
# Local Government Energy Audit Report

Bunker Hill Middle School

September 4, 2024

*Prepared for:*
Washington Township BOE
372 Pitman Downer Road
Sewell, New Jersey 08080

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

# Disclaimer

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

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

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

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

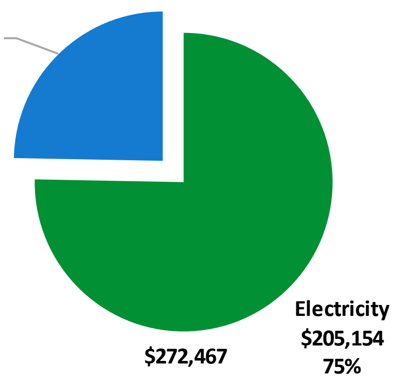
The customer and their respective contractor(s) are responsible to implement energy conservation measures in complete conformance with all applicable local, state, and federal requirements.

# Table of Contents

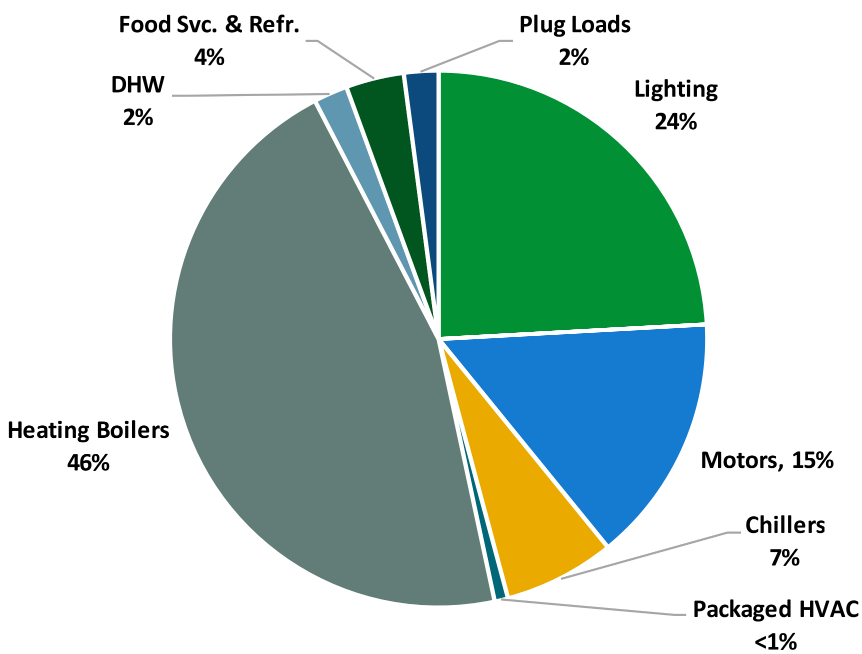
# 1 Executive Summary

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Bunker Hill Middle 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 Energy Utilities | Costs: $272,467<br>Electricity: 1,268,876 kWh<br>Natural Gas: 40,697 Therms<br>Water: 1,121,900 Gallons |  |
| ENERGY STAR® Benchmarking Score | 22<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. |





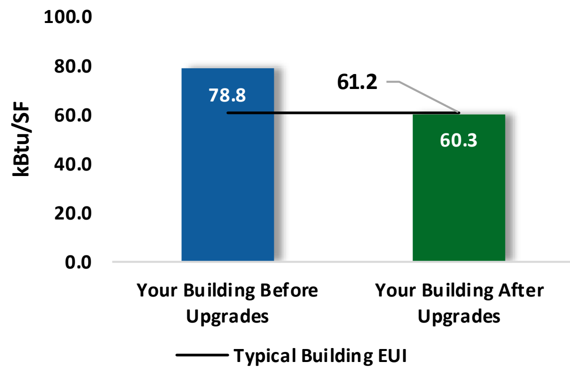

*Energy Use by System*

## 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.

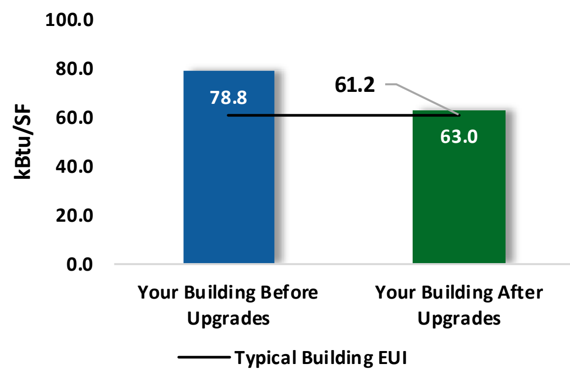
### Scenario 1: Full Package (All Evaluated Measures)

| | |
|---|---|
| Installation Cost | $512,000 |
| Potential Rebates & Incentives[1] | $58,190 |
| Annual Cost Savings | $84,455 |
| Annual Energy Savings | Electricity: 493,151 kWh<br>Natural Gas: 2,854 Therms |
| Greenhouse Gas Emission Savings | 265 Tons |
| Simple Payback | 5.4 Years |
| Site Energy Savings (All Utilities) | 23% |




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

| | |
|---|---|
| Installation Cost | $256,460 |
| Potential Rebates & Incentives | $47,590 |
| Annual Cost Savings | $79,697 |
| Annual Energy Savings | Electricity: 491,837 kWh<br>Natural Gas: 106 Therms |
| Greenhouse Gas Emission Savings | 248 Tons |
| Simple Payback | 2.6 Years |
| Site Energy Savings (all utilities) | 20% |




### 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** | | | **309,339** | **49.2** | **-64** | **$48,959** | **$113,320** | **$24,550** | **$88,770** | **1.8** | **304,027** |
| ECM 1 | Install LED Fixtures | Yes | 3,241 | 0.0 | 0 | $524 | $2,650 | $500 | $2,150 | 4.1 | 3,264 |
| ECM 2 | Retrofit Fixtures with LED Lamps | Yes | 306,098 | 49.2 | -64 | $48,435 | $110,670 | $24,050 | $86,620 | 1.8 | 300,764 |
| **Lighting Control Measures** | | | **97,335** | **15.5** | **-20** | **$15,401** | **$53,260** | **$12,720** | **$40,540** | **2.6** | **95,634** |
| ECM 3 | Install Occupancy Sensor Lighting Controls | Yes | 80,872 | 13.2 | -17 | $12,796 | $41,760 | $4,910 | $36,850 | 2.9 | 79,457 |
| ECM 4 | Install Photocell Controls | No | 43 | 0.0 | 0 | $7 | $240 | $0 | $240 | 34.4 | 43 |
| ECM 5 | Install High/Low Lighting Controls | Yes | 16,421 | 2.3 | -3 | $2,598 | $11,260 | $7,810 | $3,450 | 1.3 | 16,133 |
| **Motor Upgrades** | | | **13,749** | **5.4** | **0** | **$2,223** | **$50,800** | **$0** | **$50,800** | **22.9** | **13,845** |
| ECM 6 | Premium Efficiency Motors | No | 13,749 | 5.4 | 0 | $2,223 | $50,800 | $0 | $50,800 | 22.9 | 13,845 |
| **Variable Frequency Drive (VFD) Measures** | | | **67,116** | **22.9** | **0** | **$10,851** | **$60,200** | **$8,800** | **$51,400** | **4.7** | **67,585** |
| ECM 7 | Install VFDs on Constant Volume (CV) Fans | Yes | 67,116 | 22.9 | 0 | $10,851 | $60,200 | $8,800 | $51,400 | 4.7 | 67,585 |
| **Unitary HVAC Measures** | | | **652** | **0.8** | **0** | **$105** | **$6,400** | **$300** | **$6,100** | **57.9** | **656** |
| ECM 8 | Install High Efficiency Air Conditioning Units | No | 652 | 0.8 | 0 | $105 | $6,400 | $300 | $6,100 | 57.9 | 656 |
| **Gas Heating (HVAC/Process) Replacement** | | | **0** | **0.0** | **115** | **$1,906** | **$153,100** | **$7,600** | **$145,500** | **76.3** | **13,493** |
| ECM 9 | Install High Efficiency Hot Water Boilers | No | 0 | 0.0 | 115 | $1,906 | $153,100 | $7,600 | $145,500 | 76.3 | 13,493 |
| **HVAC System Improvements** | | | **0** | **0.0** | **31** | **$508** | **$950** | **$140** | **$810** | **1.6** | **3,597** |
| ECM 10 | Install Pipe Insulation | Yes | 0 | 0.0 | 31 | $508 | $950 | $140 | $810 | 1.6 | 3,597 |
| **Domestic Water Heating Upgrade** | | | **0** | **0.0** | **32** | **$531** | **$40,680** | **$2,880** | **$37,800** | **71.1** | **3,762** |
| ECM 11 | Install High Efficiency Gas-Fired Water Heater | No | 0 | 0.0 | 20 | $324 | $40,300 | $2,700 | $37,600 | 116.2 | 2,291 |
| ECM 12 | Install Low-Flow DHW Devices | Yes | 0 | 0.0 | 13 | $208 | $380 | $180 | $200 | 1.0 | 1,471 |
| **Food Service & Refrigeration Measures** | | | **18,090** | **2.0** | **52** | **$3,777** | **$28,590** | **$1,200** | **$27,390** | **7.3** | **24,251** |
| ECM 13 | Dishwasher Replacement | Yes | 8,110 | 0.9 | 52 | $2,164 | $22,000 | $1,000 | $21,000 | 9.7 | 14,200 |
| ECM 14 | Refrigeration Controls | Yes | 888 | 0.0 | 0 | $144 | $1,280 | $100 | $1,180 | 8.2 | 895 |
| ECM 15 | Replace Refrigeration Equipment | Yes | 5,526 | 0.6 | 0 | $893 | $4,500 | $0 | $4,500 | 5.0 | 5,565 |
| ECM 16 | Vending Machine Control | Yes | 3,566 | 0.4 | 0 | $577 | $810 | $100 | $710 | 1.2 | 3,591 |
| **Custom Measures** | | | **-13,130** | **0.0** | **140** | **$193** | **$4,700** | **$0** | **$4,700** | **24.4** | **3,170** |
| ECM 17 | Replace Gas Fired Water Heater with Heat Pump Water Heater | No | -13,130 | 0.0 | 140 | $193 | $4,700 | $0 | $4,700 | 24.4 | 3,170 |
| **TOTALS (COST EFFECTIVE MEASURES)** | | | **491,837** | **89.6** | **11** | **$79,697** | **$256,460** | **$47,590** | **$208,870** | **2.6** | **496,521** |
| **TOTALS (ALL MEASURES)** | | | **493,151** | **95.8** | **285** | **$84,455** | **$512,000** | **$58,190** | **$453,810** | **5.4** | **530,021** |

* - 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).

*All Evaluated Energy Improvements*[3]

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

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

## 1.1 Planning Your Project

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

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

### Pick Your Installation Approach

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

#### Options from Your Utility Company

*Prescriptive and Custom Rebates*

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

*Direct Install*

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

*Engineered Solutions*

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

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

## Options from New Jersey's Clean Energy Program

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

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

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

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

### *Successor Solar Incentive Program (SuSI)*

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

### *Ongoing Electric Savings with Demand Response*

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

### *Large Energy User Program (LEUP)*

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

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

# 2 Existing Conditions

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Bunker Hill Middle 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 February 24, 2024, TRC performed an energy audit at Bunker Hill Middle School located in Sewell, New Jersey. TRC met with Bob Schoenfeldt to review the facility operations and help focus our investigation on specific energy-using systems.

Bunker Hill Middle School is a two-story, 106,574 square foot building built in 1996. Spaces include classrooms, gymnasium, offices, cafeteria, corridors, stairwells, garage, offices, commercial kitchen, and mechanical space. All areas at this site are served by a single electric and a single gas meter. A natural gas generator is operated in case of a power emergency.

Lighting systems generally consist of combination of linear fluorescent lamps and LED sources. The facility is 100% heated and cooled by a combination of hot/chilled water systems connected to rooftop mounted air handlers and blower coil units.

**Recent Improvements and Facility Concerns**

No recent improvements to the facility were noted during the energy audit.

Facility staff were additionally interested in upgrading the existing metal halide exterior lighting and replacing other recessed exterior lighting with new LED fixtures. Staff is in the process of replacing fluorescent tubes with new LED lamps as they fail.

## 2.2 Building Occupancy

Bunker Hill Middle School is fully occupied for 11 months of the year. Typical weekday occupancy is 99 staff and 459 students. The facility is operated until approximately 11:00 PM for maintenance. This facility does experience summer occupancy for summer school activities, although building use is rotated between different facilities depending on the year. The facility’s gymnasium is operational during weekends for six to eight hours from November to April.

It should be noted that the energy and economic analysis for the facilities is based on the use of the building during the utility billing period, and that results will vary based on changes to the building.

| Building Name | Weekday/Weekend | Operating Schedule |
|---|---|---|
| Bunker Hill - Building Operation Hours | Weekday | 6:00 AM - 11:00 PM |
| | Weekend | NA |
| Bunker Hill - Class Hours | Weekday | 7:50 AM - 2:30 PM |
| | Weekend | NA |
| Bunker Hill - Summer Operational Hours | Weekday | 6:00 AM - 4:30 PM |
| | Weekend | NA |
| Bunker Hill - Winter Gymnasium Hours | Weekday | NA |
| | Weekend | 10:00 AM - 4:00 PM |

***Building Occupancy Schedule***

## 2.3 Building Envelope

Exterior building walls are made of concrete masonry units (CMUs) with a brick veneer façade installed on most sections. Interior walls are a mix of painted CMU interior finish and finished sheetrock with steel framing. The level of exterior wall insulation is unknown. Steel trusses support a flat roof with a black EDPM covering that is in good condition, having been replaced within the last ten years.

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

*Exterior Walls & Typical Doors*

*Flat Roof with Black Membrane*

*Typical Windows*

## 2.4 Lighting Systems

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. Linear fixture types include 1-lamp, 2-lamp, or 4-lamp, 2-foot or 4-foot-long recessed and surface mounted fixtures. These fixtures are supplemented by additional 32-Watt linear fluorescent T8 U-Bend lamps in 2-lamp recessed fixtures in most spaces within the facility. Typically, T8 fluorescent lamps use electronic ballasts.

The facility's gymnasium and weight room lighting has been updated with new LED linear tube lighting. A mixture of LED high bay and recessed downlights illuminate the main entrance.

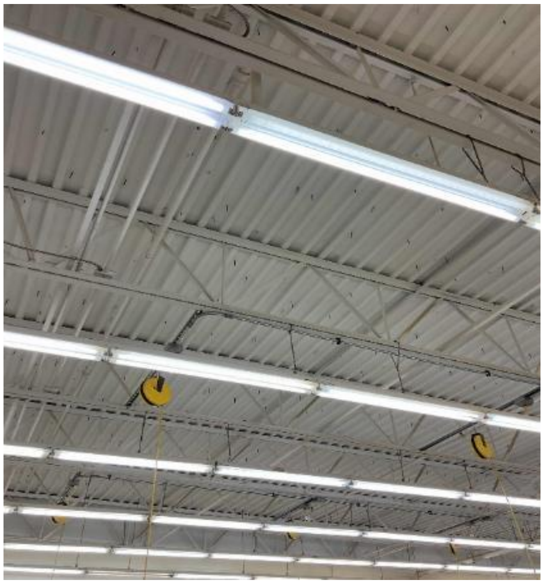
Most fixtures are in good condition. Interior lighting levels were generally sufficient. All exit signs are LED. Light fixtures in spaces are either controlled by occupancy sensors or manual wall switches. Occupancy sensors are either wall or ceiling mounted.

Exterior building illumination is provided by a mix of metal halide (MH) pole-mounted spotlights and LED wall packs. The facility has pole-mounted LED screw-in bulbs illuminating the parking lots.

Exterior fixtures are controlled by via photocells or a timeclock, depending on the fixture.



*LED Fixtures in Gymnasium and Main Corridor*

*Typical T8 Linear Fluorescent Fixtures*

*Metal Halide Spotlights*

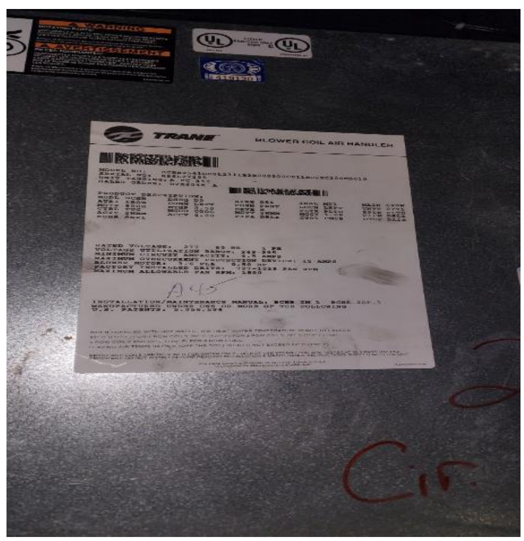
*Typical LED Wallpack Fixtures*

*LED Retrofit Street Lighting*

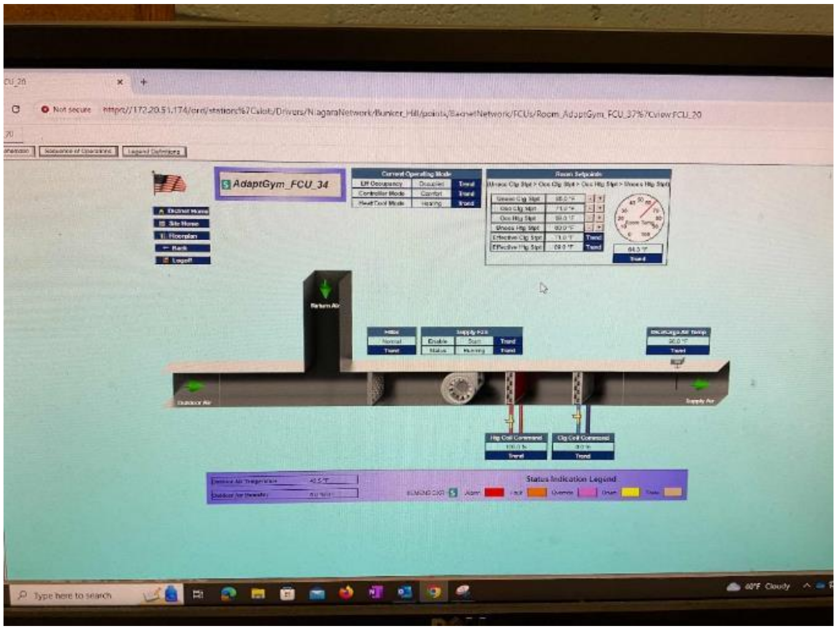
## 2.5 Air Handling Systems

**Unit Ventilators**

Unit ventilators provide heating, cooling, and ventilation to classrooms and offices. They are equipped with supply fan motors and pneumatically controlled outside air dampers and fan coil valves connected to the hot and chilled water distribution systems. This system is original to the building and appears to be in fair operating condition.




*Typical Trane Blower Coil Units Installed Above Corridor Ceiling*




*BAS Screenshot - Blower Coil Unit Configuration*

## Unitary Electric HVAC Equipment

Classrooms B7 and B9 are each conditioned by a dedicated LG split-system air-source heat pump. These units have heating capacities of 13.8 MBh with an 8.20 HSPF rating, and cooling capacities of 1 ton with a 14.0 SEER rating. Both units are in good condition. They are not ENERGY STAR labeled.

*LG Split-System Air-Sourced Heat Pumps*

## Unitary Heating Equipment

The greenhouse is heated by a natural gas-fired unit heater with a rated capacity of 50 MBh and an efficiency rating of 80%. The unit is in good condition and is controlled by a manual dial thermostat.


*Typical Facility Unit Heater*

## Packaged Units

Science classroom C-3 at the west end of the facility is served by a packaged roof top unit (RTU) that is not connected to the facility's BAS. This unit provides cooling only with a 2.5-ton capacity and a SEER rating of 8.5. The unit is not equipped with an economizer, is in poor condition, and operating past its useful life expectancy.


*Trane RTU Mounted Above Classroom C-3*

## Air Handling Units (AHUs)

The facility's gymnasium is conditioned by two Trane air handling units. These units are equipped with a supply fan motor, hot water heating coil, and chilled water coil. The units are physically located on the facility's roof adjacent to the gymnasium. The supply fan motors are 7.5 hp each and are both equipped with variable frequency drives. They are rated as standard efficiency. Both Trane units are in good condition and operating with their expected life.

The facility has four unmarked heat recovery units (HRU) that serve all areas of the building. Two are located on the two-story section of the building and two are located on the one-story section/cafeteria. Each unit is equipped with two, 10 hp constant speed supply fan motors and a single fractional hp exhaust fan. The fan motors are rated as standard efficiency. All four units are in fair condition and are operating within their expected life.

These HVAC systems are controlled by the facility BAS.

*Trane AHUs*


*Supply Fan Motor*

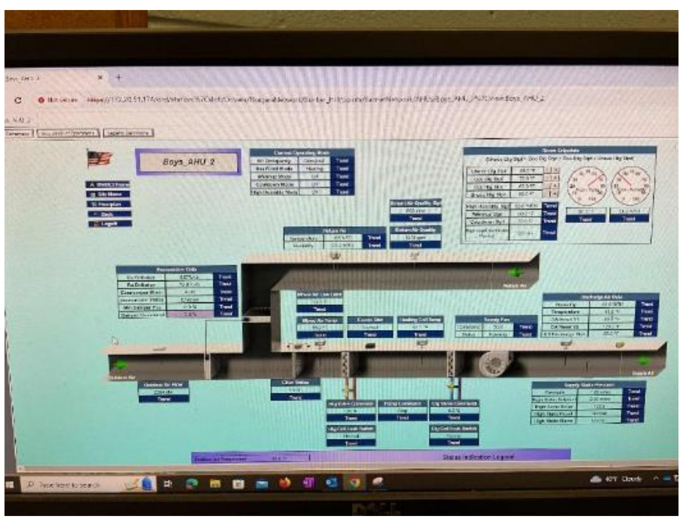
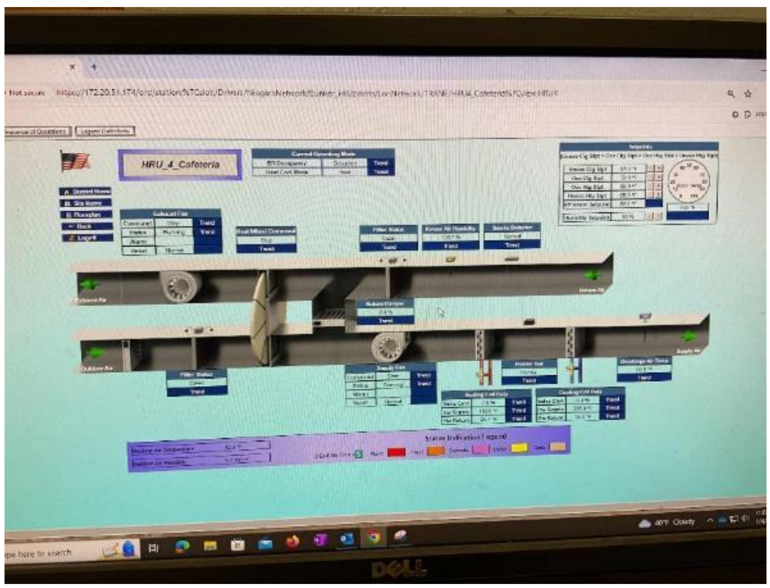



*Table 1BAS Screenshot - AHU Configuration*

*Heating Recovery Units*

*Heating Recovery Motors*




*BAS Screenshot - HRU Configuration*

## 2.6 Heating [Hot Water/Steam] Systems

Two Weil McLain 2,927 MBh non-condensing hot water boilers serve the building's heating load. The burners are non-modulating with a nominal efficiency of 82.5%. The boilers are configured in an automated scheme. Both boilers are required under high load conditions. Installed in 1997, they are in fair condition.

The hydronic distribution system is a two-pipe heating and cooling system.

Seasonal changeover begins in November for the heating season and March for the cooling season.

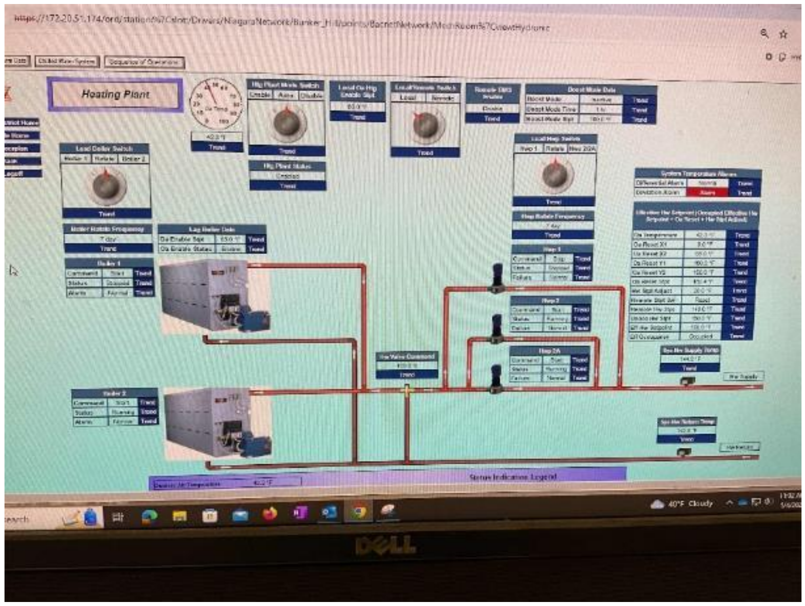
The boilers are configured in a variable flow primary distribution with two, 3 hp and one, 15 hp VFD controlled hot water pumps operating with an automated control scheme. The boilers provide hot water to blower coil units throughout the building.

There are an estimated 70.0 feet of 1-inch supply and/or return pipe at the blower coils with no insulation and/or insulation in poor condition across the facility that should be repaired/replaced.

Hot water is supplied at 180°F when the outside air temperature is low, and the setpoint is adjusted linearly to 150°F when the outside air is above 45°F. The hot water return temperature is typically 142°F. The system is locked out at an outside temperature of 65°F.


*Non-Condensing Heating Hot Water Boilers*


*Heating Hot Water Pumps*




*BAS Screenshot - Heating Hot Water System Configuration*

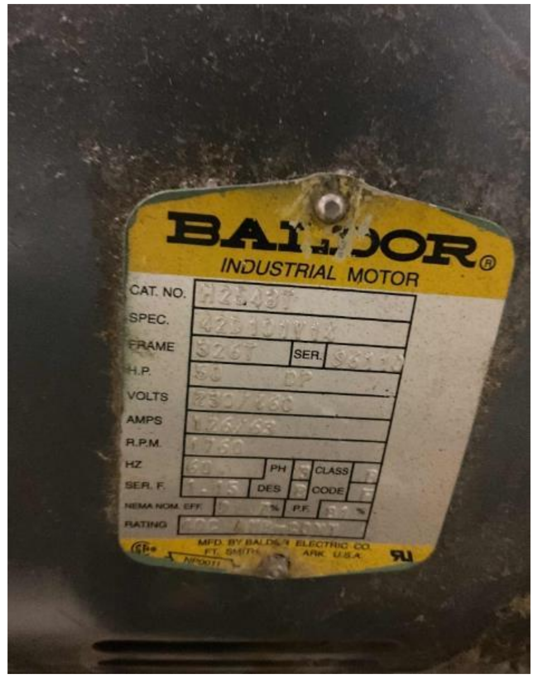
## 2.7 Chilled Water Systems

The chiller plant consists of a one, 200-ton, Trane, air-cooled screw chiller. Chilled water is circulated by two dedicated 50 hp primary pumps with a rated flow of 900 gpm. Both pumps are equipped with variable frequency drives.

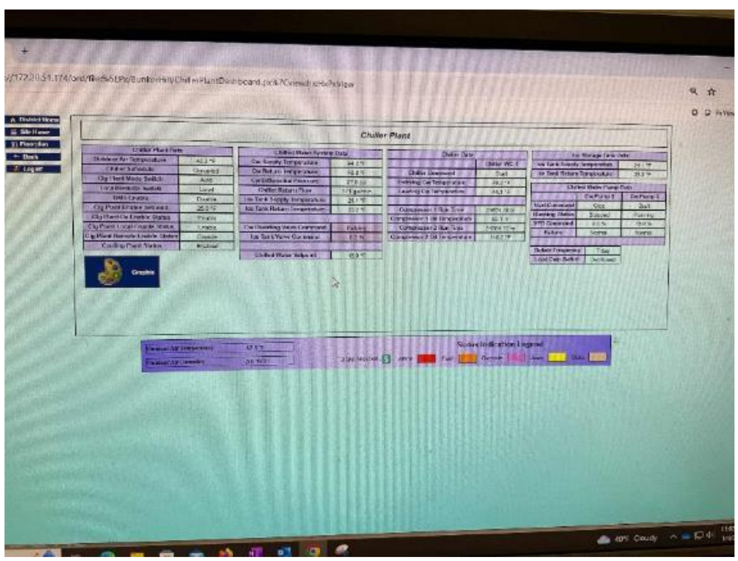
The chilled water supply temperature is reset based on outside air temperature. Chilled water is distributed at 44°F when the outside air temperature is above 60°F, and the setpoint is reset to 50°F when the outside air is below 55°F. The chiller plant is locked out when the outside air temperature is below 45°F, and it is turned off from November through March.

The chiller plant supplies chilled water to air handlers one and two, and to the fan coil units. The chiller plant has a peak load of 200 tons.

*Trane Air-Cooled Screw Chiller*



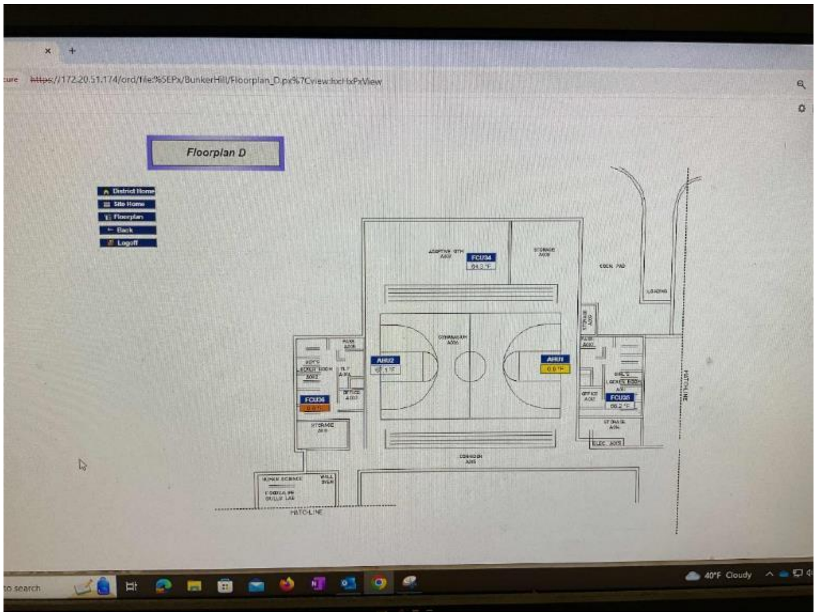

*Chilled Water Pumps and Attached VFDs*




*BAS Screenshot - Chilled Water System Configuration*

## 2.8 Building Automation System (BAS)

A Honeywell BAS controls the HVAC equipment, exhaust fans, and package units. The BAS provides equipment scheduling control and monitors space temperatures, supply air temperatures, humidity, and heating water loop temperatures.




*BAS Screenshot - Building Floorplan*

## 2.9 Domestic Hot Water

Hot water is produced by three State Industries 100 gallon, 260 MBh gas-fired storage water heaters with efficiency ratings of 80%. All three units are operating beyond their life expectancies but appear to be in fair condition. A 0.75 hp circulation pump distributes water to end uses. The circulation pump operates continuously.

The domestic hot water pipes are insulated, and the insulation is in fair condition.

*Non-Condensing Storage Tank Water Heaters*


*Circulation Pump*

## 2.10 Food Service Equipment

The kitchen has a mix of gas and electric equipment that is used to prepare meals for students. Most cooking is done using an electric oven. A gas oven is present, but facility staff stated that it was no longer used while still having an active natural gas connection. Bulk prepared foods are held in several electric holding cabinets. Equipment is not high efficiency and is in good condition.

The dishwasher is a non-ENERGY STAR high temperature, door type unit. A HATCO booster water heater is attached to the dishwasher with an assumed capacity of 10 kW.

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



*Typical Food Service Equipment*



*Non-ENERGY STAR Dishwasher*

*Attached Booster Heater*

## 2.11 Refrigeration

The kitchen has several stand-up refrigerators with either solid or glass doors. There are also two freezer chests and a refrigerator chest. All equipment is standard efficiency and in good condition. The walk-in refrigerator has an estimated 0.58-ton compressor and a two-fan evaporator. The walk-in medium temperature freezer has a 0.75-ton compressor and a two-fan evaporator.

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


*Typical Walk-In Evaporator Unit*

## 2.12 Plug Load and Vending Machines

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

There are 129 computer workstations throughout the facility. Plug loads include general cafe and office equipment. There are classroom typical loads such as televisions, projectors, and fans. The facility also has a shop classroom, which includes loads for various wood-working tools and machines.

There are several residential-style refrigerators throughout the building that are used to store faculty meals and supplies. These vary in condition and efficiency.

There are two refrigerated beverage vending machines and one non-refrigerated vending machine. Vending machines are not equipped with occupancy-based controls.


*Typical Plug Load Fixtures*

## 2.13 Water-Using Systems

Water is provided by a municipal water supply company. Potable water is used for drinking, cleaning, cooking, sanitary fixtures, and building conditioning. Water leaks were not observed/reported.

EPA WaterSense® has set maximum flow rates for sanitary fixtures. They are: 1.28 gallons per flush (gpf) for toilets, 0.5 gpf for urinals, 1.5 gallons per minute (gpm) for lavatory faucets, and 2.0 gpm for showerheads. There are 17 restrooms with toilets, urinals, and sinks. Faucet flow rates are at 1.5 gpm or higher.

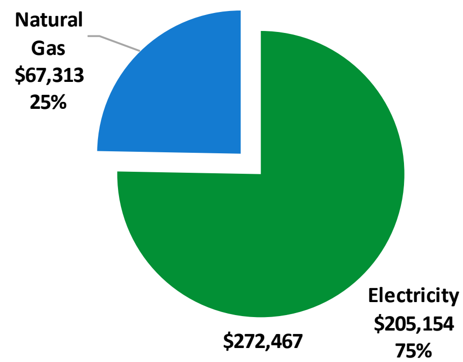
The site has a commercial kitchen with a non-ENERGY STAR dishwasher.


*Typical Water Using Fixtures*

# 3 Energy and Water Use and Costs

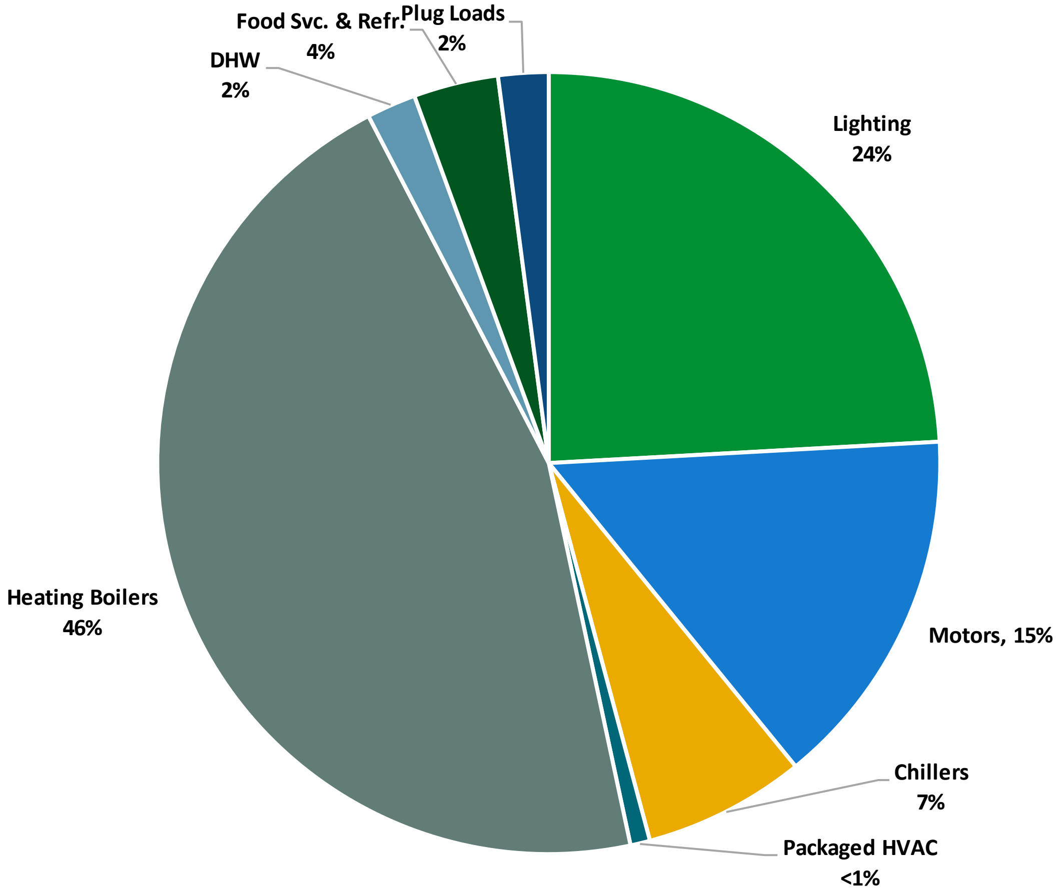
Twelve months of utility billing data are used to develop annual energy consumption and cost data. This information creates a profile of the annual energy consumption and energy costs.

| Utility Summary | | |
|---|---|---|
| **Fuel** | **Usage** | **Cost** |
| Electricity | 1,268,876 kWh | $205,154 |
| Natural Gas | 40,697 Therms | $67,313 |
| **Total** | | **$272,467** |




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

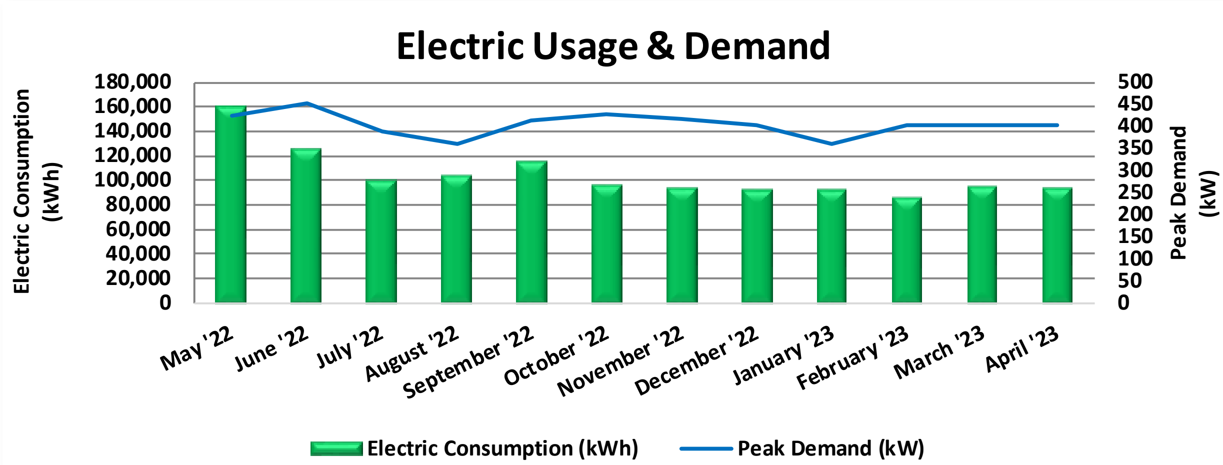
The energy auditor collects information regarding equipment operating hours, capacity, efficiency, and other operational parameters from facility staff, drawings, and on-site observations. This information is used as the inputs to calculate the existing conditions energy use for the site. The calculated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




*Energy Balance by System*

## 3.1 Electricity

Atlantic City Electric delivers electricity under rate class Annual General Service Secondary.



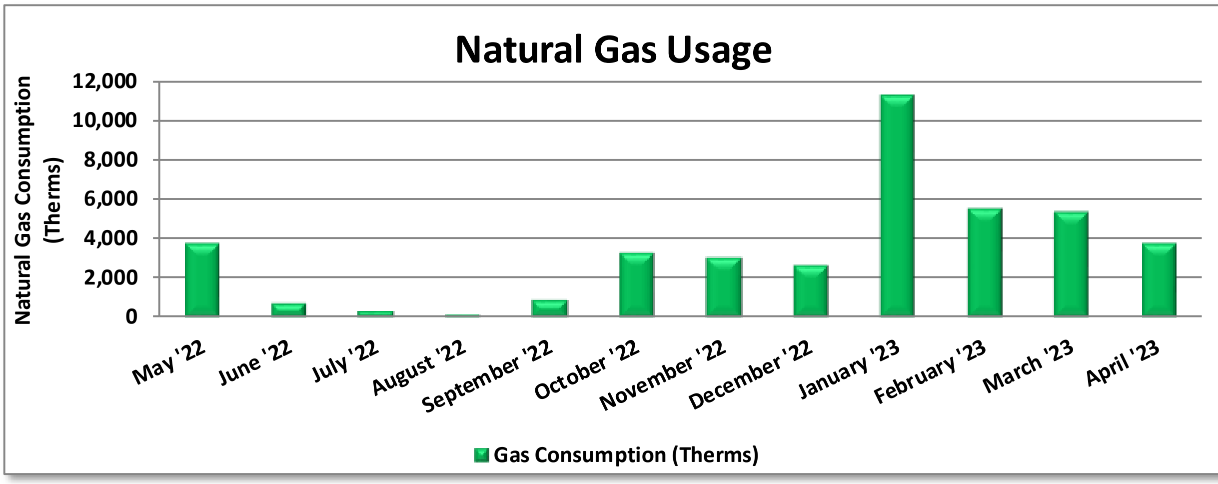

| Electric Billing Data | | | | | |
|---|---|---|---|---|---|
| Period Ending | Days in Period | Electric Usage (kWh) | Demand (kW) | Demand Cost | Total Electric Cost |
| 5/26/22 | 31 | 160,800 | 424 | $5,534 | $23,201 |
| 6/28/22 | 33 | 126,400 | 452 | $6,280 | $19,751 |
| 7/27/22 | 29 | 100,800 | 390 | $4,762 | $15,450 |
| 8/26/22 | 30 | 104,600 | 362 | $4,567 | $15,654 |
| 9/27/22 | 32 | 116,400 | 414 | $5,577 | $19,392 |
| 10/26/22 | 29 | 97,400 | 428 | $5,244 | $16,686 |
| 11/30/22 | 35 | 95,200 | 416 | $404 | $16,310 |
| 12/27/22 | 27 | 93,000 | 404 | $4,511 | $15,176 |
| 1/26/23 | 30 | 93,400 | 362 | $4,585 | $15,317 |
| 2/22/23 | 27 | 87,200 | 404 | $4,610 | $14,808 |
| 3/23/23 | 29 | 96,000 | 404 | $4,952 | $16,119 |
| 4/24/23 | 32 | 94,200 | 404 | $5,464 | $16,728 |
| **Totals** | **364** | **1,265,400** | **452** | **$56,489** | **$204,592** |
| **Annual** | **365** | **1,268,876** | **452** | **$56,644** | **$205,154** |

Notes:

- Peak demand of 452 kW occurred in June '22.
- Average demand over the past 12 months was 405 kW.
- The average electric cost over the past 12 months was $0.162/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

South Jersey Gas delivers natural gas under rate class General Service FT(SJ-GSG), with natural gas supply provided by UGI, a third-party supplier.



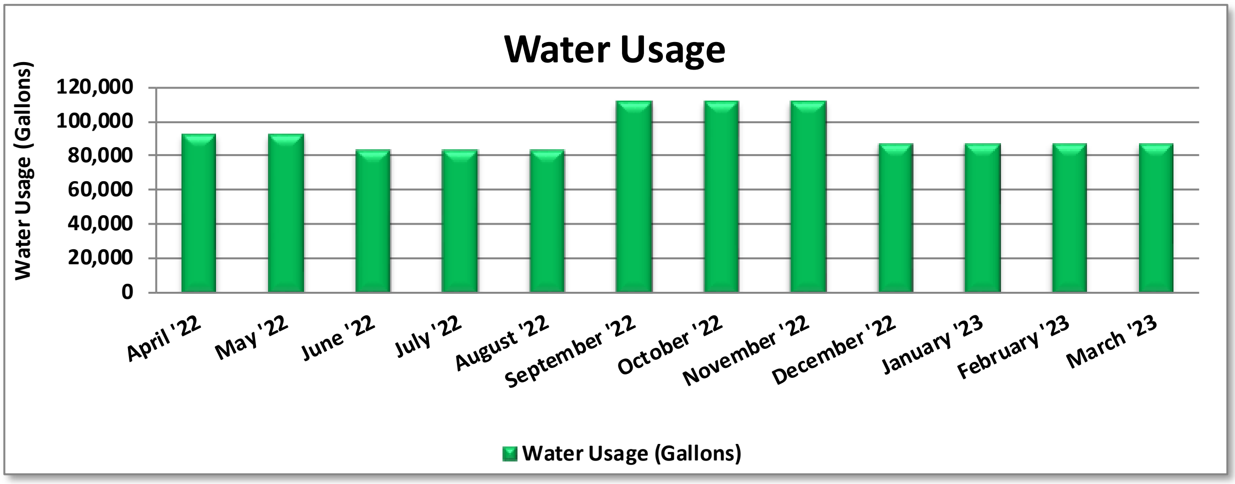

| Gas Billing Data | | | |
|---|---|---|---|
| Period Ending | Days in Period | Natural Gas Usage (Therms) | Natural Gas Cost |
| 5/26/22 | 31 | 3,732 | $6,549 |
| 6/28/22 | 33 | 680 | $1,288 |
| 7/27/22 | 29 | 278 | $495 |
| 8/26/22 | 30 | 175 | $316 |
| 9/27/22 | 32 | 866 | $1,664 |
| 10/26/22 | 29 | 3,306 | $5,910 |
| 11/22/22 | 27 | 3,056 | $5,013 |
| 12/22/22 | 30 | 2,611 | $4,387 |
| 1/26/23 | 35 | 11,240 | $18,861 |
| 2/22/23 | 27 | 5,537 | $9,005 |
| 3/23/23 | 29 | 5,320 | $8,250 |
| 4/24/23 | 32 | 3,784 | $5,389 |
| **Totals** | **364** | **40,586** | **$67,128** |
| **Annual** | **365** | **40,697** | **$67,313** |

Notes:

- The average gas cost for the past 12 months is $1.654/therm, which is the blended rate used throughout the analysis.

## 3.3 Water

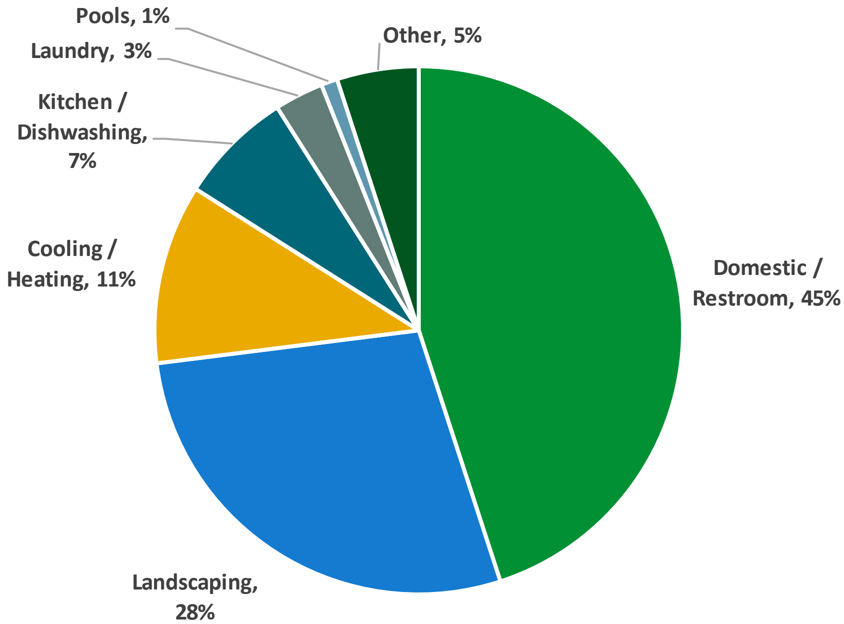
Washington Township MUA delivers water to the project site.




| Water Billing Data | | | |
|---|---|---|---|
| Period Ending | Days in Period | Water Usage (gallons) | Water Cost |
| 5/1/22 | 30 | 92,400 | $747 |
| 6/1/22 | 31 | 92,400 | $747 |
| 7/1/22 | 30 | 83,733 | $705 |
| 8/1/22 | 31 | 83,733 | $705 |
| 9/1/22 | 31 | 83,733 | $705 |
| 10/1/22 | 30 | 112,167 | $846 |
| 11/1/22 | 31 | 112,167 | $846 |
| 12/1/22 | 30 | 112,167 | $846 |
| 1/1/23 | 31 | 87,350 | $722 |
| 2/1/23 | 31 | 87,350 | $722 |
| 3/1/23 | 28 | 87,350 | $722 |
| 4/1/23 | 31 | 87,350 | $722 |
| **Totals** | **365** | **1,121,900** | **$9,036** |
| **Annual** | **365** | **1,121,900** | **$9,036** |

Notes:

- The average cost of water for the past 12 months is $0.0081/gal.




*Typical Education Water End Use*[4]

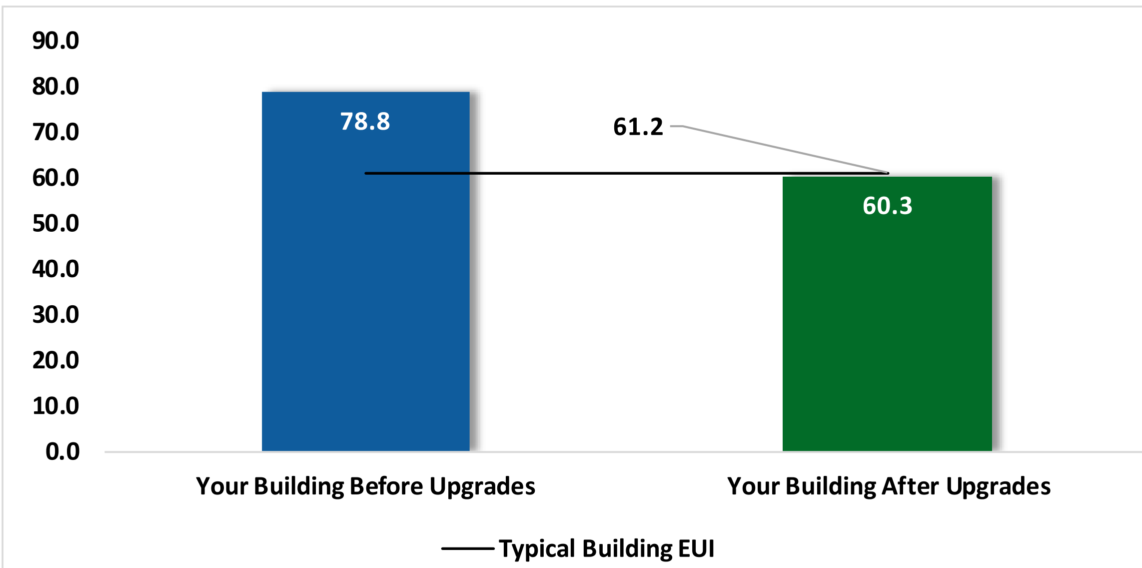
[4] Chart is of typical water end use and not specific to the facility

## 3.4 Benchmarking

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

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

| Benchmarking Score | 22 |
|---|---|



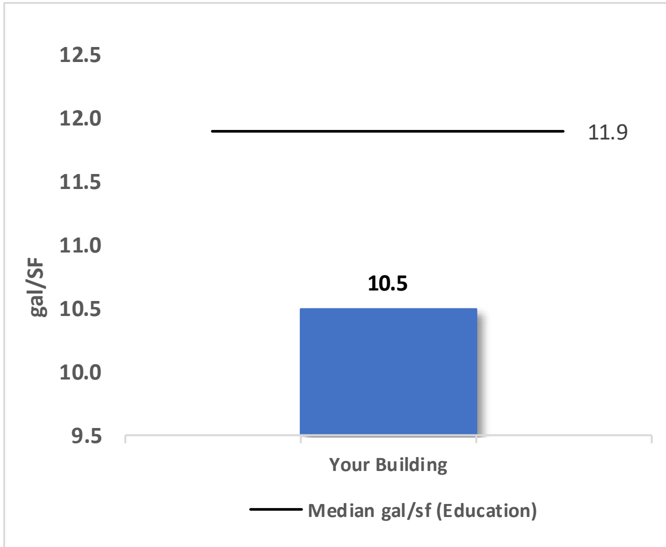

*Energy Use Intensity Comparison*[5]

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

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

[5] Based on all evaluated ECMs

# Water Benchmarking




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

Water use varies considerably depending mainly on the extent of outdoor water use and whether process water is used, such as for vehicle washing and for laboratory sterilizers. Cooling towers and steam boilers are also significant water users. Kitchens and sanitary fixtures may use varying amounts of water.

## Tracking your Energy Performance

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

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

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

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

## 3.5 Understanding Your Utility Bills

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

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

**Why Utility Bills Vary**

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

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

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

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

# 4 Energy Conservation Measures

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

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

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

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

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

| # | Energy Conservation Measure | Cost Effective? | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Upgrades** | | | **309,339** | **49.2** | **-64** | **$48,959** | **$113,320** | **$24,550** | **$88,770** | **1.8** | **304,027** |
| ECM 1 | Install LED Fixtures | Yes | 3,241 | 0.0 | 0 | $524 | $2,650 | $500 | $2,150 | 4.1 | 3,264 |
| ECM 2 | Retrofit Fixtures with LED Lamps | Yes | 306,098 | 49.2 | -64 | $48,435 | $110,670 | $24,050 | $86,620 | 1.8 | 300,764 |
| **Lighting Control Measures** | | | **97,335** | **15.5** | **-20** | **$15,401** | **$53,260** | **$12,720** | **$40,540** | **2.6** | **95,634** |
| ECM 3 | Install Occupancy Sensor Lighting Controls | Yes | 80,872 | 13.2 | -17 | $12,796 | $41,760 | $4,910 | $36,850 | 2.9 | 79,457 |
| ECM 4 | Install Photocell Controls | No | 43 | 0.0 | 0 | $7 | $240 | $0 | $240 | 34.4 | 43 |
| ECM 5 | Install High/Low Lighting Controls | Yes | 16,421 | 2.3 | -3 | $2,598 | $11,260 | $7,810 | $3,450 | 1.3 | 16,133 |
| **Motor Upgrades** | | | **13,749** | **5.4** | **0** | **$2,223** | **$50,800** | **$0** | **$50,800** | **22.9** | **13,845** |
| ECM 6 | Premium Efficiency Motors | No | 13,749 | 5.4 | 0 | $2,223 | $50,800 | $0 | $50,800 | 22.9 | 13,845 |
| **Variable Frequency Drive (VFD) Measures** | | | **67,116** | **22.9** | **0** | **$10,851** | **$60,200** | **$8,800** | **$51,400** | **4.7** | **67,585** |
| ECM 7 | Install VFDs on Constant Volume (CV) Fans | Yes | 67,116 | 22.9 | 0 | $10,851 | $60,200 | $8,800 | $51,400 | 4.7 | 67,585 |
| **Unitary HVAC Measures** | | | **652** | **0.8** | **0** | **$105** | **$6,400** | **$300** | **$6,100** | **57.9** | **656** |
| ECM 8 | Install High Efficiency Air Conditioning Units | No | 652 | 0.8 | 0 | $105 | $6,400 | $300 | $6,100 | 57.9 | 656 |
| **Gas Heating (HVAC/Process) Replacement** | | | **0** | **0.0** | **115** | **$1,906** | **$153,100** | **$7,600** | **$145,500** | **76.3** | **13,493** |
| ECM 9 | Install High Efficiency Hot Water Boilers | No | 0 | 0.0 | 115 | $1,906 | $153,100 | $7,600 | $145,500 | 76.3 | 13,493 |
| **HVAC System Improvements** | | | **0** | **0.0** | **31** | **$508** | **$950** | **$140** | **$810** | **1.6** | **3,597** |
| ECM 10 | Install Pipe Insulation | Yes | 0 | 0.0 | 31 | $508 | $950 | $140 | $810 | 1.6 | 3,597 |
| **Domestic Water Heating Upgrade** | | | **0** | **0.0** | **32** | **$531** | **$40,680** | **$2,880** | **$37,800** | **71.1** | **3,762** |
| ECM 11 | Install High Efficiency Gas-Fired Water Heater | No | 0 | 0.0 | 20 | $324 | $40,300 | $2,700 | $37,600 | 116.2 | 2,291 |
| ECM 12 | Install Low-Flow DHW Devices | Yes | 0 | 0.0 | 13 | $208 | $380 | $180 | $200 | 1.0 | 1,471 |
| **Food Service & Refrigeration Measures** | | | **18,090** | **2.0** | **52** | **$3,777** | **$28,590** | **$1,200** | **$27,390** | **7.3** | **24,251** |
| ECM 13 | Dishwasher Replacement | Yes | 8,110 | 0.9 | 52 | $2,164 | $22,000 | $1,000 | $21,000 | 9.7 | 14,200 |
| ECM 14 | Refrigeration Controls | Yes | 888 | 0.0 | 0 | $144 | $1,280 | $100 | $1,180 | 8.2 | 895 |
| ECM 15 | Replace Refrigeration Equipment | Yes | 5,526 | 0.6 | 0 | $893 | $4,500 | $0 | $4,500 | 5.0 | 5,565 |
| ECM 16 | Vending Machine Control | Yes | 3,566 | 0.4 | 0 | $577 | $810 | $100 | $710 | 1.2 | 3,591 |
| **Custom Measures** | | | **-13,130** | **0.0** | **140** | **$193** | **$4,700** | **$0** | **$4,700** | **24.4** | **3,170** |
| ECM 17 | Replace Gas Fired Water Heater with Heat Pump Water Heater | No | -13,130 | 0.0 | 140 | $193 | $4,700 | $0 | $4,700 | 24.4 | 3,170 |
| **TOTALS** | | | **493,151** | **95.8** | **285** | **$84,455** | **$512,000** | **$58,190** | **$453,810** | **5.4** | **530,021** |

* - 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).

*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** | | **309,339** | **49.2** | **-64** | **$48,959** | **$113,320** | **$24,550** | **$88,770** | **1.8** | **304,027** |
| ECM 1 | Install LED Fixtures | 3,241 | 0.0 | 0 | $524 | $2,650 | $500 | $2,150 | 4.1 | 3,264 |
| ECM 2 | Retrofit Fixtures with LED Lamps | 306,098 | 49.2 | -64 | $48,435 | $110,670 | $24,050 | $86,620 | 1.8 | 300,764 |
| **Lighting Control Measures** | | **97,292** | **15.5** | **-20** | **$15,394** | **$53,020** | **$12,720** | **$40,300** | **2.6** | **95,591** |
| ECM 3 | Install Occupancy Sensor Lighting Controls | 80,872 | 13.2 | -17 | $12,796 | $41,760 | $4,910 | $36,850 | 2.9 | 79,457 |
| ECM 5 | Install High/Low Lighting Controls | 16,421 | 2.3 | -3 | $2,598 | $11,260 | $7,810 | $3,450 | 1.3 | 16,133 |
| **Variable Frequency Drive (VFD) Measures** | | **67,116** | **22.9** | **0** | **$10,851** | **$60,200** | **$8,800** | **$51,400** | **4.7** | **67,585** |
| ECM 7 | Install VFDs on Constant Volume (CV) Fans | 67,116 | 22.9 | 0 | $10,851 | $60,200 | $8,800 | $51,400 | 4.7 | 67,585 |
| **HVAC System Improvements** | | **0** | **0.0** | **31** | **$508** | **$950** | **$140** | **$810** | **1.6** | **3,597** |
| ECM 10 | Install Pipe Insulation | 0 | 0.0 | 31 | $508 | $950 | $140 | $810 | 1.6 | 3,597 |
| **Domestic Water Heating Upgrade** | | **0** | **0.0** | **13** | **$208** | **$380** | **$180** | **$200** | **1.0** | **1,471** |
| ECM 12 | Install Low-Flow DHW Devices | 0 | 0.0 | 13 | $208 | $380 | $180 | $200 | 1.0 | 1,471 |
| **Food Service & Refrigeration Measures** | | **18,090** | **2.0** | **52** | **$3,777** | **$28,590** | **$1,200** | **$27,390** | **7.3** | **24,251** |
| ECM 13 | Dishwasher Replacement | 8,110 | 0.9 | 52 | $2,164 | $22,000 | $1,000 | $21,000 | 9.7 | 14,200 |
| ECM 14 | Refrigeration Controls | 888 | 0.0 | 0 | $144 | $1,280 | $100 | $1,180 | 8.2 | 895 |
| ECM 15 | Replace Refrigeration Equipment | 5,526 | 0.6 | 0 | $893 | $4,500 | $0 | $4,500 | 5.0 | 5,565 |
| ECM 16 | Vending Machine Control | 3,566 | 0.4 | 0 | $577 | $810 | $100 | $710 | 1.2 | 3,591 |
| **TOTALS** | | **491,837** | **89.6** | **11** | **$79,697** | **$256,460** | **$47,590** | **$208,870** | **2.6** | **496,521** |

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

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

*Cost Effective ECMs*

## 4.1 Lighting

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Upgrades** | | **309,339** | **49.2** | **-64** | **$48,959** | **$113,320** | **$24,550** | **$88,770** | **1.8** | **304,027** |
| ECM 1 | Install LED Fixtures | 3,241 | 0.0 | 0 | $524 | $2,650 | $500 | $2,150 | 4.1 | 3,264 |
| ECM 2 | Retrofit Fixtures with LED Lamps | 306,098 | 49.2 | -64 | $48,435 | $110,670 | $24,050 | $86,620 | 1.8 | 300,764 |

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

### ECM 1: Install LED Fixtures

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

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

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

**Affected Building Areas:** exterior HID fixtures

### ECM 2: Retrofit Fixtures with LED Lamps

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

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

**Affected Building Areas:** all areas with fluorescent fixtures with T8 tubes, incandescent lamps

## 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** | | **97,335** | **15.5** | **-20** | **$15,401** | **$53,260** | **$12,720** | **$40,540** | **2.6** | **95,634** |
| ECM 3 | Install Occupancy Sensor Lighting Controls | 80,872 | 13.2 | -17 | $12,796 | $41,760 | $4,910 | $36,850 | 2.9 | 79,457 |
| ECM 4 | Install Photocell Controls | 43 | 0.0 | 0 | $7 | $240 | $0 | $240 | 34.4 | 43 |
| ECM 5 | Install High/Low Lighting Controls | 16,421 | 2.3 | -3 | $2,598 | $11,260 | $7,810 | $3,450 | 1.3 | 16,133 |

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

### ECM 3: Install Occupancy Sensor Lighting Controls

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

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

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

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

**Affected Building Areas:** offices, dining areas, conference rooms, classrooms, gymnasium, library, restrooms, and storage rooms

### ECM 4: Install Photocell Controls

We evaluated installing photocells to eliminate exterior lighting use during daytime periods.

Photocells or photocell sensors are lighting controls used for dusk to dawn applications to automatically turn the fixtures on or off. Photo controls detect the amount of light outside and once the light level reaches a low point, the fixture will switch on. During the day, the photocell will detect higher amounts of light and will turn the fixture off.

Photocells may be fixture mounted or wired externally and connected by line voltage to a single light fixture or to a series of fixtures.

This measure reduces energy use in exterior areas to restrict operation to non-daylight periods.

**Affected Building Areas:** exterior fixtures, greenhouse

### ECM 5: Install High/Low Lighting Controls

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

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

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

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

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

**Affected Building Areas**: corridors and stairwells

## 4.3 Motors

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Motor Upgrades** | | **13,749** | **5.4** | **0** | **$2,223** | **$50,800** | **$0** | **$50,800** | **22.9** | **13,845** |
| ECM 6 | Premium Efficiency Motors | 13,749 | 5.4 | 0 | $2,223 | $50,800 | $0 | $50,800 | 22.9 | 13,845 |

### ECM 6: Premium Efficiency Motors

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

**Affected Motors:** blower coil supply fan motors, heating hot water pumps, and chilled water pumps

| Location | Area(s)/System(s) Served | Motor Quantity | Motor Application | HP Per Motor | Additional Motor Description |
|---|---|---|---|---|---|
| Corridors | Blower Coil Supply Fan | 1 | Supply Fan | 0.5 | Blower Coil Supply Fan |
| Corridors | Blower Coil Supply Fan | 5 | Supply Fan | 0.5 | Blower Coil Supply Fan |
| Corridors | Blower Coil Supply Fan | 6 | Supply Fan | 0.5 | Blower Coil Supply Fan |
| Corridors | Blower Coil Supply Fan | 26 | Supply Fan | 0.5 | Blower Coil Supply Fan |
| Corridors | Blower Coil Supply Fan | 36 | Supply Fan | 0.8 | Blower Coil Supply Fan |
| Mechanical Room | Chilled Water Pump | 2 | Chilled Water Pump | 50.0 | Chilled Water Pump |
| Mechanical Room | Heating Hot Water Pump | 2 | Heating Hot Water Pump | 3.0 | Heating Hot Water Pump |

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

## 4.4 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** | | **67,116** | **22.9** | **0** | **$10,851** | **$60,200** | **$8,800** | **$51,400** | **4.7** | **67,585** |
| ECM 7 | Install VFDs on Constant Volume (CV) Fans | 67,116 | 22.9 | 0 | $10,851 | $60,200 | $8,800 | $51,400 | 4.7 | 67,585 |

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 7: 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.

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

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

**Affected Air Handlers: r**ooftop heating recovery units

## 4.5 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** | | **652** | **0.8** | **0** | **$105** | **$6,400** | **$300** | **$6,100** | **57.9** | **656** |
| ECM 8 | Install High Efficiency Air Conditioning Units | 652 | 0.8 | 0 | $105 | $6,400 | $300 | $6,100 | 57.9 | 656 |

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 equipment is eventually replaced, consider purchasing equipment that exceeds the minimum efficiency required by building codes.

### ECM 8: 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:** Trane RTU

## 4.6 Gas-Fired Heating

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Gas Heating (HVAC/Process) Replacement** | | **0** | **0.0** | **115** | **$1,906** | **$153,100** | **$7,600** | **$145,500** | **76.3** | **13,493** |
| ECM 9 | Install High Efficiency Hot Water Boilers | 0 | 0.0 | 115 | $1,906 | $153,100 | $7,600 | $145,500 | 76.3 | 13,493 |

### ECM 9: Install High Efficiency Hot Water Boilers

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

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

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

## 4.7 HVAC Improvements

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **HVAC System Improvements** | | **0** | **0.0** | **31** | **$508** | **$950** | **$140** | **$810** | **1.6** | **3,597** |
| ECM 10 | Install Pipe Insulation | 0 | 0.0 | 31 | $508 | $950 | $140 | $810 | 1.6 | 3,597 |

### ECM 10: Install Pipe Insulation

Install insulation on heating water system piping. Distribution system thermal losses are dependent on system fluid temperature, the size of the distribution system, and the extent and condition of piping insulation. When the insulation has been damaged due to exposure to water, when the insulation has been removed from some areas of the pipe, or when valves have not been properly insulated, system thermal efficiency can be significantly reduced. This measure saves energy by reducing heat transfer in the distribution system.

**Affected Systems:** chilled water and hot water piping connecting to blower coil units

## 4.8 Domestic Water Heating

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Domestic Water Heating Upgrade** | | **0** | **0.0** | **32** | **$531** | **$40,680** | **$2,880** | **$37,800** | **71.1** | **3,762** |
| ECM 11 | Install High Efficiency Gas-Fired Water Heater | 0 | 0.0 | 20 | $324 | $40,300 | $2,700 | $37,600 | 116.2 | 2,291 |
| ECM 12 | Install Low-Flow DHW Devices | 0 | 0.0 | 13 | $208 | $380 | $180 | $200 | 1.0 | 1,471 |

### ECM 11: Install High Efficiency Gas-Fired Water Heater

We evaluated replacing the existing tank water heater with a high efficiency condensing tank water heater. Energy savings result from the increased efficiency of the unit, which uses less gas to heat water, and fewer operating hours to maintain the tank water temperature.

### ECM 12: Install Low-Flow DHW Devices

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

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

Low-flow devices reduce the overall water flow from the fixture, while still providing adequate pressure for washing. Additional cost savings may result from reduced water usage. This measure could also save approximately 58,500 Gallons and $471 annually.

# 4.9 Food Service and Refrigeration Measures

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Food Service & Refrigeration Measures** | | **18,090** | **2.0** | **52** | **$3,777** | **$28,590** | **$1,200** | **$27,390** | **7.3** | **24,251** |
| ECM 13 | Dishwasher Replacement | 8,110 | 0.9 | 52 | $2,164 | $22,000 | $1,000 | $21,000 | 9.7 | 14,200 |
| ECM 14 | Refrigeration Controls | 888 | 0.0 | 0 | $144 | $1,280 | $100 | $1,180 | 8.2 | 895 |
| ECM 15 | Replace Refrigeration Equipment | 5,526 | 0.6 | 0 | $893 | $4,500 | $0 | $4,500 | 5.0 | 5,565 |
| ECM 16 | Vending Machine Control | 3,566 | 0.4 | 0 | $577 | $810 | $100 | $710 | 1.2 | 3,591 |

## ECM 13: Dishwasher Replacement

Replace existing dishwasher with a new energy-efficient door type dishwasher. New high efficiency models often use an average of 40% less energy and water, compared to current standard efficiency equipment.

## ECM 14: Refrigeration Controls

Install additional controls to optimize the operation of walk-in coolers and freezers.

Many walk-in coolers and freezers have continuously operating electric heaters on the doors to prevent condensation formation. This measure adds a control system feature to shut off the door heaters when the humidity level is low enough that condensation will not occur if the heaters are off. This is done by measuring the ambient humidity and temperature of the store, comparing that to the dewpoint, and using pulse width modulation to control the anti-sweat door heaters.

Defrost controllers can be used to override defrost of evaporator fans when the defrost operation is not necessary, which reduces annual energy consumption. This measure is applicable to existing evaporator fans with a traditional electric de-frost mechanism.

Energy savings for each of the control measures account for reduction in compressor and fan operating hours as well as reduction in the refrigeration heat load as appropriate.

## ECM 15: Replace Refrigeration Equipment

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

## ECM 16: Vending Machine Control

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

## 4.10 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** | | **-13,130** | **0.0** | **140** | **$193** | **$4,700** | **$0** | **$4,700** | **24.4** | **3,170** |
| ECM 17 | Replace Gas Fired Water Heater with Heat Pump Water Heater | -13,130 | 0.0 | 140 | $193 | $4,700 | $0 | $4,700 | 24.4 | 3,170 |

### ECM 17: Replace Gas Fired Water Heater with Heat Pump Water Heater

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

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

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

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

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

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

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

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

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

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

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

**Affected Units: a**ll gas-fired water heaters

## 4.11 Measures for Future Consideration

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

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

---

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

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

- 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.

## Retro-Commissioning Study

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

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

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

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

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

## VRF Systems

Consider variable refrigerant flow (VRF) systems as part of a comprehensive package unit upgrade project. (VRF systems use direct expansion (DX) heat pumps to transport heat between an outdoor condensing unit and a network of indoor evaporators, located near or within the conditioned space, through refrigerant piping installed in the building. Attributes that distinguish VRF from other DX system types are:

- Multiple indoor units connected to a common outdoor unit
- Scalability
- Variable capacity
- Distributed control
- Simultaneous heating and cooling capability

VRF provides flexibility by allowing for many different indoor units (with different capacities and configurations), individual zone control, the unique ability to offer simultaneous heating and cooling in separate zones on a common refrigerant circuit, and heat recovery from one zone to another. VRF systems are equipped with at least one variable-speed and/or variable-capacity compressor.

To match the building's load profiles, energy is transferred from one indoor space to another through the refrigerant line, and only one energy source is necessary to provide both heating and cooling. VRF systems also operate efficiently at part load because of the compressor's variable capacity control. VRF systems are ideal for applications with varying loads or where zoning is required. Some other advantages of VRF systems include consistent comfort, quiet operation, energy efficiency, installation flexibility, zoned heating and cooling, state-of-the-art controls, and reliability.

VRF systems are more expensive than conventional heat pump systems; however, the higher initial cost can be offset by improved cooling efficiency during part load operation—a SEER (cooling) rating of 18.0 is not uncommon for small packaged VRF-equipped heat pumps.

When you are replacing packaged HVAC equipment, we recommend a comprehensive approach. Work with your contractor or design engineer to make sure your systems are sized and zoned according to current space configurations and occupancy. Select high efficiency equipment and controls that match your heating and cooling needs. Commission the system and controls to ensure proper operation, comfort, ventilation, and energy use.

# 5 Energy Efficient Best Practices

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

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

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

## Energy Tracking with ENERGY STAR Portfolio Manager

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

## Weatherization

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

## Doors and Windows

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

## 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.

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

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 Controls

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

## Motor Maintenance

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

## Economizer Maintenance

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

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

## Chiller Maintenance

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

## AC System Evaporator/Condenser Coil Cleaning

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

## HVAC Filter Cleaning and Replacement

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

## 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.

## Boiler Maintenance

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

## Optimize HVAC Equipment Schedules

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

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

## Water Heater Maintenance

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

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

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

## Compressed Air System Maintenance

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

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

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

## Refrigeration Equipment Maintenance

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

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

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

## Procurement Strategies

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

# 6 Water Best Practices

## Getting Started

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

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

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

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

## Water Metering and Submetering

Tracking a facility's total water use, as well as specific end uses, is a key component of a facility's water-efficiency efforts. Accurately measuring water use can help facility managers identify areas for targeted reductions and track progress from water-efficiency upgrades. If possible, install meters to measure all water conveyed to the facility, regardless of the source. Each source should be metered separately. Consider developing a metering plan and installing separate submeters to measure specific end uses. There are many types and sizes of meters intended for different uses. Installing the correct type and size of meter are critical to accurate water measurement. Sub-metering applications may include:

- Individual tenant spaces
- Cooling tower make-up and blowdown water supply
- Water lines serving other HVAC systems including water circulating loops
- Make up water supply for steam boiler plants with a capacity of 500,000 Btu/hr. or greater
- Systems or equipment that use single pass cooling water
- Irrigation systems

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

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

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

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

- Roof spray systems (for irrigating vegetated roofs or thermal conditioning)
- Ornamental water features
- Indoor and outdoor pools and spas
- Industrial water using processes

## Leak Detection and Repair

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

## Toilets and Urinals

Toilets and urinals are considered sanitary fixtures and are found in most facilities. High efficiency fixtures are at least 20% more efficient than available standard products. Leaking or damaged equipment is a substantial source of water waste. Train users to report continuously flushing, leaking, or otherwise improperly operating equipment to the appropriate personnel. Depending on the age of the equipment and the frequency of use, it may be cost effective to replace older inefficient fixtures with current generation WaterSense labeled equipment.

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

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

## Faucets and Showerheads

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

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

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

## Commercial Kitchen Equipment

Commercial and institutional sectors, including hospitals, offices, and schools, have substantial kitchen water use. Water in food service is used for steam cooking, spray/flow cleaning, dish washing, and ice making. In most commercial kitchens, the commercial dishwasher and pre-rinse spray valve account for over two-thirds of the water use. Newer technologies and better practices are available that can significantly reduce commercial kitchen equipment water and energy use. For example, ENERGY STAR qualified dishwashers and steam cookers are at least 10% more water-efficient and 15% more energy-efficient than standard models. With some models saving significantly more.

Cooking equipment includes combination ovens, steam cookers, and steam kettles. For efficient steam cooking operation, fill vessels to capacity when possible, set temperatures optimally for the process, and keep doors and lids closed while cooking. Replace gaskets to ensure proper sealing and repair leaks. When replacing combination ovens, select connectionless equipment; replace steam cookers with ENERGY STAR rated steam cookers.

Spray/flow cleaning equipment includes dipper wells, pre-rinse spray valves, food disposals, and wash down sprayers. Turn off water when service periods are slow and keep flow rates to minimum level. Train users to scrape food rather than rely on water pressure. Inspect for leaks and scaling. Test system pressure to ensure it is between 20 and 80 pounds per square inch (psi) for optimum flow and performance of spray equipment. For dipper wells, consider installing in-line flow restrictors to reduce flow. Pre-rinse spray valves can be replaced with new assemblies which use 1.3 gpm or less. Washdown sprayers can be equipped with self-closing nozzles or consider mopping/sweeping as an alternative.

Dishwashers range in type and include undercounter, stationary/hood, conveyor, and flight-type models. Only run dishwashers when they are full and fill racks to maximum capacity. Be sure to replace damaged dishwasher racks. Educate staff to scrape dishes prior to loading. Ensure that final rinse pressure and water temperature are within the manufacturer's recommendations. Operate the dishwasher close to or at the minimum flow rate and set rinse cycle time to the manufacturer's minimum recommended settings. Make sure that manual fill valves close completely after the wash tank is filled. Find and repair any leaks. Inspect valves and rinse nozzles for proper operation and repair worn nozzles. Look for ENERGY STAR qualified models when purchasing or leasing a new commercial dishwasher or replacing an existing unit.

Consider your kitchen throughput to select an appropriately sized commercial dishwasher since an oversized dishwasher will waste water if the machine is not loaded to capacity.

**Landscaping and Irrigation**

Most facilities that own or maintain surrounding landscape will have outdoor water use. The amount of outdoor water use is dictated by the size and design of the landscape and the need for supplemental irrigation. Studies show that average landscape water use in the institutional sector can range from 7% of total water use for hospitals, 22% for office buildings, and up to 30% for schools.

Proper landscape design can help minimize outdoor water use. Regionally appropriate plant choices, healthy soils with appropriate grading, the use of mulches, and limiting the use of high water-using plants such as turfgrass can significantly reduce the need for supplemental irrigation. In addition, proper design, installation, and maintenance of irrigation equipment can have a dramatic impact on outdoor water use.

- Retain a landscape professional certified in water-efficient landscaping.
- Maintain soil quality by applying mulch, soil amendments, and good topsoil.
- Maintain existing plants by manually pulling weeds, raising the blade on mowers, and including shaded areas in the overall landscape design.
- Minimize water used for hardscape cleaning and use recycled or reclaimed water where applicable, especially in water features.

Irrigation system optimization combines efficient irrigation practices with efficient technologies and can be complex. Irrigation professionals who are properly educated on water-efficient practices can help ensure that existing irrigation systems are efficiently operated and properly maintained. In general, plan for or adjust irrigation systems to prevent over (or under) watering.

- Improve distribution uniformity so water is evenly applied over the landscape.
- Irrigation schedules should be updated based on changing weather conditions.
- In general, apply water in larger amounts, but less frequently, resulting in deep watering.
- If a dedicated landscape water meter is installed, incorporate an outdoor water budget.
- Routinely look for leaks, overwatering, or overspray.
- Require a full irrigation system audit every 3 years by a qualified irrigation auditor.
- Consider drip irrigation systems for plant beds as they can reduce irrigation water use by 20% to 50% as compared to traditional sprinklers.
- More efficient sprinkler heads can reduce irrigation water use by 30%.
- Smart irrigation controllers can schedule irrigation based on weather data or on-site conditions, reducing irrigation water use by 15% compared to manual or clock timer irrigation systems.

# 7 On-Site Generation

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

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

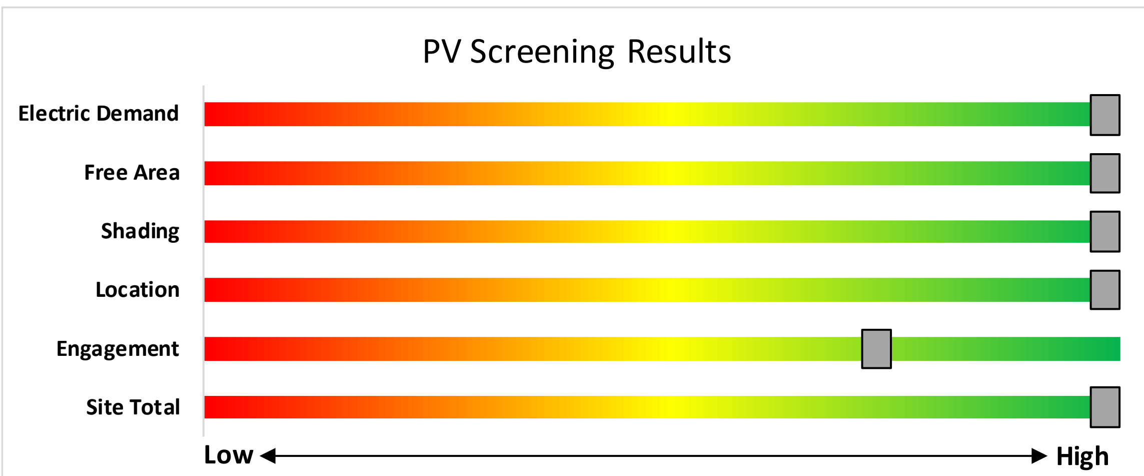
# 7.1 Solar Photovoltaic

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

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

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

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




| | | |
|---|---|---|
| **Potential** | High | |
| **System Potential** | 215 | kW DC STC |
| **Electric Generation** | 256,145 | kWh/yr |
| **Displaced Cost** | $41,410 | /yr |
| **Installed Cost** | $559,000 | |

***Photovoltaic Screening***

**Successor Solar Incentive Program (SuSI)**

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

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

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

## 7.2 Combined Heat and Power

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

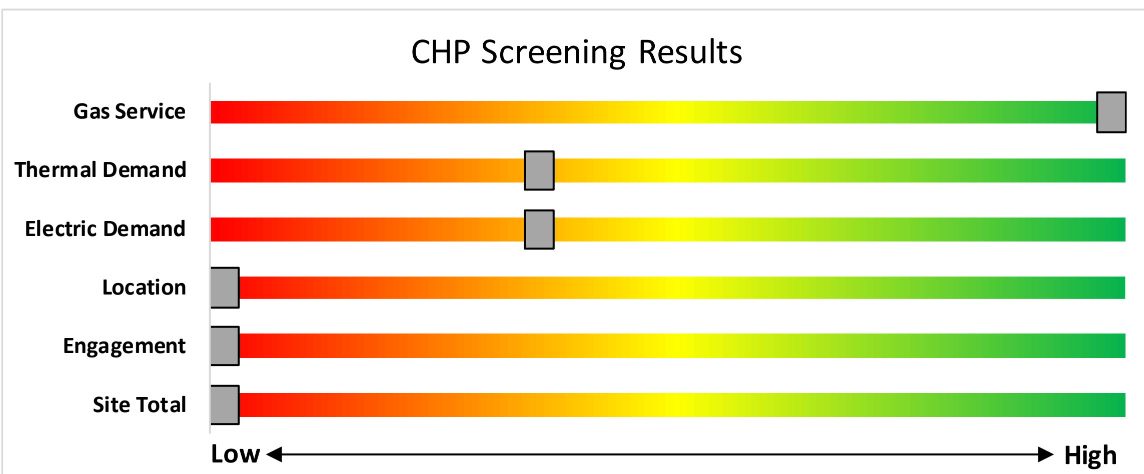
CHP systems typically produce a portion of the electric power used on-site, with the balance of electric power needs supplied by the local utility company. The heat is used to supplement (or replace) existing boilers and provide space heating and/or domestic hot water heating. Waste heat can also be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

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

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

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

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




***Combined Heat and Power Screening***

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

# 8 Electric Vehicles

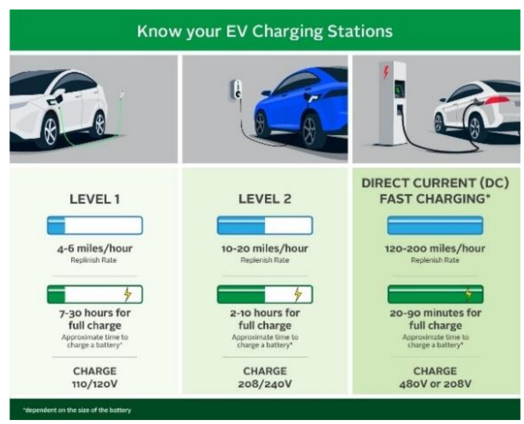
All electric vehicles (EVs) have an electric motor instead of an internal combustion engine. EVs function by plugging into a charge point, taking electricity from the grid, and then storing it in rechargeable batteries. Although electricity production may contribute to air pollution, the U.S. EPA categorizes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

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

## 8.1 EV Charging

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

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




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

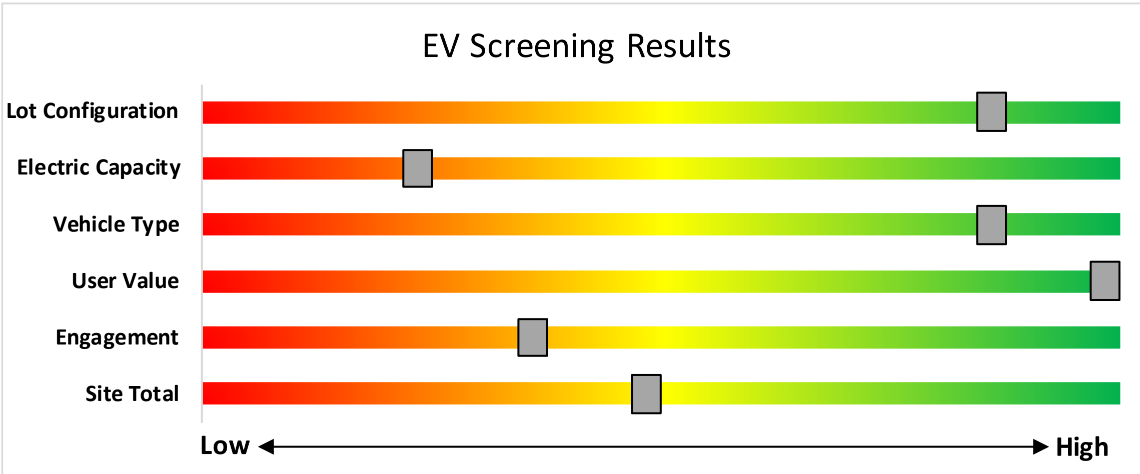
The primary costs associated with installing EV charging are the charger hardware and the cost to extend power from the facility to parking spaces. This may include upgrades to electric panels to serve increased loads.

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

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

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

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




*EV Charger Screening*

**Electric Vehicle Programs Available**

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

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

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

# 9 Project Funding and Incentives

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

## NJBPU and NJCEP Administered Programs

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

*State facilities are also eligible for utility programs

## Utility Administered Programs

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

## 9.1 New Jersey's Clean Energy Program

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

### *Large Energy Users*

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

**Incentives**

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

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

**How to Participate**

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

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

## Combined Heat and Power

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

**Incentives**[14]

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

14

1 Incentives are tiered, which means the incentive levels vary based upon the installed rated capacity, as listed in the chart above. For example, a 4 MW CHP system would receive $2.00/watt for the first 500 kW, $1.00/watt for the second 500 kW, $0.55/watt for the next 2 MW and $0.35/watt for the last 1 MW (up to the caps listed).

2 The maximum incentive will be limited to 30% of total project. For CHP projects up to 1 MW, this cap will be increased to 40% where a cooling application is used or included with the CHP system (e.g. absorption chiller).

3 Projects will be eligible for incentives shown above, not to exceed the lesser of % of total project cost per project cap or maximum $ per project cap. Projects installing CHP or FC with WHP will be eligible for incentive shown above, not to exceed the lesser caps of the CHP or FC incentive. Minimum efficiency will be calculated based on annual total electricity generated, utilized waste heat at the host site (i.e. not lost/rejected), and energy input.

4 Systems fueled by a Class 1 Renewable Fuel Source, as defined by N.J.A.C. 14:8-2.5, are eligible for a 30% incentive bonus. If the fuel is mixed, the bonus will be prorated accordingly. For example, if the mix is 60/40 (60% being a Class 1 renewable), the bonus will be 18%. This bonus will be included in the final performance incentive payment, based on system performance and fuel mix consumption data. Total incentive, inclusive of bonus, shall not exceed above stipulated caps.

5 CHP-FC systems located at Critical Facility and incorporating blackstart and islanding technology are eligible for a 25% incentive bonus. This bonus incentive will be paid with the second/Installation incentive payment. Total incentive, inclusive of bonus, shall not exceed above stipulated caps.

**How to Participate**

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

## Successor Solar Incentive Program (SuSI)

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

**Administratively Determined Incentive (ADI) Program**

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

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

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

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

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

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

**Competitive Solar Incentive (CSI) Program**

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

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

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

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

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

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

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

## *Energy Savings Improvement Program*

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

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

**How to Participate**

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

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

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

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

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

## Demand Response (DR) Energy Aggregator

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

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

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

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

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

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

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

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

## 9.2 Utility Energy Efficiency Programs

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

### ***Prescriptive and Custom***

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

**Equipment Examples**

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

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

### ***Direct Install***

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

**Incentives**

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

**How to Participate**

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

## ***Engineered Solutions***

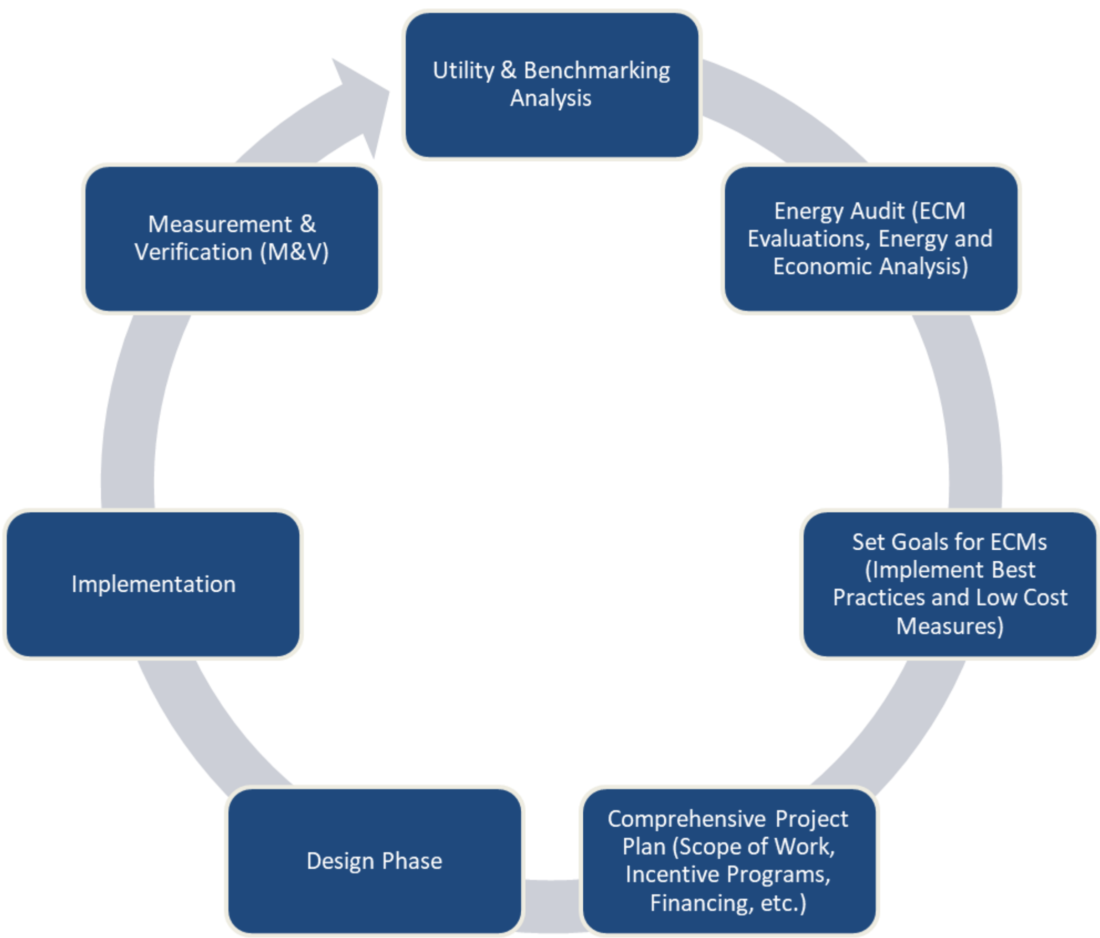
The Engineered Solutions Program provides tailored energy-efficiency assistance and services to municipalities, universities, schools, hospitals, and healthcare facilities (MUSH), non-profit entities, and multifamily buildings. Customers receive expert guided services, including investment-grade energy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

---

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

# 10 Project Development

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




***Project Development Cycle***

# 11 ENERGY PURCHASING AND PROCUREMENT STRATEGIES

## 11.1 Retail Electric Supply Options

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

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

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

## 11.2 Retail Natural Gas Supply Options

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

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

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

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

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

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

# APPENDIX A: EQUIPMENT INVENTORY & RECOMMENDATIONS

**Lighting Inventory & Recommendations**

| | Existing Conditions | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Fixture Quantity | Fixture Description | Control System | Light Level | Watts per Fixture | Annual Operating Hours | ECM # | Fixture Recommendation | Add Controls? | Fixture Quantity | Fixture Description | Control System | Watts per Fixture | Annual Operating Hours | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Classroom - A1 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A10 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A11 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A12 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A14 CST | 3 | LED Lamps: (1) 9W A19 Screw-In Lamp | Wall Switch | S | 9 | 4,000 | | None | No | 3 | LED Lamps: (1) 9W A19 Screw-In Lamp | Wall Switch | 9 | 4,000 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom - A14 CST | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A16 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A18 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A20 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A22 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A24 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A3 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A4 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A5 | 20 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 20 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 1.1 | 6,510 | -1 | $1,030 | $2,430 | $470 | 1.9 |
| Classroom - A5A | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.1 | 651 | 0 | $103 | $330 | $60 | 2.6 |
| Classroom - A6 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A7 | 4 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (2) 2' Lamps | Occupancy Sensor | 17 | 2,760 | 0.1 | 374 | 0 | $59 | $480 | $60 | 7.1 |
| Classroom - A7 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A8 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - A9 | 16 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 16 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.9 | 5,208 | -1 | $824 | $2,080 | $390 | 2.1 |
| Classroom - B1 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - B1 | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Occupancy Sensor | S | 62 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 4,000 | 0.0 | 145 | 0 | $23 | $50 | $10 | 1.7 |
| Classroom - B11 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Occupancy Sensor | S | 114 | 4,000 | 2 | Relamp | No | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 4,000 | 0.1 | 739 | 0 | $117 | $270 | $60 | 1.8 |
| Classroom - B13 | 2 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 2 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom - B13 | 2 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 2' Lamps | Occupancy Sensor | 17 | 2,760 | 0.0 | 187 | 0 | $30 | $230 | $30 | 6.8 |

| | 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 - B13 | 20 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 20 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 1.1 | 6,510 | -1 | $1,030 | $2,430 | $470 | 1.9 |
| Classroom - B13 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.2 | 977 | 0 | $155 | $600 | $100 | 3.2 |
| Classroom - B13 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Occupancy Sensor | S | 114 | 4,000 | 2 | Relamp | No | 2 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 4,000 | 0.1 | 493 | 0 | $78 | $180 | $40 | 1.8 |
| Classroom - B13 | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (4) 4' Lamps | Wall Switch | 58 | 4,000 | 0.0 | 246 | 0 | $39 | $90 | $20 | 1.8 |
| Classroom - B2 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - B3 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 2,760 | 0.3 | 2,032 | 0 | $322 | $890 | $150 | 2.3 |
| Classroom - B5 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.2 | 977 | 0 | $155 | $600 | $100 | 3.2 |
| Classroom - B6 | 2 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 2 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom - B6 | 16 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 16 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.9 | 5,208 | -1 | $824 | $2,080 | $390 | 2.1 |
| Classroom - B6 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Occupancy Sensor | S | 114 | 4,000 | 2 | Relamp | No | 2 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 4,000 | 0.1 | 493 | 0 | $78 | $180 | $40 | 1.8 |
| Classroom - B6 | 2 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 2 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom - B6 | 19 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 19 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 1.0 | 6,185 | -1 | $979 | $2,340 | $450 | 1.9 |
| Classroom - B7 | 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 |
| Classroom - B7 | 23 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 23 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 1.2 | 7,487 | -2 | $1,185 | $2,690 | $530 | 1.8 |
| Classroom - B9 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - C1 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C1 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C10 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C10 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C11 | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (4) 4' Lamps | Wall Switch | 58 | 4,000 | 0.0 | 246 | 0 | $39 | $90 | $20 | 1.8 |
| Classroom - C12 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C12 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C13 | 4 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (2) 2' Lamps | Occupancy Sensor | 17 | 2,760 | 0.1 | 374 | 0 | $59 | $480 | $60 | 7.1 |
| Classroom - C13 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - C14 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |

| | Existing Conditions | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Fixture Quantity | Fixture Description | Control System | Light Level | Watts per Fixture | Annual Operating Hours | ECM # | Fixture Recommendation | Add Controls? | Fixture Quantity | Fixture Description | Control System | Watts per Fixture | Annual Operating Hours | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Classroom - C14 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C17 | 16 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 16 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.9 | 5,208 | -1 | $824 | $2,080 | $390 | 2.1 |
| Classroom - C18 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - C18A | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.2 | 977 | 0 | $155 | $600 | $100 | 3.2 |
| Classroom - C19 | 16 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 16 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.9 | 5,208 | -1 | $824 | $2,080 | $390 | 2.1 |
| Classroom - C1A | 8 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 8 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.4 | 2,604 | -1 | $412 | $1,040 | $200 | 2.0 |
| Classroom - C2 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C2 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C20 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - C21 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C21 | 19 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 19 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 1.0 | 6,185 | -1 | $979 | $2,340 | $450 | 1.9 |
| Classroom - C21 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Occupancy Sensor | S | 114 | 4,000 | 2 | Relamp | No | 2 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 4,000 | 0.1 | 493 | 0 | $78 | $180 | $40 | 1.8 |
| Classroom - C22 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - C24 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - C26 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - C28 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - C3 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C3 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C30 | 4 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (2) 2' Lamps | Occupancy Sensor | 17 | 2,760 | 0.1 | 374 | 0 | $59 | $480 | $60 | 7.1 |
| Classroom - C30 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Classroom - C4 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C4 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C5 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C5 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C6 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |

| | Existing Conditions | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Fixture Quantity | Fixture Description | Control System | Light Level | Watts per Fixture | Annual Operating Hours | ECM # | Fixture Recommendation | Add Controls? | Fixture Quantity | Fixture Description | Control System | Watts per Fixture | Annual Operating Hours | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Classroom - C6 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C7 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C7 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C8 | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,000 | 0.0 | 70 | 0 | $11 | $40 | $10 | 2.7 |
| Classroom - C8 | 11 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 11 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,581 | -1 | $567 | $1,300 | $260 | 1.8 |
| Classroom - C9 | 4 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (2) 2' Lamps | Occupancy Sensor | 17 | 2,760 | 0.1 | 374 | 0 | $59 | $480 | $60 | 7.1 |
| Classroom - C9 | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.6 | 3,906 | -1 | $618 | $1,390 | $280 | 1.8 |
| Computer Lab - C16 | 16 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,000 | 2, 3 | Relamp | Yes | 16 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,760 | 0.9 | 5,208 | -1 | $824 | $2,080 | $390 | 2.1 |
| Conference - Counseling | 6 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Occupancy Sensor | S | 33 | 4,000 | 2 | Relamp | No | 6 | LED - Linear Tubes: (2) 2' Lamps | Occupancy Sensor | 17 | 4,000 | 0.1 | 422 | 0 | $67 | $230 | $40 | 2.8 |
| Conference - Main Office | 14 | Compact Fluorescent: (2) 36W Biaxial Plug-In Lamps | Wall Switch | S | 72 | 4,000 | 2, 3 | Relamp | Yes | 14 | LED Lamps: GX23 (Plug-In) Lamps | Occupancy Sensor | 51 | 2,760 | 0.4 | 2,267 | 0 | $359 | $860 | $70 | 2.2 |
| Conference - Main Office | 6 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,000 | 2, 3 | Relamp | Yes | 6 | LED - Linear Tubes: (2) 2' Lamps | Occupancy Sensor | 17 | 2,760 | 0.1 | 562 | 0 | $89 | $560 | $80 | 5.4 |
| Corridors | 20 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 20 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Corridors | 12 | LED - Fixtures: Downlight Surface Mount | Wall Switch | S | 11 | 4,752 | 5 | None | Yes | 12 | LED - Fixtures: Downlight Surface Mount | High/Low Control | 11 | 3,279 | 0.0 | 204 | 0 | $32 | $560 | $420 | 4.3 |
| Corridors | 4 | LED - Fixtures: High-Bay | Wall Switch | S | 30 | 4,752 | 5 | None | Yes | 4 | LED - Fixtures: High-Bay | High/Low Control | 30 | 3,279 | 0.0 | 194 | 0 | $31 | $280 | $140 | 4.6 |
| Corridors | 2 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,752 | 2, 5 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 2' Lamps | High/Low Control | 17 | 3,279 | 0.0 | 222 | 0 | $35 | $360 | $80 | 8.0 |
| Corridors | 38 | Linear Fluorescent - T8: 4' T8 (32W) - 1L | Wall Switch | S | 32 | 4,752 | 2, 5 | Relamp | Yes | 38 | LED - Linear Tubes: (1) 4' Lamp | High/Low Control | 15 | 3,279 | 0.6 | 4,369 | -1 | $691 | $2,930 | $1,520 | 2.0 |
| Corridors | 18 | Linear Fluorescent - T8: 4' T8 (32W) - 3L | Wall Switch | S | 93 | 4,752 | 2, 5 | Relamp | Yes | 18 | LED - Linear Tubes: (3) 4' Lamps | High/Low Control | 44 | 3,279 | 0.8 | 5,926 | -1 | $938 | $1,990 | $900 | 1.2 |
| Corridors | 129 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,752 | 2, 5 | Relamp | Yes | 129 | LED - Linear Tubes: (4) 4' Lamps | High/Low Control | 58 | 3,279 | 6.9 | 49,885 | -10 | $7,893 | $17,610 | $7,100 | 1.3 |
| Dining Area - 2nd Floor Faculty Lounge | 12 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 3 | Relamp | Yes | 12 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,933 | 0.6 | 4,150 | -1 | $657 | $1,390 | $280 | 1.7 |
| Dining Area - Faculty Lounge | 4 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,933 | 0.2 | 1,383 | 0 | $219 | $680 | $120 | 2.6 |
| Dining Area - Faculty Lounge | 4 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,250 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (2) 2' Lamps | Occupancy Sensor | 17 | 2,933 | 0.1 | 398 | 0 | $63 | $480 | $60 | 6.7 |
| Electrical Room - By Gym | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,380 | 0.1 | 185 | 0 | $29 | $250 | $40 | 7.2 |
| Exterior - Courtyards | 12 | LED - Fixtures: Wall Pack | Photocell | | 50 | 4,380 | | None | No | 12 | LED - Fixtures: Wall Pack | Photocell | 50 | 4,380 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Exterior - Greenhouse | 4 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | | 62 | 4,752 | 2, 4 | Relamp | Yes | 4 | LED - Linear Tubes: (2) 4' Lamps | Photocell | 29 | 4,380 | 0.0 | 670 | 0 | $108 | $440 | $40 | 3.7 |
| Exterior - Ground | 2 | Compact Fluorescent: (1) 60W Reflector Plug-In Lamp | Timeclock | | 60 | 4,380 | 2 | Relamp | No | 2 | LED Lamps: PAR38 Lamps | Timeclock | 42 | 4,380 | 0.0 | 158 | 0 | $25 | $80 | $10 | 2.7 |

| | Existing Conditions | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Fixture Quantity | Fixture Description | Control System | Light Level | Watts per Fixture | Annual Operating Hours | ECM # | Fixture Recommendation | Add Controls? | Fixture Quantity | Fixture Description | Control System | Watts per Fixture | Annual Operating Hours | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Exterior - Ground | 34 | LED Lamps: (1) 115W E37 Screw-In Lamp | Timeclock | | 115 | 4,380 | | None | No | 34 | LED Lamps: (1) 115W E37 Screw-In Lamp | Timeclock | 115 | 4,380 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Exterior - Ground | 3 | LED Lamps: (1) 115W E37 Screw-In Lamp | Timeclock | | 115 | 4,380 | | None | No | 3 | LED Lamps: (1) 115W E37 Screw-In Lamp | Timeclock | 115 | 4,380 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Exterior - Ground | 8 | LED - Fixtures: Outdoor Wall-Mounted Area Fixture | Photocell | | 40 | 4,380 | | None | No | 8 | LED - Fixtures: Outdoor Wall-Mounted Area Fixture | Photocell | 40 | 4,380 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Exterior - Ground | 10 | LED - Fixtures: Wall Pack | Photocell | | 50 | 4,380 | | None | No | 10 | LED - Fixtures: Wall Pack | Photocell | 50 | 4,380 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Exterior - Ground | 10 | Metal Halide: (1) 70W Lamp | Timeclock | | 95 | 4,380 | 1 | Fixture Replacement | No | 10 | LED - Fixtures: Outdoor Wall-Mounted Area Fixture | Timeclock | 21 | 4,380 | 0.0 | 3,241 | 0 | $524 | $2,650 | $500 | 4.1 |
| Gymnasium | 3 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 3 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Gymnasium | 30 | LED - Linear Tubes: (4) 2' Lamps | Wall Switch | S | 34 | 4,250 | 3 | None | Yes | 30 | LED - Linear Tubes: (4) 2' Lamps | Occupancy Sensor | 34 | 2,933 | 0.2 | 1,478 | 0 | $234 | $540 | $70 | 2.0 |
| Gymnasium - Weight Room | 2 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 2 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Gymnasium - Weight Room | 12 | LED - Linear Tubes: (4) 2' Lamps | Wall Switch | S | 34 | 4,250 | 3 | None | Yes | 12 | LED - Linear Tubes: (4) 2' Lamps | Occupancy Sensor | 34 | 2,933 | 0.1 | 591 | 0 | $94 | $270 | $40 | 2.5 |
| Janitorial - By A24 | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Occupancy Sensor | S | 114 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,000 | 0.0 | 123 | 0 | $19 | $90 | $20 | 3.6 |
| Kitchen | 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 |
| Kitchen | 2 | LED Lamps: (1) 9W A19 Screw-In Lamp | Wall Switch | S | 9 | 4,250 | | None | No | 2 | LED Lamps: (1) 9W A19 Screw-In Lamp | Wall Switch | 9 | 4,250 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Kitchen | 25 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 3 | Relamp | Yes | 25 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,933 | 1.3 | 8,646 | -2 | $1,368 | $2,870 | $570 | 1.7 |
| Kitchen | 3 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 4,250 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 2,933 | 0.1 | 550 | 0 | $87 | $600 | $70 | 6.1 |
| 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 |
| Library | 44 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 3 | Relamp | Yes | 44 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,933 | 2.3 | 15,218 | -3 | $2,408 | $4,880 | $990 | 1.6 |
| Library | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,933 | 0.1 | 692 | 0 | $109 | $330 | $60 | 2.5 |
| Library | 9 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 3 | Relamp | Yes | 9 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,933 | 0.5 | 3,113 | -1 | $493 | $1,130 | $220 | 1.8 |
| Library | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 4,250 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 4,250 | 0.0 | 75 | 0 | $12 | $40 | $10 | 2.5 |
| Locker Room - Boys | 4 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 4 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Locker Room - Boys | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Occupancy Sensor | S | 62 | 4,250 | 2 | Relamp | No | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 4,250 | 0.0 | 309 | 0 | $49 | $100 | $20 | 1.6 |
| Locker Room - Boys | 8 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 3 | Relamp | Yes | 8 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,933 | 0.4 | 2,767 | -1 | $438 | $1,040 | $200 | 1.9 |
| Locker Room - Boys | 5 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 4,250 | 2, 3 | Relamp | Yes | 5 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 2,933 | 0.1 | 917 | 0 | $145 | $770 | $90 | 4.7 |
| Locker Room - Girls | 4 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 4 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Locker Room - Girls | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Occupancy Sensor | S | 62 | 4,250 | 2 | Relamp | No | 2 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 4,250 | 0.0 | 309 | 0 | $49 | $100 | $20 | 1.6 |

| | Existing Conditions | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Fixture Quantity | Fixture Description | Control System | Light Level | Watts per Fixture | Annual Operating Hours | ECM # | Fixture Recommendation | Add Controls? | Fixture Quantity | Fixture Description | Control System | Watts per Fixture | Annual Operating Hours | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Restroom - Faculty by CST | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Occupancy Sensor | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Female by A12 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Restroom - Female by A12 | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Female by C12 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Restroom - Female by C12 | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Female by C24 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Restroom - Female by C24 | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Female by CST | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Restroom - Female by CST | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Female Faculty Across from B2 | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Occupancy Sensor | S | 114 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,000 | 0.0 | 123 | 0 | $19 | $90 | $20 | 3.6 |
| Restroom - Female Student Across from B2 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Occupancy Sensor | S | 114 | 2,000 | 2 | Relamp | No | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,000 | 0.1 | 370 | 0 | $58 | $270 | $60 | 3.6 |
| Restroom - Female Student Across from B2 | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Occupancy Sensor | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Male Student Across from B2 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Occupancy Sensor | S | 114 | 2,000 | 2 | Relamp | No | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,000 | 0.1 | 370 | 0 | $58 | $270 | $60 | 3.6 |
| Restroom - Male Student Across from B2 | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Occupancy Sensor | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Male by A12 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Restroom - Male by A12 | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Male by C12 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Restroom - Male by C12 | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Male by C24 | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Restroom - Male by C24 | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Male by CST | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Restroom - Male by CST | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Wall Switch | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Male Faculty by A12 | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Occupancy Sensor | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Male Faculty by CST | 1 | U-Bend Fluorescent - T8: U T8 (32W) - 2L | Occupancy Sensor | S | 62 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) U-Lamp | Occupancy Sensor | 33 | 2,000 | 0.0 | 64 | 0 | $10 | $90 | $10 | 7.9 |
| Restroom - Unisex Nurse | 1 | Linear Fluorescent - T8: 2' T8 (17W) - 2L | Wall Switch | S | 33 | 2,000 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 2' Lamps | Wall Switch | 17 | 2,000 | 0.0 | 35 | 0 | $6 | $40 | $10 | 5.4 |

| | 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 |
| Shop - B4 Wood Shop | 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 |
| Shop - B4 Wood Shop | 74 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 4,250 | 2, 3 | Relamp | Yes | 74 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 2,933 | 2.2 | 14,526 | -3 | $2,298 | $5,390 | $920 | 1.9 |
| Shop - B4 Wood Shop | 4 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 3 | Relamp | Yes | 4 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,933 | 0.2 | 1,383 | 0 | $219 | $680 | $120 | 2.6 |
| Stairs - Left Side | 1 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 1 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Stairs - Left Side | 10 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 5 | Relamp | Yes | 10 | LED - Linear Tubes: (4) 4' Lamps | High/Low Control | 58 | 2,933 | 0.5 | 3,459 | -1 | $547 | $1,440 | $550 | 1.6 |
| Stairs - Right Side | 1 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 1 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Stairs - Right Side | 10 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 4,250 | 2, 5 | Relamp | Yes | 10 | LED - Linear Tubes: (4) 4' Lamps | High/Low Control | 58 | 2,933 | 0.5 | 3,459 | -1 | $547 | $1,440 | $550 | 1.6 |
| Storage - 6th Grade Science Prep | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Storage - 7th Grade Science Prep | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Occupancy Sensor | S | 114 | 2,000 | 2 | Relamp | No | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 2,000 | 0.1 | 370 | 0 | $58 | $270 | $60 | 3.6 |
| Storage - 8th Grade Science Prep | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Storage - AV Storage | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 2 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.1 | 326 | 0 | $52 | $330 | $60 | 5.2 |
| Storage - Book Storage | 3 | Linear Fluorescent - T8: 4' T8 (32W) - 4L | Wall Switch | S | 114 | 2,000 | 2, 3 | Relamp | Yes | 3 | LED - Linear Tubes: (4) 4' Lamps | Occupancy Sensor | 58 | 1,380 | 0.2 | 488 | 0 | $77 | $600 | $100 | 6.5 |
| Storage - Gym | 16 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2, 3 | Relamp | Yes | 16 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,380 | 0.5 | 1,478 | 0 | $234 | $1,470 | $230 | 5.3 |
| Storage - Recieving | 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 |
| Storage - Recieving | 10 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,000 | 2, 3 | Relamp | Yes | 10 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,380 | 0.3 | 924 | 0 | $146 | $840 | $140 | 4.8 |

## 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 |
| Corridors | Blower Coil Supply Fan | 1 | Supply Fan | 0.50 | 68.0% | No | | | B | 2,000 | 6 | Yes | 78.2% | No | | 0.0 | 107 | 0 | $17 | $500 | $0 | 28.8 |
| Corridors | Blower Coil Supply Fan | 5 | Supply Fan | 0.50 | 68.0% | No | | | B | 2,000 | 6 | Yes | 78.2% | No | | 0.2 | 537 | 0 | $87 | $2,500 | $0 | 28.8 |
| Corridors | Blower Coil Supply Fan | 6 | Supply Fan | 0.50 | 68.0% | No | | | B | 2,000 | 6 | Yes | 78.2% | No | | 0.2 | 644 | 0 | $104 | $2,900 | $0 | 27.9 |
| Corridors | Blower Coil Supply Fan | 26 | Supply Fan | 0.50 | 68.0% | No | | | B | 2,000 | 6 | Yes | 78.2% | No | | 1.0 | 2,790 | 0 | $451 | $12,800 | $0 | 28.4 |
| Corridors | Blower Coil Supply Fan | 36 | Supply Fan | 0.75 | 70.0% | No | | | B | 2,000 | 6 | Yes | 81.1% | No | | 2.2 | 5,907 | 0 | $955 | $19,400 | $0 | 20.3 |
| Corridors | Blower Coil Supply Fan | 9 | Supply Fan | 1.50 | 84.0% | No | | | B | 2,000 | | No | 84.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Roof | Air Handler Supply Fan | 2 | Supply Fan | 7.50 | 91.0% | Yes | Trane AHU | | W | 2,750 | | No | 91.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Roof | HRU Supply Fan | 8 | Supply Fan | 10.00 | 91.7% | No | HRU Supply Fan | | W | 2,750 | 7 | No | 91.7% | Yes | 8 | 22.9 | 67,116 | 0 | $10,851 | $60,200 | $8,800 | 4.7 |
| Roof | HRU Exhaust Fan | 4 | Exhaust Fan | 0.33 | 65.0% | No | HRU Exhaust Fan | | W | 2,000 | | No | 65.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Storage - Gym | Fan Coil Unit | 1 | Fan Coil Unit | 1.50 | 84.0% | No | Gym Storage FCU | | B | 2,000 | | No | 84.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Shop - B4 Wood Shop | Air Compressor Motor | 1 | Air Compressor | 1.20 | 83.0% | No | | | W | 2,000 | | No | 83.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Shop - B4 Wood Shop | Air Compressor Motor | 1 | Air Compressor | 1.60 | 84.5% | No | | | W | 2,000 | | No | 84.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical Room | Chilled Water Pump | 2 | Chilled Water Pump | 50.00 | 91.7% | Yes | Chilled Water Pump | | W | 1,500 | 6 | Yes | 94.5% | No | | 1.3 | 2,712 | 0 | $438 | $10,900 | $0 | 24.9 |
| Mechanical Room | Heating Hot Water Pump | 1 | Heating Hot Water Pump | 15.00 | 93.0% | Yes | | | W | 2,750 | | No | 93.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical Room | Heating Hot Water Pump | 2 | Heating Hot Water Pump | 3.00 | 78.5% | Yes | | | W | 2,000 | 6 | Yes | 89.5% | No | | 0.4 | 1,051 | 0 | $170 | $1,800 | $0 | 10.6 |
| Mechanical Room | Combustion Air Fan | 2 | Combustion Air Fan | 1.50 | 82.5% | No | Combustion Air Fan | | W | 2,000 | | No | 82.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical - Elevator | Elevator Motor | 1 | Other | 20.00 | 93.0% | No | Elevator Motor | | W | 180 | | No | 93.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Exterior | Wood Dust Collector Motor | 1 | Process Fan | 7.50 | 89.5% | No | | | W | 2,750 | | No | 89.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical Room | DHW Circulation Pump | 1 | DHW Circulation Pump | 0.75 | 81.1% | No | | | W | 2,920 | | No | 81.1% | 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 |
| Classrooms B7 & B9 | Classrooms B7 & B10 | 2 | Split-System Air-Source HP | 1.00 | 13.80 | 14.00 | 8.2 HSPF | LG | LUUV246HV | B | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Roof | Classrooms | 1 | Package Unit | 2.50 | | 8.50 | | Trane | TCC030F | B | 8 | Yes | 1 | Package Unit | 2.50 | | 16.00 | | 0.8 | 652 | 0 | $105 | $6,400 | $300 | 57.9 |
| Greenhouse | Greenhouse | 1 | Unit Heater | | 50.00 | | 0.8 Et | Modine | | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

**Electric Chiller Inventory & Recommendations**

| | | Existing Conditions | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Area(s)/System(s) Served | Chiller Quantity | System Type | Cooling Capacity per Unit (Tons) | Manufacturer | Model | Remaining Useful Life | ECM # | Install High Efficiency Chillers? | Chiller Quantity | System Type | Constant/ Variable Speed | Cooling Capacity (Tons) | Full Load Efficiency (kW/Ton) | IPLV Efficiency (kW/Ton) | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Exterior | All Conditioned Space | 1 | Air-Cooled Screw Chiller | 200.00 | Trane | RTAC2004UY0HU AGQ | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

**Space Heating Boiler Inventory & Recommendations**

| | | Existing Conditions | | | | | | Proposed Conditions | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Area(s)/System(s) Served | System Quantity | System Type | Output Capacity per Unit (MBh) | Manufacturer | Model | Remaining Useful Life | ECM # | Install High Efficiency System? | System Quantity | System Type | Output Capacity per Unit (MBh) | Heating Efficiency | Heating Efficiency Units | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Mechanical Room | Bunker Hill Middle School | 2 | Non-Condensing Hot Water Boiler | 2,927 | Weil-McLain | P-1288-W | B | 9 | Yes | 2 | Non-Condensing Hot Water Boiler | 2,927 | 85.00% | Ec | 0.0 | 0 | 115 | $1,906 | $153,100 | $7,600 | 76.3 |

**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 |
| Corridor Ceiling | Blower Coil Units | 10 | 70 | 1.00 | 0.0 | 0 | 31 | $508 | $950 | $140 | 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 |
| Mechanical Room | Main School Building | 3 | Storage Tank Water Heater (> 50 Gal) | State Industries | SBF100-260 | B | 11 | Yes | 3 | Storage Tank Water Heater (> 50 Gal) | Natural Gas | 93.00% | Et | 0.0 | 0 | 20 | $324 | $40,300 | $2,700 | 116.2 |
| Kitchen | High-Temp Dishwasher | 1 | Booster Water Heater | HATCO | | 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 |
| Restrooms | 12 | 45 | Faucet Aerator (Lavatory) | 1.50 | 0.50 | 0.0 | 0 | 13 | $208 | $380 | $180 | 1.0 |

TRC

New Jersey's cleanenergy program

Walk-In Cooler/Freezer Inventory & Recommendations

| | Existing Conditions | | | | Proposed Conditions | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Cooler/ Freezer Quantity | Case Type/Temperature | Manufacturer | Model | ECM # | Install EC Evaporator Fan Motors? | Install Electric Defrost Control? | Install Evaporator Fan Control? | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Kitchen | 1 | Medium Temp Freezer (0F to 30F) | Heatcraft | LET090BK | 14 | No | Yes | No | 0.0 | 888 | 0 | $144 | $640 | $50 | 4.1 |
| Kitchen | 1 | Cooler (35F to 55F) | Heatcraft | ADT070AK | 14 | No | Yes | No | 0.0 | 0 | 0 | $0 | $640 | $50 | 0.0 |

Commercial Refrigerator/Freezer Inventory & Recommendations

| | Existing Conditions | | | | | Proposed Conditions | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Quantity | Refrigerator/ Freezer Type | Manufacturer | Model | ENERGY STAR Qualified? | ECM # | Install ENERGY STAR Equipment? | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Kitchen | 2 | Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.) | Traulsen | T548670A | No | | No | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Kitchen | 1 | Freezer Chest | C Nelson MFG | BD-4 | No | 15 | Yes | 0.3 | 2,851 | 0 | $461 | $2,300 | $0 | 5.0 |
| Kitchen | 1 | Freezer Chest | Libeherr | | No | 15 | Yes | 0.3 | 2,675 | 0 | $433 | $2,200 | $0 | 5.1 |
| Kitchen | 2 | Refrigerator Chest | Powers Equipment | 569 | No | | No | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Kitchen | 1 | Stand-Up Refrigerator, Glass Door (≤15 cu. ft.) | TRUE | GDM-37EM | No | | No | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

Cooking Equipment Inventory & Recommendations

| | Existing Conditions | | | | | Proposed Conditions | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Quantity | Equipment Type | Manufacturer | Model | High Efficiency Equipement? | ECM # | Install High Efficiency Equipment? | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Kitchen | 3 | Insulated Food Holding Cabinet (Full Size) | Beverage-Air Corp | PH1-1HS-PT | No | | No | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Kitchen | 1 | Gas Fryer | Cleveland | | No | | No | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Classroom B3 | 3 | Electric Convection Oven (Full Size) | | | No | | No | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Kitchen | 1 | Gas Rack Oven (Double) | Garland | | No | | No | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Kitchen | 1 | Gas Steamer | Cleveland | | No | | No | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Kitchen | 2 | Electric Steamer | Amana | AMSO35 | No | | No | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

**Dishwasher Inventory & Recommendations**

| | Existing Conditions | | | | | | | Proposed Conditions | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Quantity | Dishwasher Type | Manufacturer | Model | Water Heater Fuel Type | Booster Heater Fuel Type | ENERGY STAR Qualified? | ECM # | Install ENERGY STAR Equipment? | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Payback w/ Incentives in Years |
| Kitchen | 1 | Single Tank Conveyor (High Temp) | Hobart | CRS66A | Natural Gas | Electric | No | 13 | Yes | 0.9 | 8,110 | 52 | $2,164 | $22,000 | $1,000 | 9.7 |

## Plug Load Inventory

| | Existing Conditions | | | | | |
|---|---|---|---|---|---|---|
| Location | Quantity | Equipment Description | Energy Rate (W) | ENERGY STAR Qualified? | Manufacturer | Model |
| Bunker Hill Middle School | 1 | Clothes Dryer | 1,200 | No | | |
| Bunker Hill Middle School | 1 | Clothes Washer | 700 | No | | |
| Bunker Hill Middle School | 13 | Coffee Machine | 900 | No | | |
| Bunker Hill Middle School | 26 | Desktop | 140 | No | | |
| Bunker Hill Middle School | 1 | Dishwasher (Undercounter) | 600 | No | | |
| Bunker Hill Middle School | 5 | Fan (Ceiling) | 200 | No | | |
| Bunker Hill Middle School | 1 | Fan (Large) | 400 | No | | |
| Bunker Hill Middle School | 2 | Kiln | 11,000 | No | | |
| Bunker Hill Middle School | 103 | Laptop | 45 | No | | |
| Bunker Hill Middle School | 18 | Microwave | 1,000 | No | | |
| Bunker Hill Middle School | 2 | Other | 70 | No | | |
| Bunker Hill Middle School | 2 | Other | 500 | No | | |
| Bunker Hill Middle School | 2 | Other | 1,200 | No | | |
| Bunker Hill Middle School | 2 | Other | 1,000 | No | | |
| Bunker Hill Middle School | 1 | Other | 1,800 | No | | |
| Bunker Hill Middle School | 2 | Other | 2,000 | No | | |
| Bunker Hill Middle School | 2 | Other | 1,800 | No | | |
| Bunker Hill Middle School | 1 | Other | 2,200 | No | | |
| Bunker Hill Middle School | 1 | Other | 950 | No | | |
| Bunker Hill Middle School | 1 | Other | 95 | No | | |
| Bunker Hill Middle School | 4 | Paper Shredder | 150 | No | | |
| Bunker Hill Middle School | 28 | Printer (Medium/Small) | 240 | No | | |
| Bunker Hill Middle School | 8 | Printer/Copier (Large) | 600 | No | | |
| Bunker Hill Middle School | 47 | Projector | 100 | No | | |
| Bunker Hill Middle School | 8 | Refrigerator (Mini) | 126 | No | | |
| Bunker Hill Middle School | 5 | Refrigerator (Residential) | 450 | No | | |
| Bunker Hill Middle School | 2 | Serving Table (Chilled/Heated) | 300 | No | | |
| Bunker Hill Middle School | 4 | Speakers (Large) | 150 | No | | |
| Bunker Hill Middle School | 3 | Speakers (Medium/Small) | 75 | No | | |
| Bunker Hill Middle School | 16 | Television | 130 | No | | |
| Bunker Hill Middle School | 1 | Toaster | 1,000 | No | | |
| Bunker Hill Middle School | 4 | Toaster Oven | 700 | No | | |
| Bunker Hill Middle School | 12 | Water Fountain | 100 | No | | |

## Vending Machine Inventory & Recommendations

| | Existing Conditions | | Proposed Conditions | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Quantity | Vending Machine Type | ECM # | Install Controls? | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Dining Area - Faculty Lounge | 1 | Non-Refrigerated | 16 | Yes | 0.0 | 343 | 0 | $55 | $270 | $0 | 4.9 |
| Dining Area - Faculty Lounge | 1 | Refrigerated | 16 | Yes | 0.2 | 1,612 | 0 | $261 | $270 | $50 | 0.8 |
| Dining Area - 2nd Floor Faculty Lounge | 1 | Refrigerated | 16 | Yes | 0.2 | 1,612 | 0 | $261 | $270 | $50 | 0.8 |

# 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.

LEARN MORE AT energystar.gov

## ENERGY STAR® Statement of Energy Performance

**22**

ENERGY STAR® Score[1]

### Bunker Hill Middle School

**Primary Property Type:** K-12 School
**Gross Floor Area (ft²):** 106,574
**Built:** 1996

**For Year Ending:** March 31, 2023
**Date Generated:** May 07, 2024

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

### Property & Contact Information

| Property Address | Property Owner | Primary Contact |
|---|---|---|
| Bunker Hill Middle School<br>372 Pitman Downer Road<br>Sewell, New Jersey 08080 | Washington Township Board of Education<br>206 Holly Avenue<br>Sewell, NJ 08080<br>(856) 589-6644 | Janine Wechter<br>206 Holly Avenue<br>Sewell, NJ 08080<br>(856) 589-6644 x 6502<br>jwechter@wtps.org |

**Property ID**: 30742135

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

**Site EUI**
80.1 kBtu/ft²

**Source EUI**
155.1 kBtu/ft²

| Annual Energy by Fuel | |
|---|---|
| Natural Gas (kBtu) | 4,206,483 (49%) |
| Electric - Grid (kBtu) | 4,326,053 (51%) |

| National Median Comparison | |
|---|---|
| National Median Site EUI (kBtu/ft²) | 61.2 |
| National Median Source EUI (kBtu/ft²) | 118.5 |
| % Diff from National Median Source EUI | 31% |
| **Annual Emissions** | |
| Total (Location-Based) GHG Emissions (Metric Tons CO2e/year) | 612 |

### Signature & Stamp of Verifying Professional

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

LP Signature: ______________________Date: __________

**Licensed Professional**

____ ________
,
(___)____-______
_________________

**Professional Engineer or Registered Architect Stamp**
**(if applicable)**

# APPENDIX C: GLOSSARY

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

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

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