Local Government Energy Audit Report

F.N. Brown Elementary

April 30, 2024

Prepared for:
Verona Board of Education
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Verona, New Jersey 07044

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Disclaimer

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

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

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

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

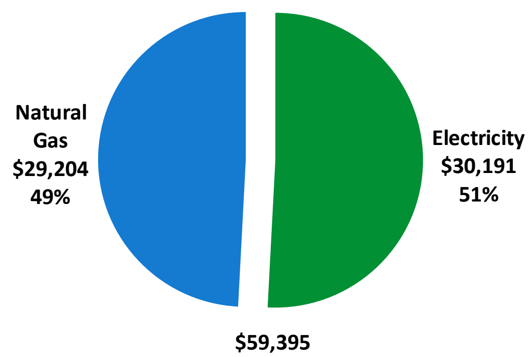
The customer and their respective contractor(s) are responsible to implement energy conservation measures in complete conformance with all applicable local, state, and federal requirements.

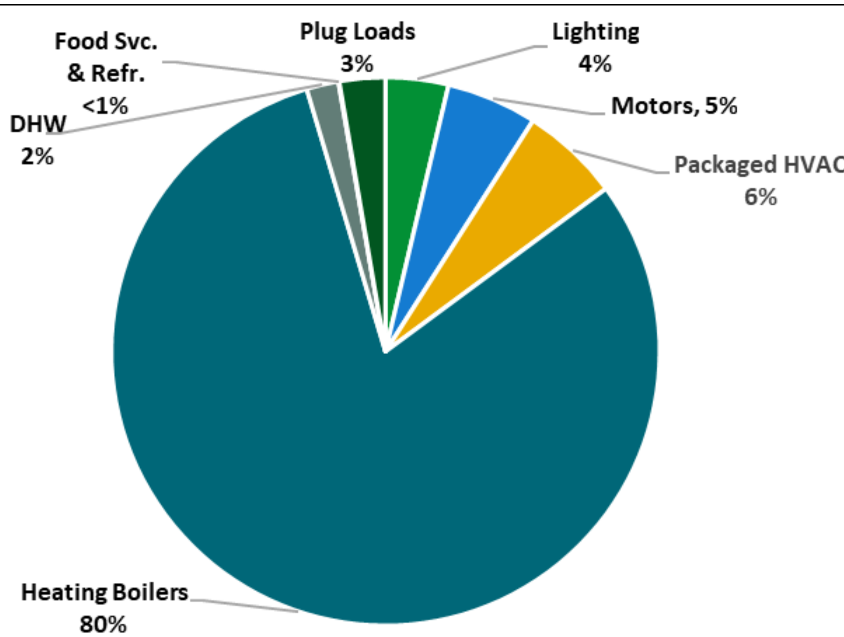
Table of Contents

1 EXECUTIVE SUMMARY

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

BUILDING PERFORMANCE REPORT

Annual Energy Utilities	Costs: $59,395 Electricity: 167,890 kWh Natural Gas: 27,145 Therms	
ENERGY STAR® Benchmarking Score	32 *(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.



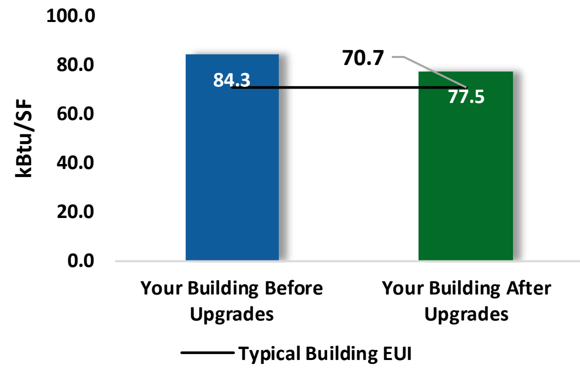
Energy Use by System

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.

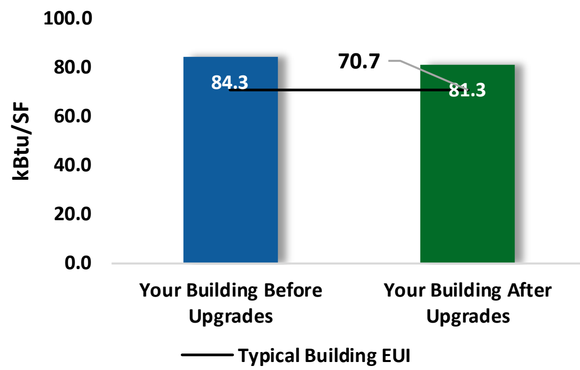
Scenario 1: Full Package (All Evaluated Measures)

Installation Cost	$241,200
Potential Rebates & Incentives[1]	$14,230
Annual Cost Savings	$5,086
Annual Energy Savings	Electricity: 15,427 kWh Natural Gas: 2,149 Therms
Greenhouse Gas Emission Savings	20 Tons
Simple Payback	44.6 Years
Site Energy Savings (All Utilities)	8%



Scenario 2: Cost Effective Package[2]

Installation Cost	$34,300
Potential Rebates & Incentives	$6,630
Annual Cost Savings	$3,931
Annual Energy Savings	Electricity: 18,723 kWh Natural Gas: 524 Therms
Greenhouse Gas Emission Savings	12 Tons
Simple Payback	7.0 Years
Site Energy Savings (all utilities)	4%



On-site Generation Potential

Photovoltaic	Medium
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			**1,531**	**0.9**	**0**	**$272**	**$1,960**	**$390**	**$1,570**	**5.8**	**1,504**
ECM 1	Retrofit Fixtures with LED Lamps	Yes	1,438	0.9	0	$255	$1,870	$390	$1,480	5.8	1,413
ECM 2	Install LED Exit Signs	Yes	94	0.0	0	$17	$90	$0	$90	5.4	92
Lighting Control Measures			**4,909**	**1.9**	**-1**	**$872**	**$12,330**	**$3,400**	**$8,930**	**10.2**	**4,823**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	3,697	1.6	-1	$656	$8,960	$1,560	$7,400	11.3	3,632
ECM 4	Install High/Low Lighting Controls	Yes	1,212	0.3	0	$215	$3,370	$1,840	$1,530	7.1	1,191
Motor Upgrades			**107**	**0.0**	**0**	**$19**	**$3,400**	**$0**	**$3,400**	**176.5**	**108**
ECM 5	Premium Efficiency Motors	No	107	0.0	0	$19	$3,400	$0	$3,400	176.5	108
Variable Frequency Drive (VFD) Measures			**13,854**	**6.9**	**0**	**$2,491**	**$29,400**	**$3,100**	**$26,300**	**10.6**	**13,951**
ECM 6	Install VFDs on Constant Volume (CV) Fans	Yes	12,283	5.1	0	$2,209	$18,700	$2,700	$16,000	7.2	12,369
ECM 7	Install Boiler Draft Fan VFDs	No	1,571	1.8	0	$282	$10,700	$400	$10,300	36.5	1,582
Unitary HVAC Measures			**935**	**2.2**	**0**	**$168**	**$29,600**	**$800**	**$28,800**	**171.3**	**941**
ECM 8	Install High Efficiency Air Conditioning Units	No	320	0.7	0	$58	$20,600	$800	$19,800	343.9	322
ECM 9	Install High Efficiency Heat Pumps	No	615	1.6	0	$111	$9,000	$0	$9,000	81.4	619
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**100**	**$1,071**	**$160,400**	**$6,400**	**$154,000**	**143.8**	**11,653**
ECM 10	Install High Efficiency Steam Boilers	No	0	0.0	100	$1,071	$160,400	$6,400	$154,000	143.8	11,653
HVAC System Improvements			**0**	**0.0**	**51**	**$549**	**$1,230**	**$130**	**$1,100**	**2.0**	**5,974**
ECM 11	Install Pipe Insulation	Yes	0	0.0	51	$549	$1,230	$130	$1,100	2.0	5,974
Domestic Water Heating Upgrade			**0**	**0.0**	**3**	**$29**	**$80**	**$10**	**$70**	**2.4**	**320**
ECM 12	Install Low-Flow DHW Devices	Yes	0	0.0	3	$29	$80	$10	$70	2.4	320
Custom Measures			**-5,909**	**0.0**	**63**	**-$385**	**$2,800**	**$0**	**$2,800**	**-7.3**	**1,426**
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater***	No	-5,909	0.0	63	-$385	$2,800	$0	$2,800	-7.3	1,426
TOTALS (COST EFFECTIVE MEASURES)			**18,723**	**7.9**	**52**	**$3,931**	**$34,300**	**$6,630**	**$27,670**	**7.0**	**24,990**
TOTALS (ALL MEASURES)			**15,427**	**12.0**	**215**	**$5,086**	**$241,200**	**$14,230**	**$226,970**	**44.6**	**40,700**

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

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

*** - - Negative payback explained in section 4.9

All Evaluated Energy Improvements[3]

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

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

1.1 Planning Your Project

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

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

Pick Your Installation Approach

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

Options from Your Utility Company

Prescriptive and Custom Rebates

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

Direct Install

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

Engineered Solutions

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

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

Options from New Jersey's Clean Energy Program

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

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

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

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

Successor Solar Incentive Program (SuSI)

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

Ongoing Electric Savings with Demand Response

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

Large Energy User Program (LEUP)

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

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

2 Existing Conditions

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

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

2.1 Site Overview

On November 20, 2023, TRC performed an energy audit at F.N. Brown Elementary located in Verona, New Jersey. TRC met with Dennis James to review the facility operations and help focus our investigation on specific energy-using systems.

F.N. Brown Elementary is a 3-story, 38,985 square foot building built in 1931. Areas include classrooms, gymnasium, auditorium, offices, cafeterias, corridors, stairwells, offices, storage rooms, and mechanical spaces.

Recent Improvements and Facility Concerns

Over the last five years, the facility has replaced most lighting fixtures and bulbs with LED equivalents. Newer BAS controlled Trane unit ventilators with variable speed fans and variable refrigerant flow (VRF) cooling have also been installed across the schools in the district. The district indicated interest in electric vehicle charging stations.

2.2 Building Occupancy

The facility is occupied Monday through Friday 6:00 AM through 6:30 PM for regular classes, after school programs, and janitorial and maintenance services.

The school is fully occupied from September through June. Typical weekday occupancy is 25 staff and 300 students. Summer occupancy includes a summer recreation program and continuing maintenance activities. There are limited weekend activities.

The facility is occupied intermittently outside of regular hours as needed for maintenance and operations. Hours on select days may go to 10:00 PM.

Building Name	Weekday/Weekend	Operating Schedule
F.N. Brown Elementary	Weekday	6:00 AM - 6:30 PM
	Weekend	as needed for events

Building Occupancy Schedule

2.3 Building Envelope

Building walls are concrete block over structural steel with a brick facade. The roof of the original section of the building is sloped with asphalt shingles. The roof on the addition is flat and covered with modified bitumen. Both roof sections are in good condition. However, the flat roof was noted to have some areas with standing water, though the access day was after a heavy rain.

Interior walls are a mix of painted concrete block, dry wall, and plaster depending on the room. Basement floor rooms have drop ceilings while other floors are a mix of hard and drop ceilings.

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

Front Entrance

Window Seals

Roof

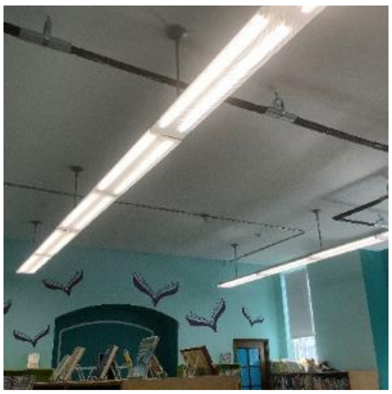
Gym Windows

2.4 Lighting Systems

The primary interior lighting system uses 4-foot 14.5-Watt and 2-foot 8.5-Watt linear LED T8 lamps. There are also several 32-Watt T8 fixtures in some of the mechanical and storage rooms. Fixture types include 2- 3- or 4-lamp, 2- or 4-foot-long recessed troffers, surface mounted wrap, and pendant fixtures. The recessed troffers primarily have prismatic lenses. Some are parabolic.

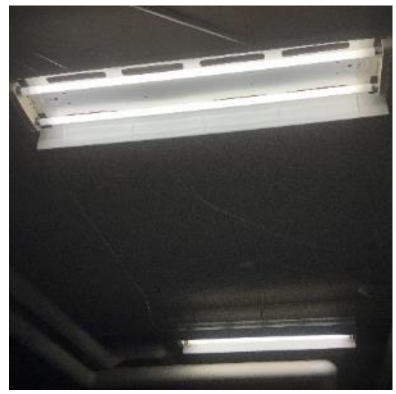
Compact fluorescent lamps (CFL) in recessed can fixtures provide illumination for a portion of both cafeterias. There are also 10-Watt A19 LED lamps in various applications and spaces including chandeliers, wall sconces, display cases, and general lighting for janitorial closets. Gymnasium fixtures incorporate LED linear tube lamps. Theater lighting uses LED sources. Most exit signs are LED.

Most fixtures are in good or new condition. Interior lighting levels were generally sufficient. Some of the classrooms with 3-lamps per fixture have lighting controls that allow for occupants to turn off 1 of the 3 lamps. These controls are frequently used by teachers to achieve lower lighting levels.

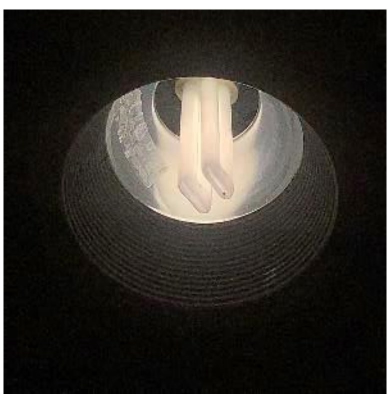


Library Pendant Wraps

Parabolic Troffers



Linear Fluorescent Lamps



CFL Recessed Can

Theater Chandeliers

Non-LED Exit Sign

Lighting is controlled primarily by occupancy sensors but some fixtures are controlled by standard manual wall switches. Corridor lights are controlled by a key operated switch and left on throughout occupied hours.

Remote Occupancy Sensor

Wall Switch with Remote Occupancy Sensor

Wall Switch Occupancy Sensor

Exterior fixtures include porch lights, flood lights, and sconces using LED sources. Some are screw-based replacement lamps while others are replacement fixtures.

Exterior light fixtures are controlled by a time clock.

Porch Light

Flood Light

Entry Sconce with LED Lamp

2.5 Air Handling Systems

Unit Ventilators

Unit ventilators provide heating, cooling, and ventilation to the library, cafeterias, and classrooms. Most unit ventilators are relatively new Trane units. These are equipped with variable speed supply fan motors, air dampers and fan coil valves controlled by the BAS. They obtain heating and cooling through five roof mounted variable refrigerant flow (VRF) heat pump systems. Each are 14 tons in cooling capacity and have efficiency ratings of 11.70 SEER. The rated heating output of these units is 188 MBh with a heating efficiency of about 4.02 COP. The units are controlled by the Trane Synchrony BAS.

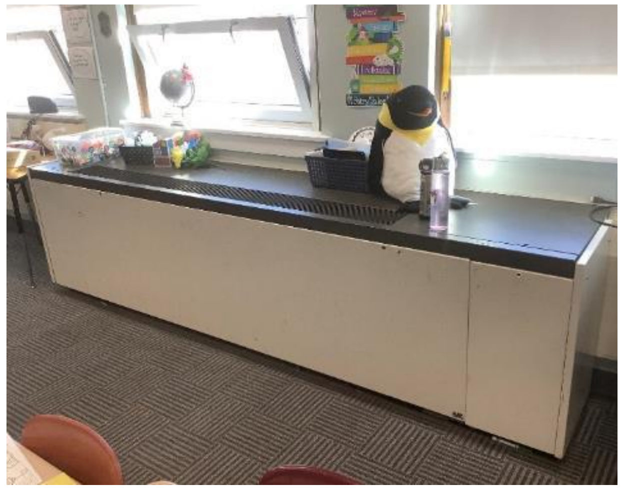
At the time of the audit, the zone temperature setpoints were programmed at 72 degrees in the BAS. Local thermostats allow small adjustments to space temperatures.

A few spaces, including the computer lab and faculty break room, have older unit ventilators. Most are heating only with steam coils. There are also a few fan coil units (FCU) that provide heating only with steam coils. These are typically ceiling mounted in stairwells, corridors, and bathrooms.

Several classrooms in the basement level have hot water FCUs in the ceilings that have each have a DX cooling coils supplied by six split system condensing units. The following section provides detail on those condensing units.

The FCUs and steam unit ventilators are controlled by local thermostats. Local heating control setpoints for the units at the time of the site visit varied greatly from off to 60 degrees to 80 degrees.

VRF Unit Ventilator - Library



Older Unit Ventilator

Steam FCU

FCU Local Controls

Unitary Electric HVAC Equipment

Cooling is provided for the gym and theater areas by three large split system condensing units, labeled ACCU-FN-1A, -1B and -2. They are each 15-ton units with an efficiency rating of 14 EER. These units were installed in 2021 and are in good condition with DX line insulation well protected. These units are BAS controlled. These units serve the cooling needs of the three air handling units for the theater and gym.

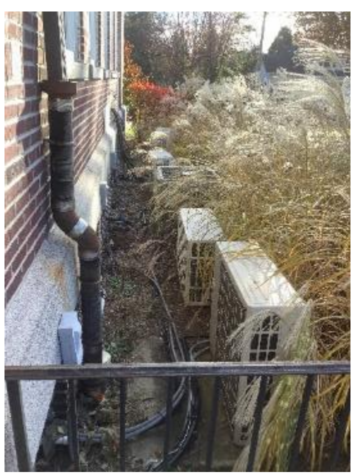
ACCU-FN-1A, - 1B, and -2

The FCUs serving the basement classrooms receive cooling from six smaller split system condensing units that range from 1.5 to 5 tons of cooling capacity, with efficiencies ranging from 13 to 16 SEER.

Classrooms without VRF unit ventilators or the hot water FCUs are cooled using either AC or heat pump ductless mini-split units. These vary in cooling capacity between 1.42 and 2.57 tons. The units range from fair to good condition. They range in efficiency between 16 to 20 SEER. The heat pump units have a heating efficiency of 9 HSPF.

Many DX lines have degraded or missing insulation. Some units well within their useful life were missing insulation, but most were missing on older units.

Condensing Unit missing DX Insulation



Mini-Split Condensing Units

VFR Split Condensing Units

Air Handling Units (AHUs)

The Theater is conditioned by two air handling units (AHU), AHU 1 and AHU 3. This units are equipped with a supply fan motor, a steam heating coil, and a refrigerant coil for cooling. One is physically located above each wing of the stage. The supply fan motors are each 5 hp, operate at constant speed, and were standard efficiency at the time they were installed. They are currently operating beyond what is typically considered their useful life.

AHU-2 serves the gym and back hallways rooms. It is equipped with a supply fan motor, a steam heating coil, and a refrigerant coil for cooling. It is physically located in a mechanical room behind the theater. The supply fan motor is 7.5 hp, constant speed, and of standard efficiency.

The AHUs are served by 3 identical split system condensing units, labeled ACCU-FN-1A, -1B and -2. They are 15-ton units with 14 EER. Each has two 1 hp supply motor. These units were installed in 2021 and are in good condition with DX line insulation well protected. AHUs are BAS controlled.

Theater AHU

AHU-2

ACCU-FN-1A, - 1B, and -2

The building is served by several rooftop and constant speed exhaust fans, ranging up to 0.5 hp. Many of the larger exhaust fans have Siemens controllers. Most are BAS controlled.

EF-9

EF-7

EF-5

2.6 Heating Steam and Hot Water Systems

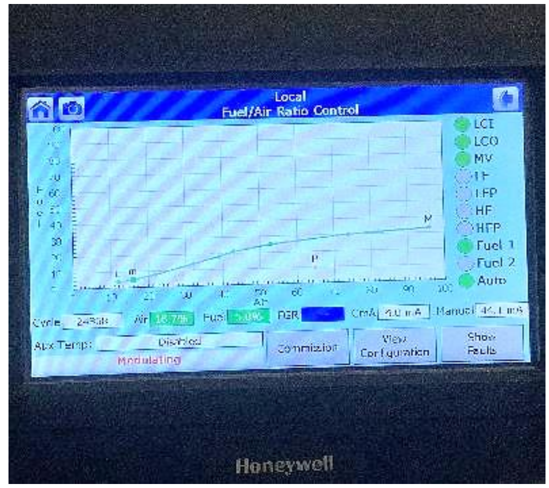
Two Cleaver Brooks 3,225 MBh forced draft steam boilers serve the building heating load. The burners are fully modulating and have a nominal efficiency of 78 percent. The boilers are configured in an automated lead-lag control scheme. Each has a 3 hp constant speed combustion air fan. Typically, only one boiler is required under high load conditions. Installed in 1998, they are in fair condition. There is a service contract in place. The boilers are BAS controlled. The outside air lockout temperature setpoint is 58 degrees.

A two-pipe steam distribution system serves the majority of the building heating terminals, which include fin tube radiators, FCUs, AHUs, and a few of the older unit ventilators. There are three 0.5 hp boiler feed water pumps in the mechanical room. Two of the pumps operate lead lag while the third is a standby pump.

The building has a small heat exchanger that was not accessible at the time of the audit. Hot water is distributed by two 0.5 hp constant speed hot water pumps to number of classroom fan coil units on the basement level adjacent to the boiler room. Pumps operate with an automated lead-lag control scheme. The hydronic system was observed to have 2-way valves.

In the boiler room there is approximately 55 feet of 1 to 2.5-inch steam supply and hot water pipes with no insulation that should be replaced.

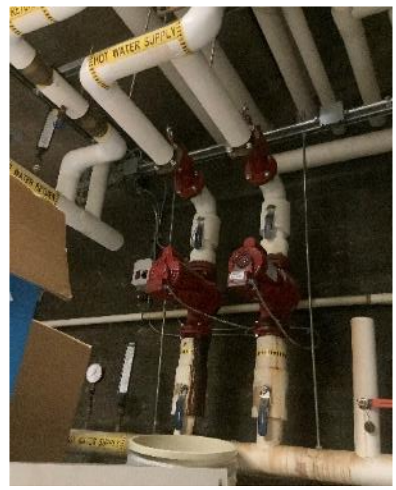
Steam Boilers



Boiler Local Controls Display

Feedwater Pumps

Feedwater Tank



HHW Pumps

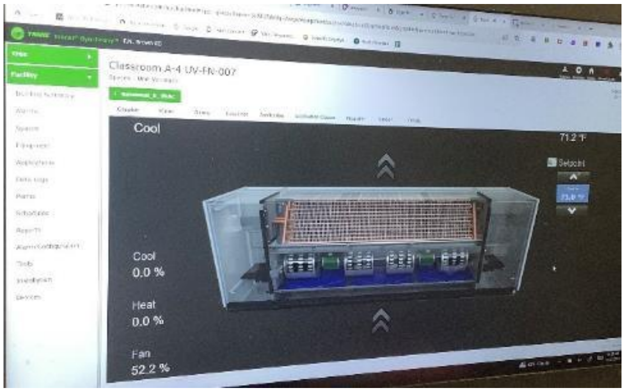
2.7 Building Automation System (BAS)

The Verona school district has three BAS controls systems that control and monitor the HVAC equipment, the boilers, the air handlers, the package units, and unit ventilators, and exhaust fans across the schools.

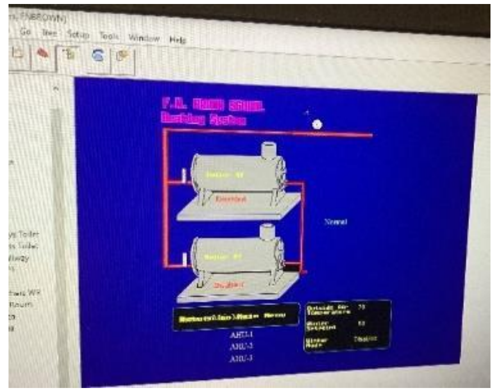
Some F. N. Brown mechanical equipment such as the VRF unit ventilators are operated from new Trane Tracer Synchrony system while other equipment including boilers, AHUs, and exhaust fans are operated by the older Tracer Summit system.

The various BAS control systems provide equipment scheduling control and monitors and controls space temperatures, supply air temperatures, outside air dampers, humidity, heating water loop temperatures, and fan speeds.

The site staff expressed an interest in transitioning all equipment to a single BAS.



Synchrony BAS – VRF Unit Ventilator



Summit BAS – Boilers

2.8 Domestic Hot Water

Hot water is produced by a 48 gallon 65 MBh gas-fired storage water heater with an efficiency of rating 81 percent. The unit is new. At the time of the site visit, the domestic water heater supply temperature was 100°F. A 0.125 hp circulation pump distribute water to end uses. The circulation pump operates continuously.

The domestic hot water pipes are partially uninsulated, but the existing insulation is in good condition.

DHW Heater

DHW Pump and Uninsulated Pumps

2.9 Food Service Equipment

Food is prepared at the high school and delivered to this facility's the kitchen then kept in a full-size insulated food holding cabinet. Equipment is not high efficiency but however is in good condition. When food service equipment is eventually replaced, consider installing high efficiency or ENERGY STAR labeled equipment.

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

Food Holding Cabinet

2.10 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 approximately 21 computer workstations throughout the facility. The students and faculty have laptops available to them. The building has ten portable charging carts for the devices. Plug loads include general cafe and office equipment. There are classroom typical loads such as smart boards, projectors, server equipment, and air purifiers. The cafeterias and most classrooms have two to three wall mounted fans that get regular use throughout the year. The corridors have water fountains.

There are several residential and mini style refrigerators throughout the building. These vary in condition and efficiency. The building also has a 5,550-Watt electric kiln, but it is estimated to operate infrequently.

Lap Top Charging Carts

Wall Fan

Air Purifier and Dehumidifier

Water Fountains

Refrigerator and General Café Equipment

2.11 Water-Using Systems

Water is provided by a municipal water supply company. Potable water is used for drinking, cleaning, building conditioning, and gardening. Water leaks were not observed or 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.

This facility has 16 restrooms with toilets, urinals, and sinks. Most restroom faucet flow rates are at 1 to 2.5 gallons per minute (gpm), but a few are low flow 0.5 gpm. Kitchen and classroom faucets are 2.2 gpm.

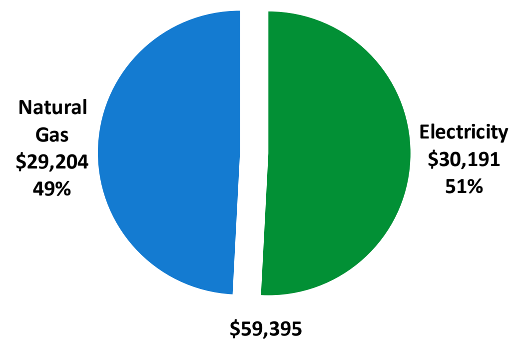
Restroom Faucet

Break Room Faucet

3 Energy Use and Costs

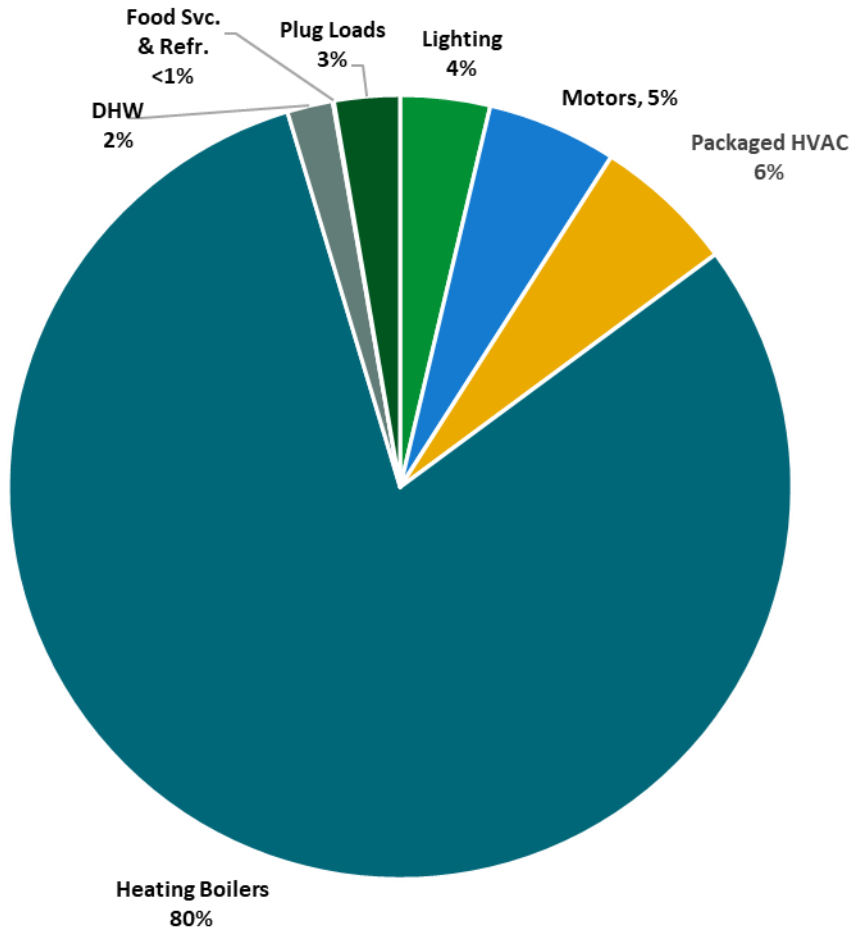
Twelve months of utility billing data are used to develop annual energy consumption and cost data. This information creates a profile of the annual energy consumption and energy costs.

Utility Summary		
Fuel	**Usage**	**Cost**
Electricity	167,890 kWh	$30,191
Natural Gas	27,145 Therms	$29,204
Total		**$59,395**



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.

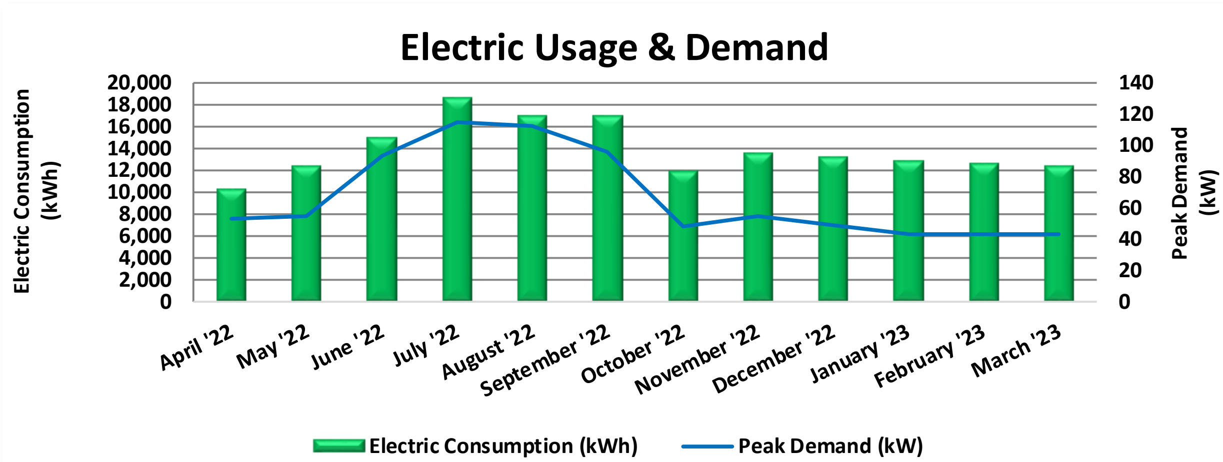
The energy auditor collects information regarding equipment operating hours, capacity, efficiency, and other operational parameters from facility staff, drawings, and on-site observations. This information is used as the inputs to calculate the existing conditions energy use for the site. The calculated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

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



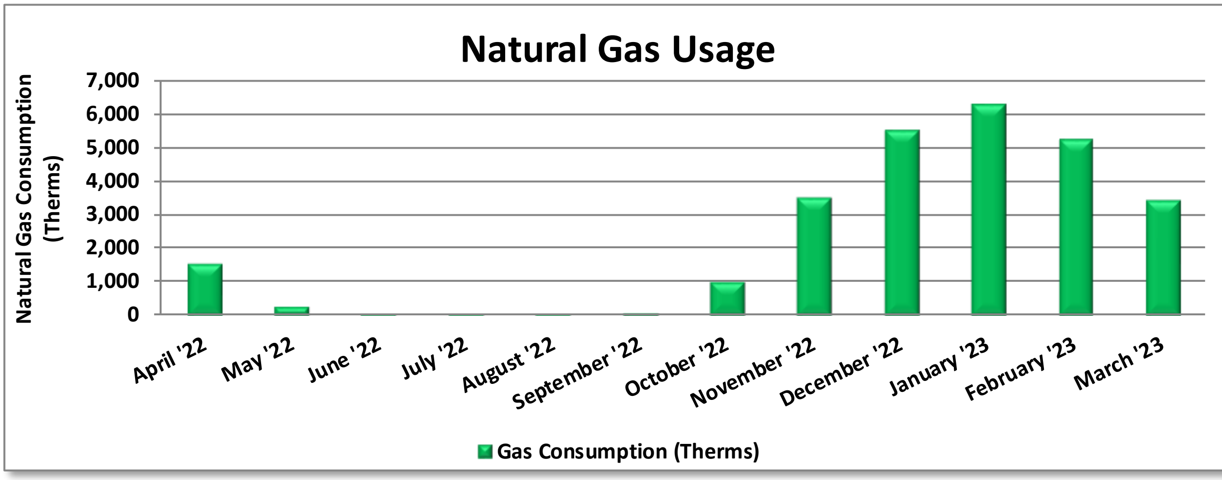
Electric Billing Data					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
4/29/22	30	10,320	53	$209	$1,625
5/31/22	32	12,480	55	$218	$1,879
6/29/22	29	15,130	94	$1,340	$3,282
7/29/22	30	18,720	115	$1,687	$4,039
8/29/22	31	17,040	113	$1,651	$3,862
9/28/22	30	17,040	96	$1,406	$3,598
10/27/22	29	12,000	48	$224	$1,988
11/29/22	33	13,680	55	$257	$2,264
12/29/22	30	13,320	49	$229	$2,003
1/30/23	32	12,960	43	$201	$1,936
3/1/23	30	12,720	43	$201	$1,876
3/30/23	29	12,480	43	$201	$1,839
Totals	**365**	**167,890**	**115**	**$7,825**	**$30,191**
Annual	**365**	**167,890**	**115**	**$7,825**	**$30,191**

Notes:

- Peak demand of 115 kW occurred in July '22.
- Average demand over the past 12 months was 67 kW.
- The average electric cost over the past 12 months was $0.180/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.
- The school operates year-round, and a significant portion of the site uses heap pump technology for both heating and cooling. This results in relatively constant electricity use with a slight spike in the summer for air conditioning.
- The usage for the month of December was estimated.

3.2 Natural Gas

PSE&G delivers natural gas under rate class Large Volume Gas (LVG), with natural gas supply provided by Aggressive Energy LLC, a third-party supplier.



Gas Billing Data			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
4/29/22	30	1,548	$1,679
5/31/22	32	260	$466
6/29/22	29	52	$213
7/29/22	30	50	$212
8/29/22	31	45	$207
9/28/22	30	81	$237
10/27/22	29	1,020	$1,103
11/29/22	33	3,512	$3,835
12/29/22	30	5,548	$5,714
1/30/23	32	6,293	$6,481
3/1/23	30	5,283	$5,381
3/30/23	29	3,453	$3,676
Totals	**365**	**27,145**	**$29,204**
Annual	**365**	**27,145**	**$29,204**

Notes:

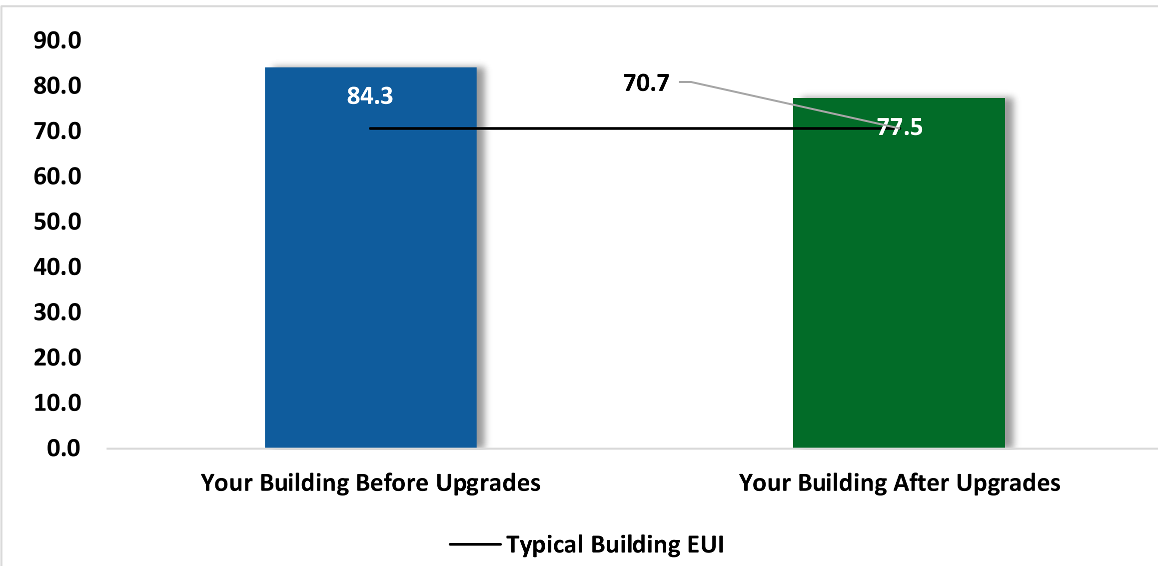
- The average gas cost for the past 12 months is $1.076/therm, which is the blended rate used throughout the analysis.
- Natural gas is used primarily for heating but due to domestic hot water use, it still has limited use in the summer months.
- The usage for the month of December was estimated.

3.3 Benchmarking

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

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

Benchmarking Score	32



Energy Use Intensity Comparison[4]

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.

[4] Based on all evaluated ECMs

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.

3.4 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			**1,531**	**0.9**	**0**	**$272**	**$1,960**	**$390**	**$1,570**	**5.8**	**1,504**
ECM 1	Retrofit Fixtures with LED Lamps	Yes	1,438	0.9	0	$255	$1,870	$390	$1,480	5.8	1,413
ECM 2	Install LED Exit Signs	Yes	94	0.0	0	$17	$90	$0	$90	5.4	92
Lighting Control Measures			**4,909**	**1.9**	**-1**	**$872**	**$12,330**	**$3,400**	**$8,930**	**10.2**	**4,823**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	3,697	1.6	-1	$656	$8,960	$1,560	$7,400	11.3	3,632
ECM 4	Install High/Low Lighting Controls	Yes	1,212	0.3	0	$215	$3,370	$1,840	$1,530	7.1	1,191
Motor Upgrades			**107**	**0.0**	**0**	**$19**	**$3,400**	**$0**	**$3,400**	**176.5**	**108**
ECM 5	Premium Efficiency Motors	No	107	0.0	0	$19	$3,400	$0	$3,400	176.5	108
Variable Frequency Drive (VFD) Measures			**13,854**	**6.9**	**0**	**$2,491**	**$29,400**	**$3,100**	**$26,300**	**10.6**	**13,951**
ECM 6	Install VFDs on Constant Volume (CV) Fans	Yes	12,283	5.1	0	$2,209	$18,700	$2,700	$16,000	7.2	12,369
ECM 7	Install Boiler Draft Fan VFDs	No	1,571	1.8	0	$282	$10,700	$400	$10,300	36.5	1,582
Unitary HVAC Measures			**935**	**2.2**	**0**	**$168**	**$29,600**	**$800**	**$28,800**	**171.3**	**941**
ECM 8	Install High Efficiency Air Conditioning Units	No	320	0.7	0	$58	$20,600	$800	$19,800	343.9	322
ECM 9	Install High Efficiency Heat Pumps	No	615	1.6	0	$111	$9,000	$0	$9,000	81.4	619
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**100**	**$1,071**	**$160,400**	**$6,400**	**$154,000**	**143.8**	**11,653**
ECM 10	Install High Efficiency Steam Boilers	No	0	0.0	100	$1,071	$160,400	$6,400	$154,000	143.8	11,653
HVAC System Improvements			**0**	**0.0**	**51**	**$549**	**$1,230**	**$130**	**$1,100**	**2.0**	**5,974**
ECM 11	Install Pipe Insulation	Yes	0	0.0	51	$549	$1,230	$130	$1,100	2.0	5,974
Domestic Water Heating Upgrade			**0**	**0.0**	**3**	**$29**	**$80**	**$10**	**$70**	**2.4**	**320**
ECM 12	Install Low-Flow DHW Devices	Yes	0	0.0	3	$29	$80	$10	$70	2.4	320
Custom Measures			**-5,909**	**0.0**	**63**	**-$385**	**$2,800**	**$0**	**$2,800**	**-7.3**	**1,426**
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater***	No	-5,909	0.0	63	-$385	$2,800	$0	$2,800	-7.3	1,426
TOTALS			**15,427**	**12.0**	**215**	**$5,086**	**$241,200**	**$14,230**	**$226,970**	**44.6**	**40,700**

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

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

*** - Negative payback explained in section 4.9

All Evaluated ECMs

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**1,531**	**0.9**	**0**	**$272**	**$1,960**	**$390**	**$1,570**	**5.8**	**1,504**
ECM 1	Retrofit Fixtures with LED Lamps	1,438	0.9	0	$255	$1,870	$390	$1,480	5.8	1,413
ECM 2	Install LED Exit Signs	94	0.0	0	$17	$90	$0	$90	5.4	92
Lighting Control Measures		**4,909**	**1.9**	**-1**	**$872**	**$12,330**	**$3,400**	**$8,930**	**10.2**	**4,823**
ECM 3	Install Occupancy Sensor Lighting Controls	3,697	1.6	-1	$656	$8,960	$1,560	$7,400	11.3	3,632
ECM 4	Install High/Low Lighting Controls	1,212	0.3	0	$215	$3,370	$1,840	$1,530	7.1	1,191
Variable Frequency Drive (VFD) Measures		**12,283**	**5.1**	**0**	**$2,209**	**$18,700**	**$2,700**	**$16,000**	**7.2**	**12,369**
ECM 6	Install VFDs on Constant Volume (CV) Fans	12,283	5.1	0	$2,209	$18,700	$2,700	$16,000	7.2	12,369
HVAC System Improvements		**0**	**0.0**	**51**	**$549**	**$1,230**	**$130**	**$1,100**	**2.0**	**5,974**
ECM 11	Install Pipe Insulation	0	0.0	51	$549	$1,230	$130	$1,100	2.0	5,974
Domestic Water Heating Upgrade		**0**	**0.0**	**3**	**$29**	**$80**	**$10**	**$70**	**2.4**	**320**
ECM 12	Install Low-Flow DHW Devices	0	0.0	3	$29	$80	$10	$70	2.4	320
TOTALS		**18,723**	**7.9**	**52**	**$3,931**	**$34,300**	**$6,630**	**$27,670**	**7.0**	**24,990**

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

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

*** - Negative payback explained in section 4.9

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		**1,531**	**0.9**	**0**	**$272**	**$1,960**	**$390**	**$1,570**	**5.8**	**1,504**
ECM 1	Retrofit Fixtures with LED Lamps	1,438	0.9	0	$255	$1,870	$390	$1,480	5.8	1,413
ECM 2	Install LED Exit Signs	94	0.0	0	$17	$90	$0	$90	5.4	92

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: Retrofit Fixtures with LED Lamps

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

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

Affected Building Areas: all areas with fluorescent fixtures with T8 tubes and cafeteria compact fluorescent lamps

ECM 2: Install LED Exit Signs

Replace compact fluorescent exit signs with LED exit signs. LED exit signs require virtually no maintenance and have a life expectancy of at least 20 years. This measure saves energy by installing LED fixtures, which use less power than other technologies with an equivalent lighting output. Maintenance savings and improved reliability may also be achieved, as the longer-lasting LED lamps will not need to be replaced as often as the existing 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		**4,909**	**1.9**	**-1**	**$872**	**$12,330**	**$3,400**	**$8,930**	**10.2**	**4,823**
ECM 3	Install Occupancy Sensor Lighting Controls	3,697	1.6	-1	$656	$8,960	$1,560	$7,400	11.3	3,632
ECM 4	Install High/Low Lighting Controls	1,212	0.3	0	$215	$3,370	$1,840	$1,530	7.1	1,191

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, conference rooms, classrooms, library, restrooms, and storage rooms

ECM 4: Install High/Low Lighting Controls

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

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

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

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

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

Affected Building Areas: hallways and lobby

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		**107**	**0.0**	**0**	**$19**	**$3,400**	**$0**	**$3,400**	**176.5**	**108**
ECM 5	Premium Efficiency Motors	107	0.0	0	$19	$3,400	$0	$3,400	176.5	108

ECM 5: Premium Efficiency Motors

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

Affected Motors:

Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Additional Motor Description
Mechanical theater balcony, various	Ventilation	7	Exhaust Fan	0.5	EF-9,-10,-11,-12,-13,-14,-15,

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		**13,854**	**6.9**	**0**	**$2,491**	**$29,400**	**$3,100**	**$26,300**	**10.6**	**13,951**
ECM 6	Install VFDs on Constant Volume (CV) Fans	12,283	5.1	0	$2,209	$18,700	$2,700	$16,000	7.2	12,369
ECM 7	Install Boiler Draft Fan VFDs	1,571	1.8	0	$282	$10,700	$400	$10,300	36.5	1,582

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 6: 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.

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

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

Affected Air Handlers: theater AHUs 1 & 3; AHU-2

ECM 7: Install Boiler Draft Fan VFDs

We evaluates replacement of existing volume control devices on boiler draft fans, such as inlet vanes or dampers, with VFDs. Inlet vanes or dampers are an inefficient means of controlling the air volume compared to VFDs. The existing volume control device will be removed or permanently disabled, and the control signal will be redirected to the VFD to determine proper fan motor speed.

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

Additional maintenance savings may result from this measure. VFDs are solid state electronic devices, which generally require less maintenance than mechanical air volume control devices.

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		**935**	**2.2**	**0**	**$168**	**$29,600**	**$800**	**$28,800**	**171.3**	**941**
ECM 8	Install High Efficiency Air Conditioning Units	320	0.7	0	$58	$20,600	$800	$19,800	343.9	322
ECM 9	Install High Efficiency Heat Pumps	615	1.6	0	$111	$9,000	$0	$9,000	81.4	619

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

ECM 8: Install High Efficiency Air Conditioning Units

We evaluated the replacement of 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: split system condensing units for teacher's work room, OT/PT, CST, classroom B8, and classroom B3

ECM 9: Install High Efficiency Heat Pumps

We evaluated the replacement of standard efficiency heat pumps with high efficiency heat pumps. A higher EER or SEER rating indicates a more efficient cooling system, and a higher HSPF rating indicates more efficient heating mode. The magnitude of energy savings for this measure depends on the relative efficiency of the older unit versus the new high efficiency unit, the average heating and cooling loads, and the estimated annual operating hours.

Affected Units: nurse's office mini-split HP and rooftop mini-split HP

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**	**100**	**$1,071**	**$160,400**	**$6,400**	**$154,000**	**143.8**	**11,653**
ECM 10	Install High Efficiency Steam Boilers	0	0.0	100	$1,071	$160,400	$6,400	$154,000	143.8	11,653

ECM 10: Install High Efficiency Steam Boilers

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

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

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

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**	**51**	**$549**	**$1,230**	**$130**	**$1,100**	**2.0**	**5,974**
ECM 11	Install Pipe Insulation	0	0.0	51	$549	$1,230	$130	$1,100	2.0	5,974

ECM 11: Install Pipe Insulation

Install insulation on steam, heating water and domestic hot 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: steam piping, condensate return and hot water piping, and domestic hot water piping

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**	**3**	**$29**	**$80**	**$10**	**$70**	**2.4**	**320**
ECM 12	Install Low-Flow DHW Devices***	0	0.0	3	$29	$80	$10	$70	2.4	320

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.

4.9 Custom Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Custom Measures		**-5,909**	**0.0**	**63**	**-$385**	**$2,800**	**$0**	**$2,800**	**-7.3**	**1,426**
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater****	-5,909	0.0	63	-$385	$2,800	$0	$2,800	-7.3	1,426

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

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

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

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

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

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

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

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

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

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

Switching from a gas fired water heater to a HPWH has the potential to reduce the sites overall greenhouse gas emissions. If the electricity for the HPWH is provided by an on-site photovoltaic (PV) system then there are essentially no greenhouse gas (GHG) emissions. A 2016 study conducted at Cornell[7]

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

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

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

calculated the kg of methane (CH_4) and carbon dioxide (CO_2) produced per GJ of water heated. The study compared HPWH to gas and electric fired, storage and tankless water heaters. The study also considered electricity produced from natural gas and coal fired electric plants. In all cases the study found that HPWHs produced less methane than all of the other water heaters. The study also found that HPWH produced less carbon dioxide than electric resistance water heaters but more carbon dioxide than tankless gas water heaters and about the same amount of carbon dioxide as storage gas water heaters. The summary tables provide the reduction in CO2 equivalent emissions based on the typical New Jersey electric utility.

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

Affected Units: DHW heater

4.10 Measures for Future Consideration

There are additional opportunities for improvement that Verona Board of Education 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.

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

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

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

Upgrade/Replace Building Automation System

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

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

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

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

Heating System Conversion from Steam to Hot Water

Replacing the steam boilers with natural gas fired, high-efficiency water boilers may be of interest to site personal since the system is already partially converted to using heating hot water and air source heat pumps. This type of system upgrade/conversion has significant up-front capital costs. However, there are benefits with modular hot water boiler system designs with advanced control strategies. Advantages associated with configuring a boiler plant around several modular boilers include the better system performance at low load conditions, and the modular boilers will often take less space than multiple old large boilers.

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

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

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

Upgrade to a Heat Pump System

The site has already converted most of its unit ventilators to a heat pump system. Electric resistance heating units work by passing an electric current through wires to heat them. The system is 100% efficient since for every unit of electricity consumed, one unit of heat is produced.

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

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

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

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

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

5 Energy Efficient Best Practices

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

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

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

Energy Tracking with ENERGY STAR Portfolio Manager

You've heard it before—you cannot manage what you do not measure. ENERGY STAR Portfolio Manager is an online tool that you can use to measure and track energy and water consumption, as well as greenhouse gas emissions[8] . Your account has already been established. Now you can continue to keep tabs on your energy performance every month.

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.

Lighting Maintenance

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

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

Lighting Controls

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

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

that setpoints and sensitivity are configured properly. Adjust exterior lighting time clock controls seasonally as needed to match your lighting requirements.

Motor Maintenance

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

Fans to Reduce Cooling Load

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

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.

Ductwork Maintenance

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

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

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

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

Steam Trap Repair and Replacement

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

Boiler Maintenance

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

Label HVAC Equipment

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

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

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.

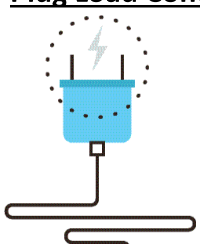
Refrigeration Equipment Maintenance

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.

Plug Load Controls



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

Computer Monitor Replacement

ENERGY STAR labeled computer monitors can be up to 25% more efficient than standard monitors. ENERGY STAR rated monitors have power consumption requirements for different operating modes such as on, idle, and sleep.

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.

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

6 Water Best Practices

Getting Started

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

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

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

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

Leak Detection and Repair

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

Toilets and Urinals

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

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

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

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

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

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

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

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

Faucets and Showerheads

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

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

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

Steam Boiler System

Typically, boilers that produce hot water are closed loop systems and do not have significant water losses as long as there are no leaks in the boiler or distribution piping. Therefore, this section focuses on boilers that produce steam. Steam is typically used for space heating, indirectly to heat domestic water and for process heating.

As steam is distributed, its heat is transferred to the process or the ambient environment and, as a result, the steam condenses to water. This condensate is then either discharged to the sewer or captured and returned to the boiler for reuse.

As water is converted to steam within the boiler, dissolved solids, such as calcium, magnesium, chloride, and silica, are left behind. With evaporation, the total dissolved solids (TDS) concentration increases. If the concentration gets too high, the TDS can cause scale to form within the system or can lead to corrosion. The concentration of TDS is controlled by removing (i.e., blowing down) a portion of the water that has a high concentration of TDS and replacing that water with make-up water, which has a lower concentration of TDS. Some boiler operators practice continuous blowdown by leaving the blowdown valve partially open, requiring a continuous feed of make-up water.

Proper control of boiler blowdown water is critical to ensure efficient boiler operation and minimize make-up water use. Insufficient blowdown can lead to scaling and corrosion, while excessive blowdown wastes water, energy, and chemicals. The optimum blowdown rate is influenced by several factors, including boiler type, operating pressure, water treatment, and quality of make-up water. Generally, blowdown rates range from 4% to 8% of the make-up water flow rate, although they can be as high as 10% if the make-up water is poor quality with high concentrations of solids.

Blowdown is typically assessed and controlled by measuring the conductivity of the boiler make-up water compared to that in the boiler blowdown water. Conductivity provides an indication of the overall TDS concentration in the boiler. The blowdown percentage can be calculated as indicated below. The boiler water quality is often expressed in terms of cycles of concentration, which is the inverse of the blowdown percentage. See figure below.

Blowdown Percentage = Make-up Water Conductivity / Blowdown Conductivity

Blowdown Percentage

Controlling the blowdown percentage and maximizing the cycles of concentration will reduce make-up water use; however, this can only be done within the constraints of the make-up and boiler water chemistry. As the TDS concentration in the blowdown water increases, scaling and corrosion problems can occur, unless carefully controlled.

For optimum steam boiler water efficiency, there are several operations, maintenance, and user education strategies to consider.

- Check steam, hot water, and condensate lines for leaks regularly and make repairs promptly.
- Regularly clean and inspect boiler water and fire tubes.
- Develop and implement an annual boiler tune-up program.
- Provide proper insulation on piping and the central storage tank to conserve heat.
- Implement a steam trap inspection program for boiler systems with condensate recovery. Repair leaking traps as soon as possible.

- Choose a water treatment vendor that will work with you to minimize water use, chemical use, and cost, while maintaining appropriate water chemistry for efficient scale and corrosion control.
- Have the water treatment vendor produce a report every time they evaluate the water chemistry in the boiler. Review the reports to ensure that characteristics, such as conductivity and cycles of concentration, are within the target range.
- To minimize blowdown, calculate and understand the boiler's cycles of concentration.
- Consider pre-treating boiler make-up water to remove impurities, which can increase the cycles of concentration the boiler can achieve.

There are also retrofits to consider if the steam system is not already equipped with these items.

- Install and maintain a condensate recovery system to return condensate to the boiler for reuse. If there already is a condensate recovery system inspect and maintain it regularly to maintain the maximum level of condensate return possible. Maximizing condensate return to the boiler is the most effective way to reduce water use. Recovering condensate:
  - Reduces the amount of make-up water required,
  - Reduces the frequency of blowdown,
  - Reduces boiler fuel use since the temperature of the condensate is considerably higher than the temperature of the make-up water.
- Where condensate cannot be returned to the boiler and must be discharged to the sanitary sewer, consider one of the following options:
  - Installing a heat exchanger to recover heat from the condensate to preheat the make-up water,
  - Install an expansion tank to temper hot condensate rather than adding water to cool it.
- Install an automatic blowdown control system, particularly on boilers that are more than 200 horsepower (6,700 kBtu/hr), to control the amount and frequency of blowdown rather than relying on continuous blowdown. Control systems with a conductivity controller will initiate blowdown only when the TDS concentrations in the boiler have built up to a specified concentration.
- Install flow meters on the make-up water line and the condensate return line to monitor the amount of make-up water added to the boiler.
- Install automated chemical feed systems to monitor conductivity, control blowdown, and add chemicals based on make-up water flow. These systems minimize water and chemical use while protecting against scale buildup and corrosion.

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.

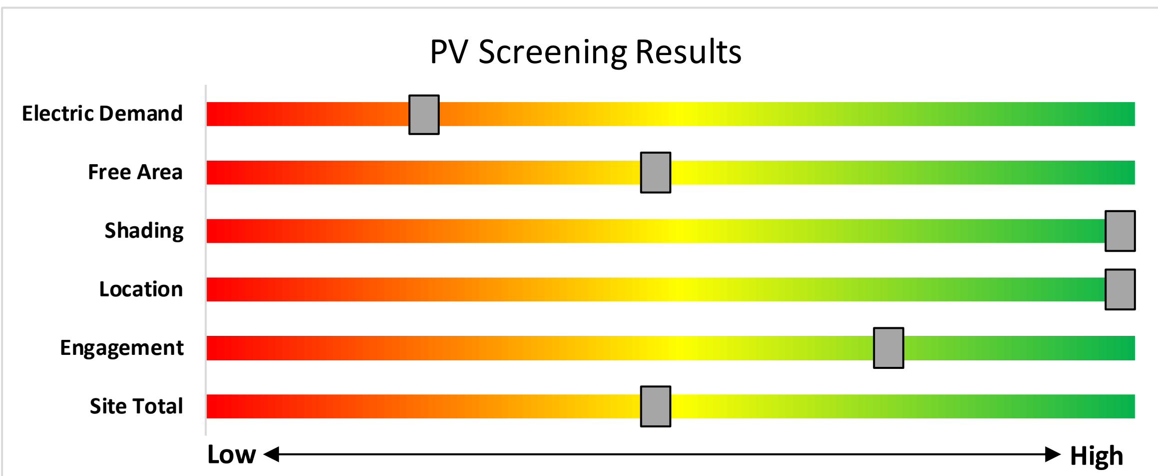
7.1 Solar Photovoltaic

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 medium potential for installing a PV array.

The amount of free area and low electric demand contribute to the medium 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	Medium	
System Potential	67	kW DC STC
Electric Generation	79,822	kWh/yr
Displaced Cost	$14,350	/yr
Installed Cost	$174,200	

Photovoltaic Screening

Successor Solar Incentive Program (SuSI)

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

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

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

7.2 Combined Heat and Power

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

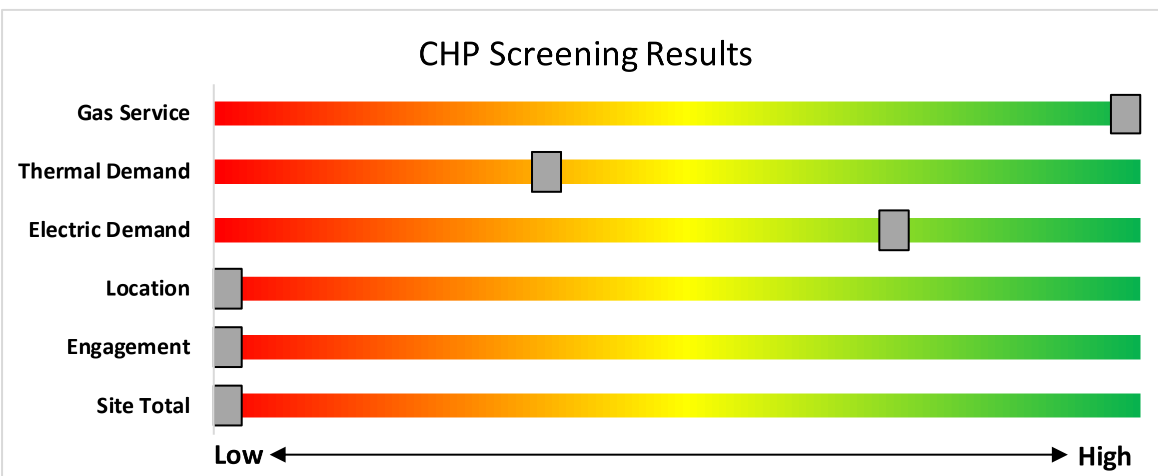
CHP systems typically produce a portion of the electric power used on-site, with the balance of electric power needs supplied by the local utility company. The heat is used to supplement (or replace) existing boilers and provide space heating and/or domestic hot water heating. Waste heat can also be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

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

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

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

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



Combined Heat and Power Screening

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

8 Electric Vehicles

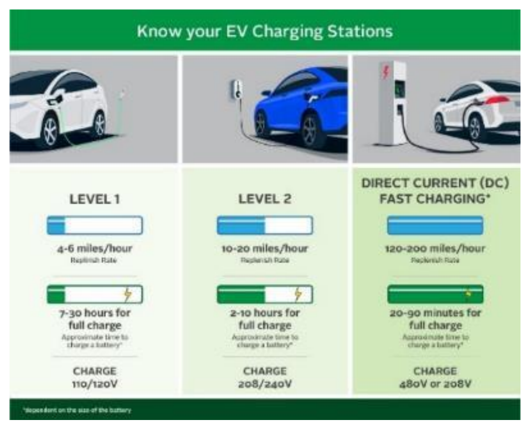
All electric vehicles (EVs) have an electric motor instead of an internal combustion engine. EVs function by plugging into a charge point, taking electricity from the grid, and then storing it in rechargeable batteries. Although electricity production may contribute to air pollution, the U.S. EPA categorizes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

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

8.1 EV Charging

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

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



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

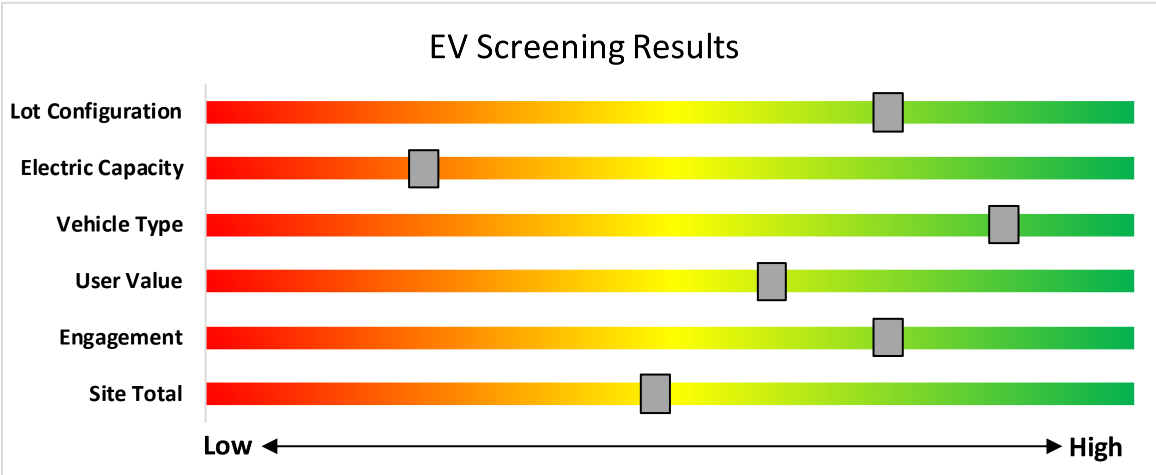
The primary costs associated with installing EV charging are the charger hardware and the cost to extend power from the facility to parking spaces. This may include upgrades to electric panels to serve increased loads.

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

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

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

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



EV Charger Screening

Electric Vehicle Programs Available

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

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

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

9 Project Funding and Incentives

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

NJBPU and NJCEP Administered Programs

New Jersey's cleanenergy program™

- 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

atlantic city electric (An Exelon Company) · Jersey Central Power & Light (A FirstEnergy Company) · PSEG · Rockland Electric Company · Elizabethtown Gas · South Jersey Gas · New Jersey Natural Gas

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

9.1 New Jersey's Clean Energy Program

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

Large Energy Users

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

Incentives

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

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

How to Participate

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

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

Combined Heat and Power

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

Incentives[14]

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

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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.

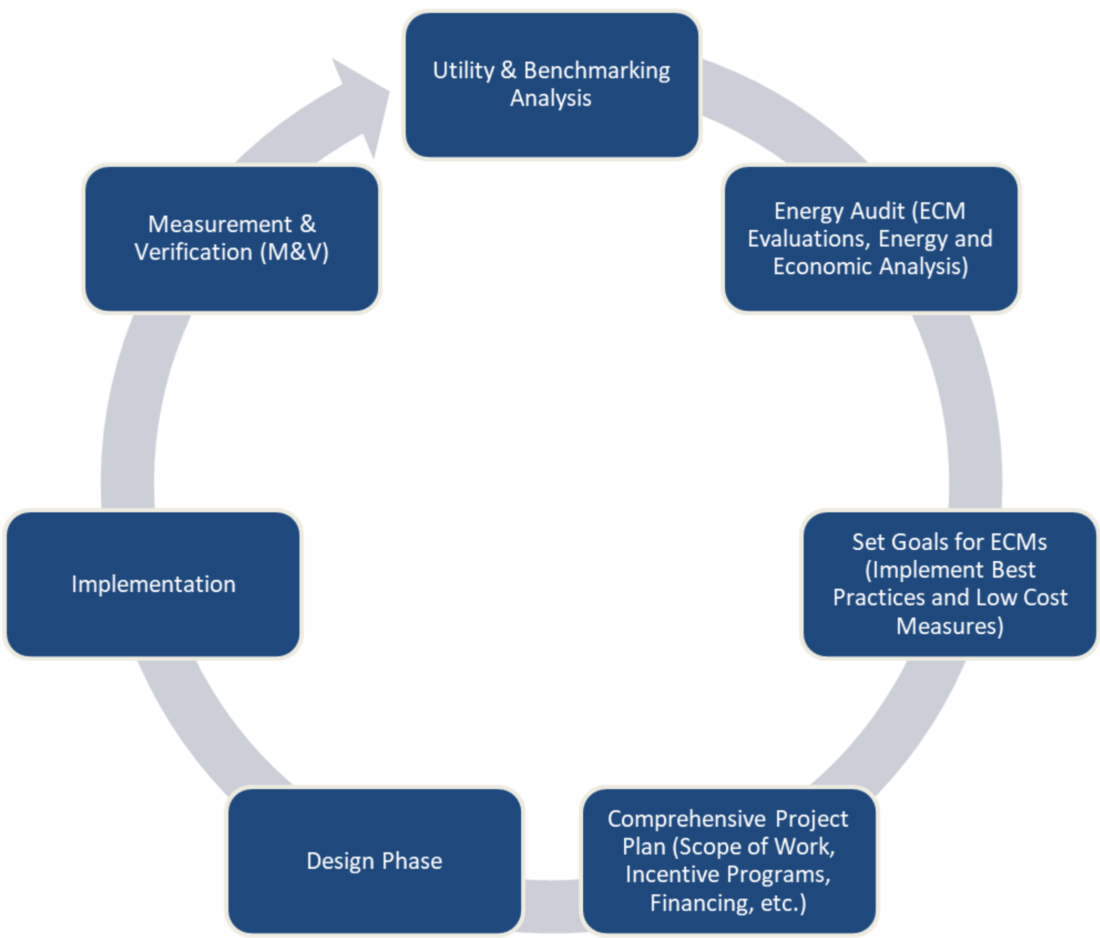
Engineered Solutions

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].

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

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

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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 6	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	1,700		None	No	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,700	0.0	0	0	$0	$0	$0	0.0
Classroom 6	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Classroom 7	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	1,800		None	No	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,800	0.0	0	0	$0	$0	$0	0.0
Classroom 7	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Computer Lab	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,700	3	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,173	0.0	34	0	$6	$150	$20	21.8
Computer Lab	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	S	44	1,700		None	No	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,700	0.0	0	0	$0	$0	$0	0.0
Conference 1	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	2,000	3	None	Yes	4	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,380	0.0	46	0	$8	$330	$40	35.2
Corridor - back	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Corridor - back	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,200	1, 4	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	828	0.1	111	0	$20	$380	$90	14.7
Corridor 1	1	Exit Signs: Fluorescent	None		14	8,760		None	No	1	Exit Signs: Fluorescent	None	14	8,760	0.0	0	0	$0	$0	$0	0.0
Corridor 1	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
Corridor 1	3	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	1,000	4	None	Yes	3	LED Lamps: (1) 10W A19 Screw-In Lamp	High/Low Control	10	690	0.0	10	0	$2	$280	$110	93.6
Corridor 1	11	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,500	4	None	Yes	11	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,725	0.1	272	0	$48	$560	$390	3.5
Exterior 1	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Timeclock		10	4,380		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Timeclock	10	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	2	LED Lamps: (2) 8W G11 Screw-In Lamps	Timeclock		16	4,380		None	No	2	LED Lamps: (2) 8W G11 Screw-In Lamps	Timeclock	16	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	5	LED - Fixtures: Wall Sconces	Timeclock		15	4,380		None	No	5	LED - Fixtures: Wall Sconces	Timeclock	15	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	3	LED - Fixtures: Wall Sconces	Timeclock		20	4,380		None	No	3	LED - Fixtures: Wall Sconces	Timeclock	20	4,380	0.0	0	0	$0	$0	$0	0.0
Faculty Room	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,500	3	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,035	0.0	89	0	$16	$330	$40	18.3
Faculty Room	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	1,500	3	None	Yes	2	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,035	0.0	17	0	$3	$150	$20	42.1
Janitorial 1	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	1,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	1,000	0.0	0	0	$0	$0	$0	0.0
Lobby A2	3	LED Lamps: (4) 10W A19 Screw-In Lamps	Wall Switch		40	1,000	4	None	Yes	3	LED Lamps: (4) 10W A19 Screw-In Lamps	High/Low Control	40	690	0.0	41	0	$7	$280	$110	23.4
Lobby A2	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	2,500	4	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,725	0.0	49	0	$9	$0	$0	0.0
Lobby Library Exit	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	2,500		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,500	0.0	0	0	$0	$0	$0	0.0
Lobby Main Entrance A1	1	LED Lamps: (4) 10W A19 Screw-In Lamps	Wall Switch		40	2,500	2	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	Wall Switch	6	2,500	0.0	94	0	$17	$90	$0	5.4
Mechanical 3	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,000	1	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	36	0	$6	$50	$10	6.2

	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
Media Center	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
Media Center	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	1,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	1,000	0.0	0	0	$0	$0	$0	0.0
Media Center	16	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,800	3	None	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,242	0.1	285	0	$51	$330	$40	5.7
Media Center	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,800	3	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,242	0.0	36	0	$6	$150	$20	20.6
Media Center	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,800		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,800	0.0	0	0	$0	$0	$0	0.0
Office - 115D	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,800	1	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,800	0.0	65	0	$12	$50	$10	3.4
Office - 1A	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,800	3	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,242	0.0	36	0	$6	$150	$20	20.6
Office - Library	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	1,500		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,500	0.0	0	0	$0	$0	$0	0.0
Office - Main	7	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	S	17	2,000		None	No	7	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	2,000	0.0	0	0	$0	$0	$0	0.0
Office - Main (1)	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	S	9	3,000		None	No	1	LED - Linear Tubes: (1) 2' Lamp	Wall Switch	9	3,000	0.0	0	0	$0	$0	$0	0.0
Office - Main (1)	2	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	S	17	1,800		None	No	2	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,800	0.0	0	0	$0	$0	$0	0.0
Office - Nurse	5	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	S	17	1,800		None	No	5	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,800	0.0	0	0	$0	$0	$0	0.0
Office - Nurse	6	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	S	17	1,800		None	No	6	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,800	0.0	0	0	$0	$0	$0	0.0
Restroom - Female 1	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,000		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Female 1	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	2,000	3	None	Yes	2	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,380	0.0	23	0	$4	$150	$20	31.6
Restroom - Library	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,000		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Male 1	3	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	30	2,000	3	None	Yes	3	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	30	1,380	0.0	61	0	$11	$330	$40	26.6
Restroom - Nurse	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,000		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	0	0	$0	$0	$0	0.0
Restroom- Faculty Room	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,000		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	0	0	$0	$0	$0	0.0
Storage - back hall	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,200	1	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,200	0.0	44	0	$8	$50	$10	5.2
Storage / Music Office	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,200	1	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,200	0.0	44	0	$8	$50	$10	5.2
Storage 5	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,000	1	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	36	0	$6	$50	$10	6.2
Teacher Storage	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,000	1	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	36	0	$6	$50	$10	6.2
Theater 1	7	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	7	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Theater 1	10	LED Lamps: Stage Lights	Wall Switch		100	1,200	3	None	Yes	10	LED Lamps: Stage Lights	Occupancy Sensor	100	828	0.2	409	0	$73	$330	$40	4.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Theater 1	1	LED Lamps: Stage Lights	Wall Switch		200	1,200		None	No	1	LED Lamps: Stage Lights	Wall Switch	200	1,200	0.0	0	0	$0	$0	$0	0.0
Theater 1	3	LED Lamps: Stage Lights	Wall Switch		200	1,200	3	None	Yes	3	LED Lamps: Stage Lights	Occupancy Sensor	200	828	0.1	246	0	$44	$330	$40	6.7
Theater 1	2	LED Lamps: (4) 10W A19 Screw-In Lamps	Wall Switch	S	40	1,200	3	None	Yes	2	LED Lamps: (4) 10W A19 Screw-In Lamps	Occupancy Sensor	40	828	0.0	33	0	$6	$150	$20	22.4
Theater 1	6	LED Lamps: (6) 10W A19 Screw-In Lamps	Wall Switch	S	60	1,200	3	None	Yes	6	LED Lamps: (6) 10W A19 Screw-In Lamps	Occupancy Sensor	60	828	0.1	147	0	$26	$330	$40	11.1
Art Room	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	3	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.0	40	0	$7	$150	$20	18.5
Art Room	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	S	44	1,800		None	No	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,800	0.0	0	0	$0	$0	$0	0.0
Classroom 10	9	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	S	17	1,700		None	No	9	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,700	0.0	0	0	$0	$0	$0	0.0
Classroom 11	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Classroom 11	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	S	44	1,800		None	No	15	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,800	0.0	0	0	$0	$0	$0	0.0
Classroom 13	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Classroom 13	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	S	44	1,800		None	No	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,800	0.0	0	0	$0	$0	$0	0.0
Classroom 14	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Classroom 14	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	S	44	1,800		None	No	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,800	0.0	0	0	$0	$0	$0	0.0
Classroom 15	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Classroom 15	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	S	44	1,800		None	No	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,800	0.0	0	0	$0	$0	$0	0.0
Classroom 16	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Classroom 16	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	S	44	1,800		None	No	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,800	0.0	0	0	$0	$0	$0	0.0
Classroom 17	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Classroom 17	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	S	44	1,800		None	No	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,800	0.0	0	0	$0	$0	$0	0.0
Corridor 2	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
Corridor 2	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,500	4	None	Yes	10	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,725	0.1	247	0	$44	$560	$350	4.8
Janitorial 2	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	500		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	500	0.0	0	0	$0	$0	$0	0.0
Restroom - Female 2	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,000		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Female 2	2	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	2,000	3	None	Yes	2	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,380	0.0	23	0	$4	$150	$20	31.6
Restroom - Male 2	3	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	2,000	3	None	Yes	3	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,380	0.0	35	0	$6	$330	$40	47.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Speech/Language	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	S	58	1,200		None	No	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,200	0.0	0	0	$0	$0	$0	0.0
Art Storages	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	1,000	1, 3	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	690	0.4	554	0	$98	$840	$120	7.3
Boiler Room	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	3	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	158	0	$28	$330	$40	10.3
Boiler storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,200	1, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	828	0.1	111	0	$20	$250	$20	11.7
Cafeteria #1	6	Compact Fluorescent: (1) 26W Double Biaxial Plug-In Lamp	Wall Switch	S	26	1,500	1, 3	Relamp	Yes	6	LED Lamps: GX23 (Plug-In) Lamps	Occupancy Sensor	19	1,035	0.1	128	0	$23	$410	$50	15.9
Cafeteria #1	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Cafeteria #1	10	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,500	3	None	Yes	10	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,035	0.1	223	0	$40	$330	$40	7.3
Cafeteria #1	3	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	1,500	3	None	Yes	3	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,035	0.0	26	0	$5	$0	$0	0.0
Cafeteria #2	6	Compact Fluorescent: (1) 26W Double Biaxial Plug-In Lamp	Wall Switch	S	26	1,500	1, 3	Relamp	Yes	6	LED Lamps: GX23 (Plug-In) Lamps	Occupancy Sensor	19	1,035	0.1	128	0	$23	$410	$50	15.9
Cafeteria #2	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Cafeteria #2	16	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,500	3	None	Yes	16	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,035	0.2	356	0	$63	$660	$70	9.3
Cafeteria #2	4	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	1,500	3	None	Yes	4	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,035	0.0	35	0	$6	$0	$0	0.0
Classroom A1	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	1,700		None	No	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,700	0.0	0	0	$0	$0	$0	0.0
Classroom A2	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	1,700		None	No	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,700	0.0	0	0	$0	$0	$0	0.0
Classroom A3	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	1,700		None	No	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,700	0.0	0	0	$0	$0	$0	0.0
Classroom A4	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	1,700		None	No	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,700	0.0	0	0	$0	$0	$0	0.0
Classroom A5	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	1,700		None	No	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,700	0.0	0	0	$0	$0	$0	0.0
Classroom A6	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	1,700		None	No	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,700	0.0	0	0	$0	$0	$0	0.0
Corridor A	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
Corridor A	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,500	4	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,725	0.1	198	0	$35	$560	$280	8.0
Corridor B	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
Corridor B	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,500	4	None	Yes	15	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	1,725	0.1	371	0	$66	$850	$530	4.9
CST Room	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	S	58	1,200		None	No	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,200	0.0	0	0	$0	$0	$0	0.0
Gymnasium	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	3	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.0	40	0	$7	$150	$20	18.5
Gymnasium	12	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	2,000	3	None	Yes	12	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,380	0.2	475	0	$84	$330	$40	3.4

	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
Janitorial 3	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	300		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	300	0.0	0	0	$0	$0	$0	0.0
Kitchen	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
Kitchen	3	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	1,800	3	None	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,242	0.0	80	0	$14	$330	$40	20.4
Mechanical B8	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,000	1	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	36	0	$6	$50	$10	6.2
Mechanical/Electrical	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,000		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Female 3	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,000		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Female 3	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,000		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Female 3	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	3	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.0	40	0	$7	$150	$20	18.5
Restroom - Female 3 faculty	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,500		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,500	0.0	0	0	$0	$0	$0	0.0
Restroom - Male 3	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,000		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Male 3	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,000		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Male 3	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	3	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.0	40	0	$7	$150	$20	18.5
Room B3	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	S	58	800		None	No	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	800	0.0	0	0	$0	$0	$0	0.0
Room B7 Music Room	13	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	S	58	1,500		None	No	13	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,500	0.0	0	0	$0	$0	$0	0.0
Room B7 Music Room	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	1,500		None	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,500	0.0	0	0	$0	$0	$0	0.0
Room B8	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	S	58	1,500		None	No	3	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,500	0.0	0	0	$0	$0	$0	0.0
Room B9	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	S	58	1,500		None	No	6	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,500	0.0	0	0	$0	$0	$0	0.0
Storage C1	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	800	1, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	552	0.1	74	0	$13	$250	$20	17.5
Mechanical theater balcony	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	800	1	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	800	0.0	49	0	$9	$90	$20	8.0
Mechanical theater balcony	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	800	1	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	800	0.0	49	0	$9	$90	$20	8.0
Mechanical theater balcony	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	800	1	Relamp	No	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	800	0.1	99	0	$18	$180	$40	8.0
Mechanical theater balcony	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	800	1	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	800	0.0	49	0	$9	$90	$20	8.0
Storage theater balcony	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,200	1	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,200	0.0	44	0	$8	$50	$10	5.2
Storage theater balcony	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,200	1	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,200	0.0	44	0	$8	$50	$10	5.2
Balcony Stairs	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	1,200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,200	0.0	0	0	$0	$0	$0	0.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Stairs C3	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 C3	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	1,600	3	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,104	0.0	95	0	$17	$280	$210	4.2
Stairs C3	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch		58	1,600	3	None	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,104	0.0	63	0	$11	$280	$70	18.7
Stairs C5	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 C5	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	1,600	3	None	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,104	0.0	111	0	$20	$280	$250	1.5
Stairs C5	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch		58	1,600	3	None	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,104	0.0	63	0	$11	$280	$70	18.7
Stairs gym B2	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 gym B2	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	2,000	3	None	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.0	59	0	$11	$280	$110	16.1

Motor Inventory & Recommendations

		Existing Conditions									Proposed Conditions					Energy Impact & Financial Analysis						
Location	**Area(s)/System(s) Served**	**Motor Quantity**	**Motor Application**	**HP Per Motor**	**Full Load Efficiency**	**VFD Control?**	**Manufacturer**	**Model**	**Remaining Useful Life**	**Annual Operating Hours**	**ECM #**	**Install High Efficiency Motors?**	**Full Load Efficiency**	**Install VFDs?**	**Number of VFDs**	**Total Peak kW Savings**	**Total Annual kWh Savings**	**Total Annual MMBtu Savings**	**Total Annual Energy Cost Savings**	**Estimated M&L Cost ($)**	**Total Incentives**	**Simple Payback w/ Incentives in Years**
Boiler Room	Boiler	2	Combustion Air Fan	3.00	85.5%	No	Cleaver Brooks	5VA145TDR5906AB	B	800	7	No	85.5%	Yes	2	1.8	1,571	0	$282	$10,700	$400	36.5
Mechanical 3	Air Handling Unit	1	Supply Fan	7.40	91.7%	No			W	2,200	6	No	91.7%	Yes	1	2.1	4,967	0	$893	$7,400	$900	7.3
Theater 1	Air Handling Unit	2	Supply Fan	5.00	87.5%	No			B	2,200	6	No	89.5%	Yes	2	3.0	7,317	0	$1,316	$11,300	$1,800	7.2
Boiler Room	heating system	1	Boiler Feed Water Pump	0.50	77.0%	No	Marathon	5K36JN56	W	1,800		No	77.0%	No		0.0	0	0	$0	$0	$0	0.0
Boiler Room	heating system	1	Boiler Feed Water Pump	0.50	77.0%	No	WEG	23D1711	W	1,800		No	77.0%	No		0.0	0	0	$0	$0	$0	0.0
Boiler Room	heating system	1	Boiler Feed Water Pump	0.50	77.0%	No	Century	H155	W	50		No	77.0%	No		0.0	0	0	$0	$0	$0	0.0
Boiler Room	Steam Heat System	2	Air Compressor	2.00	78.0%	No	Baldor	M315776	B	730		No	78.0%	No		0.0	0	0	$0	$0	$0	0.0
Boiler storage	HHW system - Basement Floor Classrooms	2	Heating Hot Water Pump	0.50	78.2%	No	Bell & gossett	56A17D58F	W	2,555		No	78.2%	No		0.0	0	0	$0	$0	$0	0.0
Boiler Room	DHW system	1	DHW Circulation Pump	0.13	60.0%	No	Taco	0012-SF4	W	8,760		No	60.0%	No		0.0	0	0	$0	$0	$0	0.0
Storage - back hall	Ventilation	1	Exhaust Fan	0.50	77.0%	No			W	2,745		No	77.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical theater balcony, various	Ventilation	7	Exhaust Fan	0.50	77.0%	No	Marathon	5VD56T17D1071B	W	2,745	5	Yes	78.2%	No		0.0	107	0	$19	$3,400	$0	176.5
Roof - white	Ventilation	1	Exhaust Fan	0.50	77.0%	No			W	2,745		No	77.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof - white	Ventilation	1	Exhaust Fan	0.13	60.0%	No			W	2,745		No	60.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof, boiler room	Ventilation	1	Exhaust Fan	0.10	60.0%	No			W	2,745		No	60.0%	No		0.0	0	0	$0	$0	$0	0.0
Lobby A2	Lobby A2	2	Fan Coil Unit	0.10	65.0%	No			W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Office - 1A	Office - 1A	1	Fan Coil Unit	0.10	65.0%	No			W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Office - Library	Office - Library	1	Fan Coil Unit	0.10	65.0%	No			W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Restroom - Female 1	Restroom - Female 1	1	Fan Coil Unit	0.10	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Restroom - Male 1	Restroom - Male 1	1	Fan Coil Unit	0.10	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Restroom - Female 2	Restroom - Female 2	1	Fan Coil Unit	0.10	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0

		Existing Conditions									Proposed Conditions					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantit y	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
Restroom - Male 2	Restroom - Male 2	1	Fan Coil Unit	0.10	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Corridor B	Corridor B	3	Fan Coil Unit	0.10	65.0%	No			W	1,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
CST Room	CST Room	1	Supply Fan	0.25	69.5%	No			W	2,000		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Kitchen	Kitchen	1	Fan Coil Unit	0.10	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Room B3	Room B3	1	Supply Fan	0.25	69.5%	No			W	2,000		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Room B8	Room B8	1	Supply Fan	0.25	69.5%	No			W	2,000		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Room B9	Room B9	1	Supply Fan	0.25	69.5%	No			W	2,000		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Stairs C3	Stairs C3	1	Fan Coil Unit	0.10	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Stairs C5	Stairs C5	1	Fan Coil Unit	0.10	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Stairs gym B2	Stairs gym B2	1	Fan Coil Unit	0.10	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom 6	Classroom 6	1	Fan Coil Unit	0.08	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom 7	Classroom 7	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Computer Lab	Computer Lab	2	Fan Coil Unit	0.08	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Faculty Room	Faculty Room	1	Fan Coil Unit	0.08	65.0%	No			W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Media Center	Media Center	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Art Room	Art Room	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom 10	Classroom 10	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom 11	Classroom 11	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom 13	Classroom 13	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom 14	Classroom 14	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0

		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
Classroom 15	Classroom 15	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom 16	Classroom 16	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom 17	Classroom 17	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Speech/Language	Speech/Language	1	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Cafeteria #1	Cafeteria #1	4	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Cafeteria #2	Cafeteria #2	4	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom A1	Classroom A1	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom A2	Classroom A2	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom A3	Classroom A3	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom A4	Classroom A4	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom A5	Classroom A5	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom A6	Classroom A6	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Room B7 Music Room	Room B7 Music Room	2	Fan Coil Unit	0.08	65.0%	Yes			W	1,600		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior	ACCU-FN-1A.1B.2	6	Supply Fan	1.00	85.5%	No			W	150		No	85.5%	No		0.0	0	0	$0	$0	$0	0.0
Crawl Space	Building	1	Supply Fan	0.50	78.2%	No			W	200		No	78.2%	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
Exterior	Teacher's Work Room	1	Split-System	2.00		13.00		York	CZB02411A	B	8	Yes	1	Split-System	2.00		16.00		0.2	87	0	$16	$4,400	$200	269.9
Exterior	OT/PT, CST	2	Split-System	1.50		13.00		York	CZB01811A	B	8	Yes	2	Split-System	1.50		16.00		0.3	130	0	$23	$8,100	$300	334.2
Exterior, Roof	Classroom/Cafeteria Unit Ventilators	5	Split-System Air-Source HP	14.00	188.00	11.70	4.02 COP	Mitsubishi Electric Trane	TUHYP1683AN40AN	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior	SGI B8, B3	2	Split-System	1.50		13.00		York	CZB01811A	B	8	Yes	2	Split-System	1.50		16.00		0.3	104	0	$19	$8,100	$300	417.7
Exterior	Room B9	1	Split-System	5.00		16.00		Trane	4TTA7060A3000AB	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior	Theater wing AHUs, Gym	3	Split-System	15.00		14.00		Trane	TT418043CAA01AS01	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior	Office	1	Ductless Mini-Split AC	1.92		20.00		Friedrich	MR24C3E	B		No							0.0	0	0	$0	$0	$0	0.0
Exterior	Faculty Room	1	Ductless Mini-Split AC	1.50		16.00		Mitsubishi	unknown	B		No							0.0	0	0	$0	$0	$0	0.0
Exterior	Nurse's Office	1	Ductless Mini-Split HP	1.83	27.00	16.00	9 HSPF	Friedrich	MR24Y3J	W	9	Yes	1	Ductless Mini-Split HP	1.83	27.00	18.00	3.8 COP	0.9	306	0	$55	$4,500	$0	81.8
Exterior	Office	1	Ductless Mini-Split AC	1.42		18.00		Friedrich	MR18C3J	W		No							0.0	0	0	$0	$0	$0	0.0
Roof	Library	1	Ductless Mini-Split AC	2.57		16.50		Friedrich	MR30C3G	W		No							0.0	0	0	$0	$0	$0	0.0
Roof	Classrooms	1	Ductless Mini-Split HP	1.83	23.00	16.00	9 HSPF	Luxaire	DHP24CSB21S	W	9	Yes	1	Ductless Mini-Split HP	1.83	23.00	18.00	3.8 COP	0.7	309	0	$56	$4,500	$0	81.0
Roof	Classrooms	1	Ductless Mini-Split AC	1.83		20.00		Friedrich	MR24C3J	W		No							0.0	0	0	$0	$0	$0	0.0
Mechanical/Electrical Room	Mechanical/Electrical Room	1	Window AC	0.75		10.20		Frigidaire	FFPA1422U10	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
Boiler Room	Primary Heating System	2	Forced Draft Steam Boiler	3,225	Cleaver Brooks	CB700100015	B	10	Yes	2	Forced Draft Steam Boiler	3,225	81.00%	Et	0.0	0	100	$1,071	$160,400	$6,400	143.8

Pipe Insulation Recommendations

		Recommendation Inputs			Energy Impact & Financial Analysis						
Location	**Area(s)/System(s) Affected**	**ECM #**	**Length of Uninsulated Pipe (ft)**	**Pipe Diameter (in)**	**Total Peak kW Savings**	**Total Annual kWh Savings**	**Total Annual MMBtu Savings**	**Total Annual Energy Cost Savings**	**Estimated M&L Cost ($)**	**Total Incentives**	**Simple Payback w/ Incentives in Years**
Boiler Room	Steam Heating System	11	15	2.50	0.0	0	19	$205	$370	$30	1.7
Boiler Room	Boiler Feed Water	11	20	2.00	0.0	0	16	$176	$380	$40	1.9
Boiler Room	Heating System	11	10	1.50	0.0	0	7	$72	$190	$20	2.4
Boiler Room	DHW System	11	10	1.00	0.0	0	4	$47	$140	$20	2.5
Boiler Room	Boiler Feed Water	11	10	1.00	0.0	0	5	$49	$150	$20	2.7

DHW Inventory & Recommendations

		Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	**Area(s)/System(s) Served**	**System Quantity**	**System Type**	**Manufacturer**	**Model**	**Remaining Useful Life**	**ECM #**	**Replace?**	**System Quantity**	**System Type**	**Fuel Type**	**System Efficiency**	**Efficiency Units**	**Total Peak kW Savings**	**Total Annual kWh Savings**	**Total Annual MMBtu Savings**	**Total Annual Energy Cost Savings**	**Estimated M&L Cost ($)**	**Total Incentives**	**Simple Payback w/ Incentives in Years**
Boiler room	DHW - entire building	1	Storage Tank Water Heater (≤ 50 Gal)	Bradford White Corporation	RG250H6N	N		No						0.0	0	0	$0	$0	$0	0.0

Low-Flow Device Recommendations

	Recommedation 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**
Faculty Room	12	1	Faucet Aerator (Kitchen)	2.20	1.50	0.0	0	0	$4	$10	$0	2.4
Art Storage	12	1	Faucet Aerator (Kitchen)	2.20	1.50	0.0	0	0	$2	$10	$0	4.8
Restroom - Library	12	1	Faucet Aerator (Lavatory)	1.20	0.50	0.0	0	0	$2	$10	$0	4.8
Restroom - Male 1	12	1	Faucet Aerator (Lavatory)	1.50	0.50	0.0	0	0	$3	$10	$0	3.3
Restroom - Nurse	12	1	Faucet Aerator (Lavatory)	2.00	0.50	0.0	0	1	$9	$10	$0	1.1
Restroom- Faculty Room	12	1	Faucet Aerator (Lavatory)	1.50	0.50	0.0	0	0	$3	$10	$0	3.3
Restroom - Female 2	12	2	Faucet Aerator (Lavatory)	1.50	0.50	0.0	0	1	$6	$20	$10	1.7

Cooking Equipment Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	Manufacturer	Model	High Efficiency Equipement?	ECM #	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Insulated Food Holding Cabinet (Full Size)	Metro	C5HLE010909	No		No	0.0	0	0	$0	$0	$0	0.0

Plug Load Inventory

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Faculty Room	1	Coffee Machine	800	No		
Mechanical B8	1	Dehumidifier	200	No		
Room B7 Music Room	1	Dehumidifier	200	No		
Room B9	1	Dehumidifier	200	No		
Classroom 7	1	Desktop	220	No		
Conference 1	1	Desktop	220	No		
Media Center	2	Desktop	220	No		
Office - Main	1	Desktop	220	No		
Office - Main (1)	1	Desktop	220	No		
Office - Nurse	1	Desktop	220	No		
Art Room	1	Desktop	220	No		
Classroom 10	1	Desktop	220	No		
Classroom 11	1	Desktop	220	No		
Classroom 13	1	Desktop	220	No		
Classroom 14	1	Desktop	220	No		
Classroom 15	1	Desktop	220	No		
Classroom 16	1	Desktop	220	No		
Classroom 17	1	Desktop	220	No		
Boiler Room	1	Desktop	220	No		
Classroom A2	1	Desktop	220	No		
Classroom A3	1	Desktop	220	No		
Classroom A4	1	Desktop	220	No		
Classroom A5	1	Desktop	220	No		
Classroom A6	1	Desktop	220	No		
Classrooms, Caferterias	22	Wall Fan	20	No	Rin King	Various
Mechanical/Electrical	1	Kiln	5,550	No		
Various	10	Laptop Charging Cart	1,440	No	Dell	
Faculty Room	1	Microwave	1,500	No		
Boiler Room	1	Microwave	1,500	No		
Kitchen	1	Microwave	1,500	No		
Various	2	Server Equipment	800	No		
Classrooms, Offices	13	Air purifier	120	No		
Classrooms, Offices	10	Air purifier - mini	68	No		
Kitchen	1	Electric range	1,500	No	Fridgeaire	
Office - Main	1	Paper Shredder	220	No		

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Office - 1A	1	Printer/Copier (Large)	800	No		
Office - Main	1	Printer/Copier (Large)	800	No		
Art Storages	1	Printer/Copier (Large)	800	No		
Classroom 6	1	Projector	220	No		
Classroom 7	2	Projector	220	No		
Computer Lab	1	Projector	220	No		
Media Center	1	Projector	220	No		
Art Room	1	Projector	220	No		
Classroom 10	1	Projector	220	No		
Classroom 11	1	Projector	220	No		
Classroom 13	1	Projector	220	No		
Classroom 14	1	Projector	220	No		
Classroom 15	1	Projector	220	No		
Classroom 16	1	Projector	220	No		
Classroom 17	1	Projector	220	No		
Cafeteria #1	1	Projector	220	No		
Cafeteria #2	1	Projector	220	No		
Classroom A1	1	Projector	220	No		
Classroom A2	1	Projector	220	No		
Classroom A3	1	Projector	220	No		
Classroom A4	1	Projector	220	No		
Classroom A5	1	Projector	220	No		
Classroom A6	1	Projector	220	No		
Room B7 Music Room	1	Projector	220	No		
Room B8	1	Projector	220	No		
Office - Nurse	1	Refrigerator (Mini)	180	No		
Boiler Room	1	Refrigerator (Mini)	180	No		
Faculty Room	1	Refrigerator (Residential)	380	No		
Kitchen	1	Refrigerator (Residential)	380	No		
Media Center	1	Smart Board	75	No		
Classroom A2	1	Smart Board	75	No		
Classroom A3	1	Smart Board	75	No		
Classroom A4	1	Smart Board	75	No		
Classroom A5	1	Smart Board	75	No		
Classroom A6	1	Smart Board	75	No		

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Room B7 Music Room	1	Smart Board	75	No		
Media Center	1	Television	200	No		
Office - Main	1	Television	150	No		
Faculty Room	1	Toaster	1,000	No		
Boiler Room	1	Toaster Oven	1,500	No		
Corridor 1	1	Water Fountain	115	No	Elkay	
Corridor 2	1	Water Fountain	115	No	Elkay	
Corridor A	1	Water Fountain	200	No	Elkay	
Corridor B	2	Water Fountain	200	No	Elkay	

Appendix B: ENERGY STAR Statement of Energy Performance

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

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ENERGY STAR® Statement of Energy Performance

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ENERGY STAR® Score[1]

F.N. Brown Elementary

Primary Property Type: K-12 School
Gross Floor Area (ft²): 38,985
Built: 1931

For Year Ending: February 28, 2023
Date Generated: February 02, 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
F.N. Brown Elementary 125 Grove Avenue Verona, New Jersey 07044	Verona Board of Education 121 Fairview Avenue Verona, NJ 07044 (973) 571-2029	Henry Bottiglierie, CEFM 121 Fairview Avenue Verona, NJ 07044 (973) 571-2029 hbottiglierie@veronaschools.org

Property ID: 30587125

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
84.4 kBtu/ft²

Source EUI
114.1 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	567,108 (17%)
Natural Gas (kBtu)	2,724,166 (83%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	70.7
National Median Source EUI (kBtu/ft²)	95.6
% Diff from National Median Source EUI	19%

Annual Emissions

Total (Location-Based) GHG Emissions (Metric Tons CO2e/year)	196

Signature & Stamp of Verifying Professional

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

LP Signature: ______________________ Date: ___________

Licensed Professional

____ ________
,
(____)____-______
____

Professional Engineer or Registered Architect Stamp
(if applicable)

APPENDIX C: GLOSSARY

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

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

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