | 63.8 |

**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 |
| Boiler Room - Old Building | Heating System - Boiler #1 | 1 | Forced Draft Steam Boiler | 2,766 | Smith | 28A-S/W-14 | B | 8 | Yes | 1 | Forced Draft Steam Boiler | 2,766 | 81.00% | Et | 0.0 | 0 | 77 | $602 | $51,410 | $2,766 | 80.8 |
| Boiler Room - Old Building | Heating System - Boiler #2 | 1 | Forced Draft Steam Boiler | 2,800 | Smith | 4500A-S-18 | B | 8 | Yes | 1 | Forced Draft Steam Boiler | 2,800 | 81.00% | Et | 0.0 | 0 | 78 | $610 | $52,042 | $2,800 | 80.8 |

**Pipe Insulation Recommendations**

| | | Recommendation Inputs | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Area(s)/System(s) Affected | ECM # | Length of Uninsulated Pipe (ft) | Pipe Diameter (in) | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Boiler Room | Steam System | 9 | 12 | 1.50 | 0.0 | 0 | 10 | $80 | $150 | $24 | 1.6 |

## DHW Inventory & Recommendations

| | | Existing Conditions | | | | | Proposed Conditions | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Location** | **Area(s)/System(s) Served** | **System Quantity** | **System Type** | **Manufacturer** | **Model** | **Remaining Useful Life** | **ECM #** | **Replace?** | **System Quantity** | **System Type** | **Fuel Type** | **System Efficiency** | **Efficiency Units** | **Total Peak kW Savings** | **Total Annual kWh Savings** | **Total Annual MMBtu Savings** | **Total Annual Energy Cost Savings** | **Estimated M&L Cost ($)** | **Total Incentives** | **Simple Payback w/ Incentives in Years** |
| Boiler Room - New Wing | Domestic Hot Water | 1 | Storage Tank Water Heater (≤ 50 Gal) | Rheem | | W | | No | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Boiler Room - Old Building | Domestic Hot Water | 1 | Storage Tank Water Heater (> 50 Gal) | Rheem | PRO+G75-76N RH | 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** |
| Maugham Elementary School | 10 | 19 | Faucet Aerator (Lavatory) | 2.20 | 0.50 | 0.0 | 0 | 9 | $70 | $136 | $68 | 1.0 |
| Maugham Elementary School | 10 | 10 | Faucet Aerator (Lavatory) | 2.20 | 0.50 | 0.0 | 1,390 | 0 | $219 | $72 | $36 | 0.2 |

## Plug Load Inventory

| | Existing Conditions | | | | | |
|---|---|---|---|---|---|---|
| **Location** | **Quantity** | **Equipment Description** | **Energy Rate (W)** | **ENERGY STAR Qualified?** | **Manufacturer** | **Model** |
| Maugham Elementary School | 3 | Coffee Machine | 500 | No | | |
| Maugham Elementary School | 11 | Desktop | 120 | No | | |
| Maugham Elementary School | 3 | Fan (Large) | 200 | No | | |
| Maugham Elementary School | 18 | Fan (Portable) | 200 | No | | |
| Maugham Elementary School | 4 | Microwave | 1,000 | No | | |
| Maugham Elementary School | 31 | Printer (Medium/Small) | 450 | No | | |
| Maugham Elementary School | 2 | Printer/Copier (Large) | 600 | No | | |
| Maugham Elementary School | 2 | Refrigerator (Residential) | 340 | No | | |
| Maugham Elementary School | 27 | Smart Board | 215 | Yes | | |
| Maugham Elementary School | 1 | Television | 224 | No | | |
| Maugham Elementary School | 2 | Toaster | 600 | No | | |
| Maugham Elementary School | 2 | Toaster Oven | 600 | No | | |

## Custom (High Level) Measure Analysis

**Heat Pump Water Heater**

| Existing Conditions | | | | | | Proposed Conditions | | | | Energy Impact & Financial Analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Area(s)/System(s) Served | SF of Area Served | Fuel Type | Input Capacity per Unit (kW) | Tank Capacity per Unit (Gal) | Description | COP | Tank Capacity per Unit (Gal) | Estimated Unit Cost | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Base Incentives | Enhanced Incentives | Total Incentives | Total Net Cost | Payback w/o Incentives in Years | Payback w/ Incentives in Years |
| Storage Tank Water Heater (≤50 Gal) | New Wing Domestic Hot Water System | 2,000 | Electric | 4.5 | 36 | Heat Pump Water Heater | 2.5 | 36 | $1,944.59 | 0.00 | 2,462 | 0 | $388 | $1,945 | $0 | $0 | $0 | $1,945 | 5.01 | 5.01 |

# APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE

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

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## ENERGY STAR® Statement of Energy Performance

**36**

**ENERGY STAR® Score**[1]

### Maugham Elementary School

**Primary Property Type:** K-12 School
**Gross Floor Area (ft²):** 41,450
**Built:** 1928

**For Year Ending:** June 30, 2021
**Date Generated:** August 02, 2022

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

### Property & Contact Information

| Property Address | Property Owner | Primary Contact |
|---|---|---|
| Maugham Elementary School<br>111 Magnolia Avenue<br>Tenafly, New Jersey 07670 | Tenafly Public Schools<br>500 Tenafly Road<br>Tenafly, NJ 07670<br>201-816-4504 | Victor Annaya<br>500 Tenafly Road<br>Tenafly, NJ 07670<br>201-816-4504<br>vanaya@tenafly.k12.nj.us |

**Property ID**: 20783911

### Energy Consumption and Energy Use Intensity (EUI)

**Site EUI**
121.1 kBtu/ft²

**Annual Energy by Fuel**

| | |
|---|---|
| Electric - Grid (kBtu) | 697,230 (14%) |
| Natural Gas (kBtu) | 4,324,344 (86%) |

**Source EUI**
156.6 kBtu/ft²

**National Median Comparison**

| | |
|---|---|
| National Median Site EUI (kBtu/ft²) | 105.9 |
| National Median Source EUI (kBtu/ft²) | 137 |
| % Diff from National Median Source EUI | 14% |

**Annual Emissions**

| | |
|---|---|
| Greenhouse Gas Emissions (Metric Tons CO2e/year) | 294 |

### 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**

____ ________
,
(____)____-______
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**Professional Engineer or Registered Architect Stamp (if applicable)**

# APPENDIX C: GLOSSARY

| TERM | DEFINITION |
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| **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* |

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

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| **SEER** | *Seasonal energy efficiency ratio:* a measure of efficiency in terms of annual cooling energy provided divided by total electric input. |
| **SEP** | *Statement of energy performance:* a summary document from the ENERGY STAR® Portfolio Manager®. |
| **Simple Payback** | The amount of time needed to recoup the funds expended in an investment or to reach the break-even point between investment and savings. |
| **SREC** | *Solar renewable energy credit*: a credit you can earn from the state for energy produced from a photovoltaic array. |
| **TREC** | *Transition Incentive Renewable Energy Certificate:* a factorized renewable energy certificate you can earn from the state for energy produced from a photovoltaic array. |
| **T5, T8, T12** | A reference to a linear lamp diameter. The number represents increments of 1/8$^{th}$ 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. |