Local Government Energy Audit Report

Sussex Avenue Elementary

August 8, 2024

Prepared for:
Morris School District BOE
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Morristown, New Jersey 07950

Prepared by:
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Disclaimer

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

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

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

Incentive values provided in this report are estimated based 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.

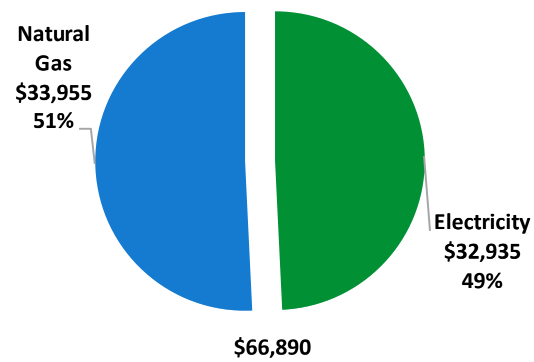
The customer and their respective contractor(s) are responsible to implement energy conservation measures in complete conformance with all applicable local, state, and federal requirements.

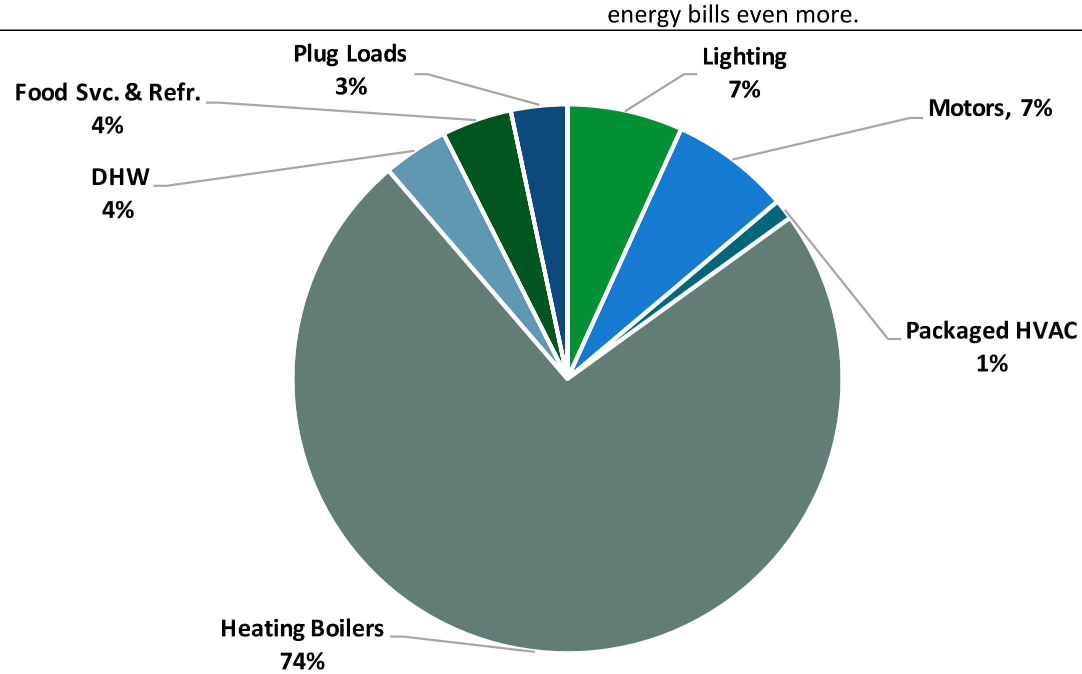
Table of Contents

1 Executive Summary

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Sussex Avenue 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: $66,890 Electricity: 232,211 kWh Natural Gas: 27,335 Therms Water: 463,566 Gallons	
ENERGY STAR® Benchmarking Score	55 *(1-100 scale)*	Congratulations, your building performs better than the national average. This report has suggestions about how to keep your building running efficiently, further improve performance, and lower your energy bills even more.



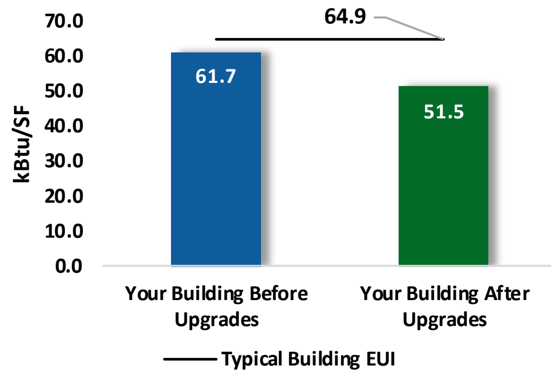
Energy Use by System

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.

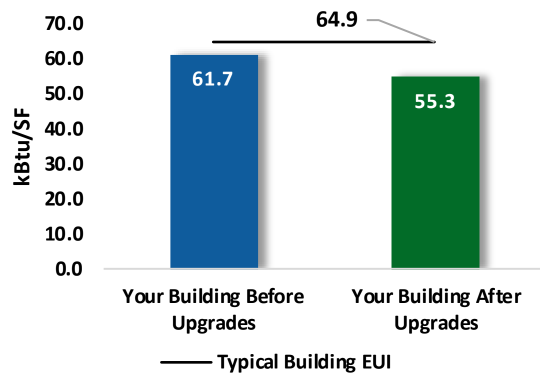
Scenario 1: Full Package (All Evaluated Measures)

Installation Cost	$140,310
Potential Rebates & Incentives[1]	$11,720
Annual Cost Savings	$13,183
Annual Energy Savings	Electricity: 59,708 kWh Natural Gas: 3,795 Therms
Greenhouse Gas Emission Savings	52 Tons
Simple Payback	9.8 Years
Site Energy Savings (All Utilities)	17%



Scenario 2: Cost Effective Package[2]

Installation Cost	$94,910
Potential Rebates & Incentives	$10,520
Annual Cost Savings	$10,351
Annual Energy Savings	Electricity: 58,453 kWh Natural Gas: 1,659 Therms
Greenhouse Gas Emission Savings	39 Tons
Simple Payback	8.2 Years
Site Energy Savings (all utilities)	10%



On-site Generation Potential

Photovoltaic	High
Combined Heat and Power	None

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

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

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**13,862**	**0.1**	**0**	**$1,964**	**$13,390**	**$1,180**	**$12,210**	**6.2**	**13,937**
ECM 1	Install LED Fixtures	Yes	13,046	0.0	0	$1,850	$12,900	$1,100	$11,800	6.4	13,137
ECM 2	Retrofit Fixtures with LED Lamps	Yes	816	0.1	0	$113	$490	$80	$410	3.6	800
Lighting Control Measures			**13,914**	**2.9**	**-3**	**$1,934**	**$22,560**	**$5,730**	**$16,830**	**8.7**	**13,636**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	10,419	2.3	-2	$1,448	$16,830	$1,980	$14,850	10.3	10,212
ECM 4	Install Daylight Dimming Controls	Yes	919	0.2	0	$128	$1,230	$1,120	$110	0.9	900
ECM 5	Install High/Low Lighting Controls	Yes	2,576	0.3	-1	$358	$4,500	$2,630	$1,870	5.2	2,524
Variable Frequency Drive (VFD) Measures			**26,657**	**8.9**	**0**	**$3,781**	**$34,300**	**$3,500**	**$30,800**	**8.1**	**26,844**
ECM 6	Install VFDs on Constant Volume (CV) Fans	Yes	26,657	8.9	0	$3,781	$34,300	$3,500	$30,800	8.1	26,844
Unitary HVAC Measures			**254**	**0.3**	**0**	**$36**	**$2,900**	**$0**	**$2,900**	**80.4**	**256**
ECM 7	Install High Efficiency Air Conditioning Units	No	254	0.3	0	$36	$2,900	$0	$2,900	80.4	256
HVAC System Improvements			**0**	**0.0**	**121**	**$1,506**	**$19,500**	**$0**	**$19,500**	**13.0**	**14,191**
ECM 8	Install Programmable Thermostats	No	0	0.0	88	$1,089	$15,100	$0	$15,100	13.9	10,263
ECM 9	Implement Demand Control Ventilation (DCV)	Yes	0	0.0	34	$417	$4,400	$0	$4,400	10.6	3,928
Domestic Water Heating Upgrade			**417**	**0.0**	**7**	**$144**	**$260**	**$110**	**$150**	**1.0**	**1,218**
ECM 10	Install Low-Flow DHW Devices	Yes	417	0.0	7	$144	$260	$110	$150	1.0	1,218
Food Service & Refrigeration Measures			**12,818**	**1.5**	**0**	**$1,818**	**$22,000**	**$1,200**	**$20,800**	**11.4**	**12,907**
ECM 11	Replace Refrigeration Equipment	No	12,818	1.5	0	$1,818	$22,000	$1,200	$20,800	11.4	12,907
Custom Measures			**-8,214**	**0.0**	**255**	**$2,001**	**$25,400**	**$0**	**$25,400**	**12.7**	**21,575**
ECM 12	Retro-Commissioning Study	Yes	3,603	0.0	129	$2,112	$20,000	$0	$20,000	9.5	18,721
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater***	No	-11,817	0.0	126	-$111	$5,400	$0	$5,400	-48.6	2,853
TOTALS (COST EFFECTIVE MEASURES)			**58,453**	**11.9**	**166**	**$10,351**	**$94,910**	**$10,520**	**$84,390**	**8.2**	**78,284**
TOTALS (ALL MEASURES)			**59,708**	**13.7**	**380**	**$13,183**	**$140,310**	**$11,720**	**$128,590**	**9.8**	**104,564**

* - 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 4.8

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 Sussex Avenue 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 February 22, 2024, TRC performed an energy audit at Sussex Avenue Elementary located in Morristown, New Jersey. TRC met with Alfred Rapa to review the facility operations and help focus our investigation on specific energy-using systems.

The Sussex Avenue Elementary is a two-story, 57,180 square foot building built in 1954. Spaces include classrooms, gymnasium, multipurpose room, offices, corridors, stairwells, kitchen, and mechanical space.

Lighting for the facility is primarily provided by linear LED tube fixtures. Cooling in certain offices and classrooms is provided by window air conditioners, while heating is supplied by steam boilers. The roof was replaced around 2010. The site is interested in upgrading the controls for the HVAC system, which is mostly pneumatically controlled. Additionally, there are plans to add a new elevator to the building.

2.2 Building Occupancy

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

The school is fully occupied from September through June. Typical weekday occupancy is 80 staff and 300 students. During the summer, occupancy primarily involves ongoing maintenance tasks and limited use of office space, with a few summer classes being held.

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

Building Occupancy Schedule

2.3 Building Envelope

The walls are made of brick over structural steel with a painted CMU interior finish. The flat roof is supported by steel trusses and a reinforced concrete deck. It is finished with a built-up aggregate roof with a gravel pebble finish. The roof encloses a plenum area with conditioned space below a drop ceiling. Most of the windows are double paned with aluminum frames that have a thermal break. The seals between the glass and frames are in fair condition. The operable window weather seals are also in fair condition and show no signs of excessive wear. Exterior doors are made from FRP composite material with aluminum frames. They are in fair condition with undamaged door seals. Degraded window and door seals can lead to increased drafts and outside air infiltration.

Building Envelope

Building Doors

Typical Windows

Typical Windows

Building Envelope

Typical Doors

Roof

Building Envelope with Windows

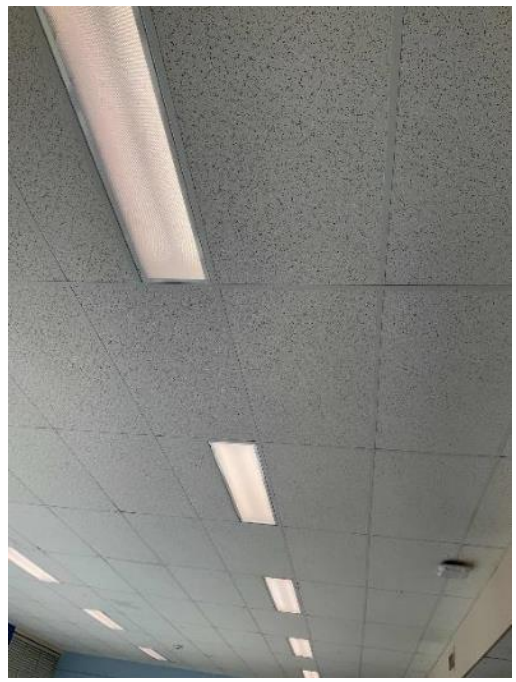
2.4 Lighting Systems

The primary interior lighting system uses LED linear T8 equivalent tubes. There are also several general-purpose screw-in LED lamps around the building. Fixture types include 1-lamp, 2-lamp, 3-lamp, and 4-lamp, 4-foot-long recessed fixtures U-bend, and linear tube lamps.

Most linear fixtures have been replaced with LED tube lamps, except for a few in the mechanical room. Some incandescent lamps are also found in the gymnasium, girl's locker room, and main office closet. The gymnasium fixtures have occupancy-controlled high-bay linear LED lamps, and all exit signs feature LED lighting.

Most fixtures are in fair condition, and interior lighting levels are generally sufficient. The gymnasium area's lighting fixtures are regulated by occupancy sensors, while wall switches control other areas, such as classrooms and corridors.

LED Linear Tube Fixture



LED Linear Tube Fixture

LED High Bay Fixture

LED Lamp

Incandescent Lamp | *Linear Fluorescent Fixture*

Exterior fixtures include wall packs and floodlights, which use a mix of high-intensity discharge (HID) and LED lamps, as well as HID flood lamps.

Most exterior light fixtures are controlled by photocells.

Exterior HID Fixture | *Exterior HID Fixture*

Exterior LED Fixture

Exterior LED Fixture

2.5 Air Handling Systems

Unitary Electric HVAC Equipment

Some classrooms, library, main office, and nurse's office are cooled by window air conditioning (AC) units. These units have capacities ranging from 10,000 Btu to 28,000 Btu and are in good condition. Their efficiencies range from 8.5 EER to 11 EER. Most units are still within their useful lifes, in fair condition, and standard efficiency. The newer systems are operated using remote control units located within the space, while the older window air conditioners have manual controls with rotary knobs to control the temperature and fan speed of the air conditioner.

Typical Classroom Window AC

Main Office Window AC

Unitary Heating Equipment

Most classrooms use baseboard steam heaters, while the kitchen has a few steam-powered, ceiling-hung unit heaters of different capacities. The units are in fair condition and are locally controlled.

The heating side of these systems is described in Section 2.6

The HVAC system is pneumatically controlled. A 3/4 hp air compressor located in the mechanical room serves the pneumatic system. During the audit, it was observed that the air compressor was set at a pressure of 100 PSI and was vibrating excessively. Please see Section 5 for more information on compressors and best practices. No air leaks were observed during the inspection.

Unit Heater

Baseboard Steam Heater

Air Handling Units (AHUs)

In the school, there are four air handling units (AHUs) mainly used for heating and exchanging air. These units serve the kitchen, corridors, classrooms, and gymnasium. Each unit has a supply fan motor and a steam heating coil. The gymnasium units also have return motors. The size of the supply fan motors varies across different air handling units. The AHU located in the kitchen has an estimated supply fan motor size of 3 hp, while the one in the storage closet has a supply fan motor size of 5 hp. Additionally, the two AHUs located in the gym area have a supply fan motor size of 7.5 hp and a return fan motor size of 3 hp. All units operate at a constant speed and have standard efficiency. According to facility personnel, these fan motors run continuously.

The heating coil is supplied by a steam boiler, which will be discussed in the following section.

Air Handling Unit - Kitchen Area

Air Handling Unit - Storage Room

2.6 Heating Steam Systems

Two A.O. Smith 3,033 MBh input steam boilers serve the building's heating load. The burners modulate with a 4:1 turndown ratio and operate with a nominal efficiency of 82%. The boilers are configured in a lead-lag control scheme. Both boilers are required under high-load conditions. Installed in 2017, they are in good condition. The facility regularly tests the air-fuel ratio with combustion tests and tunes the boilers for maximum efficiency.

The building's heating terminals are served by a steam distribution system with baseboard heating. The mechanical room houses three fractional horsepower boiler feed pumps and two, 1.5 hp condensate return pumps. Most of the insulation for the steam supply and condensate return is in good condition. The steam traps are changed and repaired as needed. The controls for heating the classrooms and other areas are pneumatically controlled. During the audit, the steam pressure setpoint was 5 PSI.

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

Steam Boiler

Feed Water and Condensate Return Loop

Steam Boilers

Feed Water Pumps

2.7 Building Automation System (BAS)

The HVAC system is remotely managed by a third party, Energy for America. Energy for America controls occupied and unoccupied temperature setpoints, as well as equipment operating times (including AHUs, and boilers). Classrooms and similar spaces are scheduled based upon occupancy, while areas like the cafeteria, gymnasium, and multipurpose room are scheduled based upon both typical occupancy and events. According to staff, Energy for America's control functions are not accessible to local staff.

The mechanical room has a 0.75-hp compressor set at around 100 PSI, dedicated to the pneumatic system. The site staff are interested in expanding the control provided by the BAS. Retro-commissioning of the BAS system has been evaluated and is recommended. Whether or not to replace remaining pneumatic controls with solid state systems should be considered. System upgrade planning and retro-commissioning activities should be coordinated among the various stakeholder parties.

Honeywell Control System

Air Compressor- Pneumatic system

2.8 Domestic Hot Water

Hot water is produced by an A.O. Smith 119-gallon, 300 MBh gas-fired storage water heater. The water heater was manufactured in 2017 and is ENERGY STAR-rated. Additionally, there is an A.O. Smith electric storage water heater located in the custodial closet.

During the site visit, the domestic water heaters were set at 130°F.

Domestic hot water is recirculated from end uses through 1/12 horsepower recirculation pumps that operate continuously. The domestic hot water pipes are insulated, and the insulation is in fair condition.

Gas Fired Storage Tank Heater

Operating Set Point DHW

Electric Storage Water Tank Heater

DHW Circulation Pumps

2.9 Food Service Equipment

The kitchen has a combination of gas and electric appliances used for preparing breakfast and lunch for students. Most of the cooking is done using a gas-fired oven and an electric oven. Non-insulated electric holding cabinets are used for storing bulk prepared foods. The equipment is in fair condition and not high efficiency.

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

Gas-fired Cooktop/Oven

Convection Oven (Full Size)

Non-Insulated Food Holding Cabinet

2.10 Refrigeration

The kitchen has several stand-up refrigerators with either solid or glass doors. There is a freezer chest as well as a refrigerator chest. Some of the equipment is ENERGY STAR rated and is in fair condition. This report makes additional suggestions for ECMs in this area as well as energy efficient best practices.

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

Stand-Up Solid Door Refrigerators

Stand-Up Solid Door Freezer

Stand-Up Glass Door Refrigerator

Stand-Up Solid Door Refrigerator

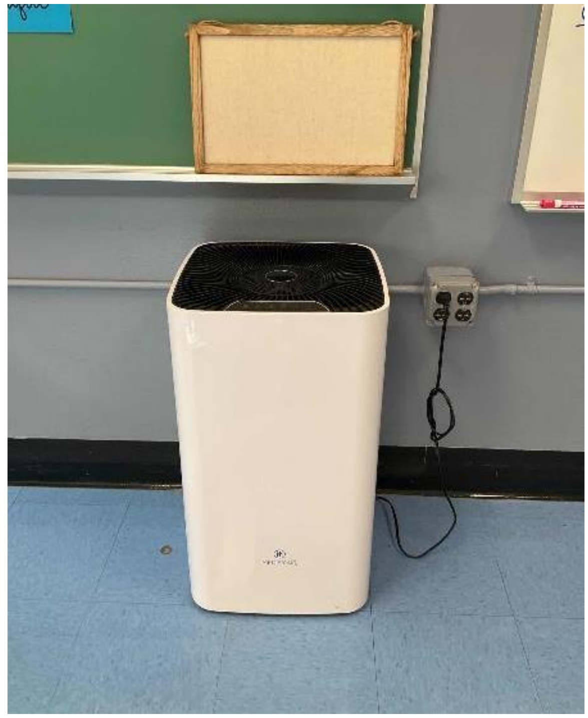
2.11 Plug Load and Vending Machines

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

There are also a few residential-style refrigerators throughout the building that are used to store food. These vary in condition and efficiency.

Printer/Copier



Air Purifier

Smartboard

Typical Plug Loads

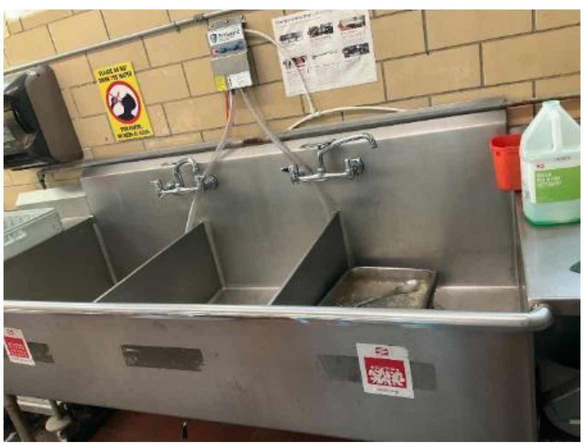
Serving Table

Residential-style Refrigerator

2.12 Water-Using Systems

Water is provided by a municipal water supply company. Water is mainly used for drinking, cleaning, cooking, landscaping, and sanitary fixtures. Water leaks were not observed.

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



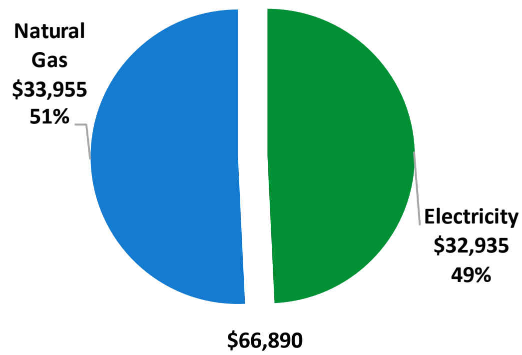
Typical Kitchen Faucet

Typical Restroom Faucets

3 Energy and Water Use and Costs

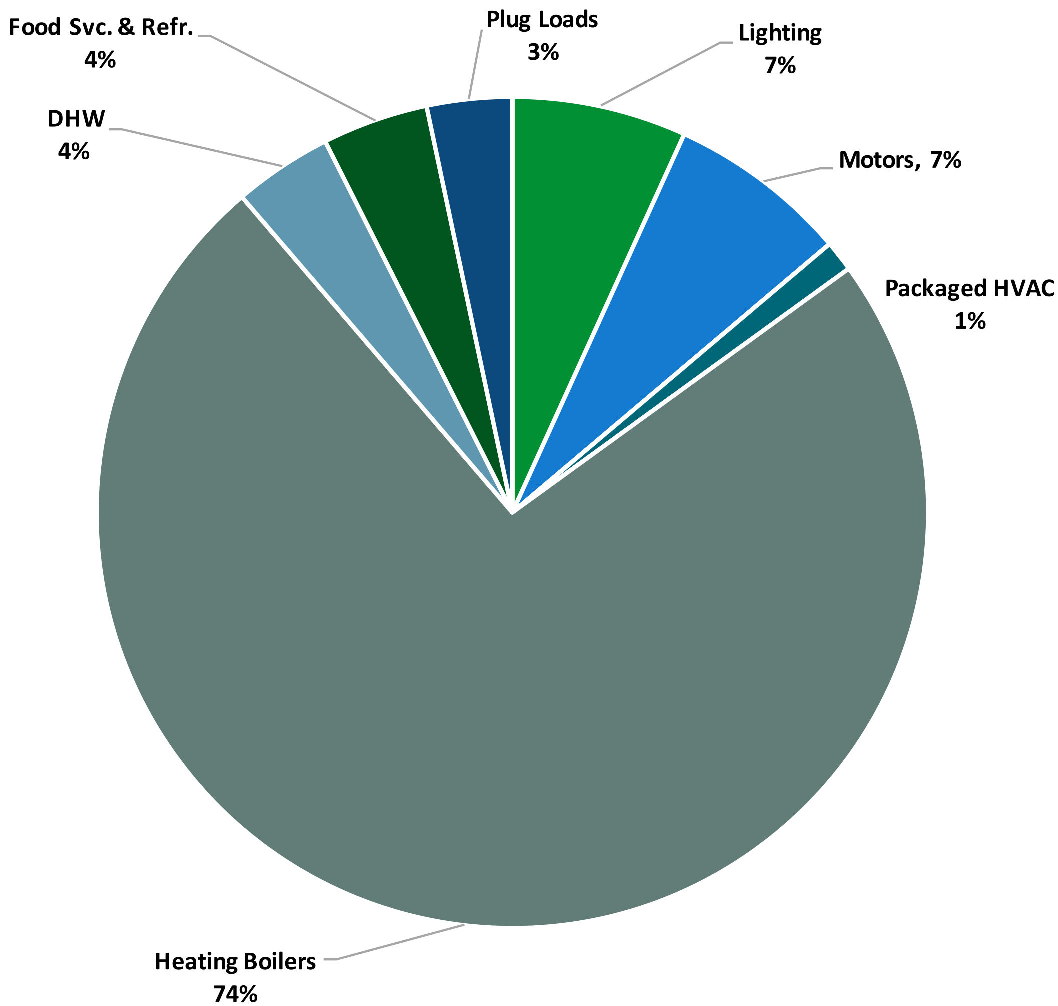
Twelve months of utility billing data are used to develop annual energy consumption and cost data. This information creates a profile of the annual energy consumption and energy costs.

Utility Summary		
Fuel	**Usage**	**Cost**
Electricity	232,211 kWh	$32,935
Natural Gas	27,335 Therms	$33,955
Total		**$66,890**



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

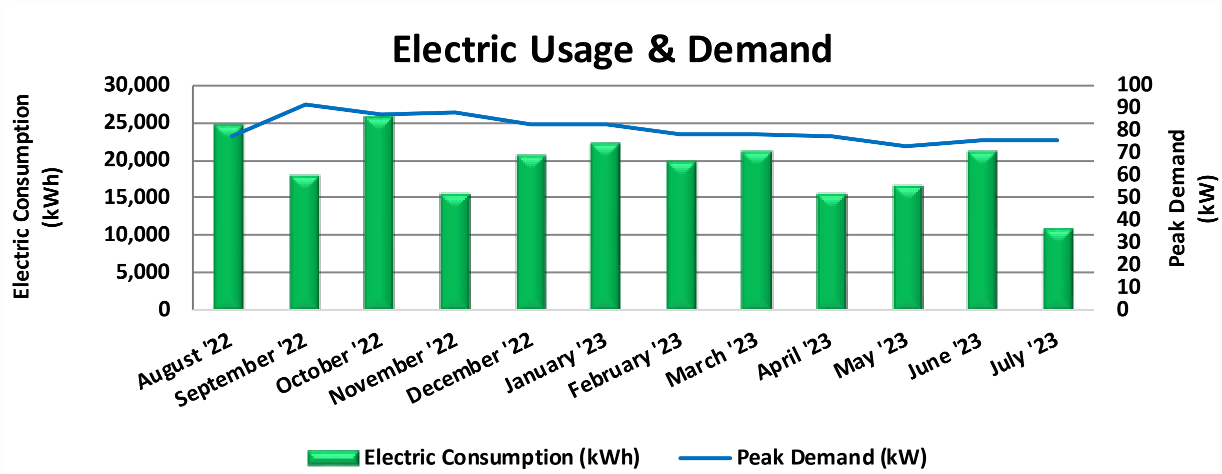
The energy auditor collects information regarding equipment operating hours, capacity, efficiency, and other operational parameters from facility staff, drawings, and on-site observations. This information is used as the inputs to calculate the existing conditions energy use for the site. The calculated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



Energy Balance by System

3.1 Electricity

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



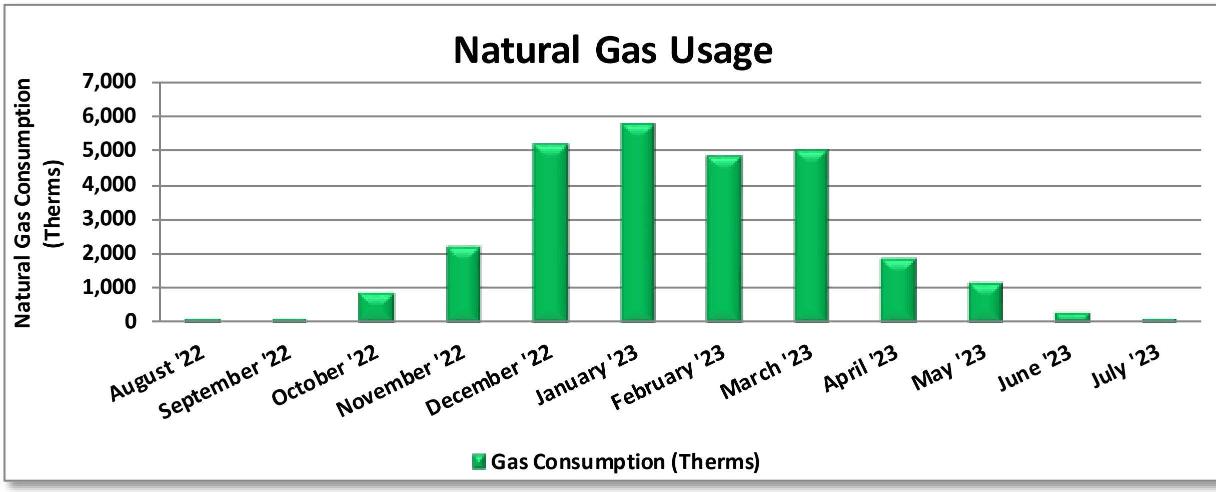
Electric Billing Data					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
8/19/22	30	24,456	77	$408	$2,962
9/20/22	32	18,028	92	$526	$2,680
10/19/22	29	25,778	88	$461	$3,458
11/17/22	29	15,406	88	$464	$2,383
12/17/22	30	20,487	83	$427	$2,872
1/19/23	33	22,284	83	$427	$3,054
2/16/23	28	19,841	79	$395	$2,769
3/20/23	32	21,001	79	$395	$2,916
4/18/23	29	15,640	78	$389	$2,349
5/17/23	29	16,565	73	$356	$2,409
6/16/23	30	21,023	76	$479	$3,028
7/19/23	33	11,066	76	$479	$1,964
Totals	**364**	**231,575**	**92**	**$5,207**	**$32,845**
Annual	**365**	**232,211**	**92**	**$5,221**	**$32,935**

Notes:

- Peak demand of 92 kW occurred in September '22.
- Average demand over the past 12 months was 81 kW.
- The average electric cost over the past 12 months was $0.142/kWh, which is the blended rate that includes energy supply, distribution, demand, and other charges. This report uses this blended rate to estimate energy cost savings.

3.2 Natural Gas

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



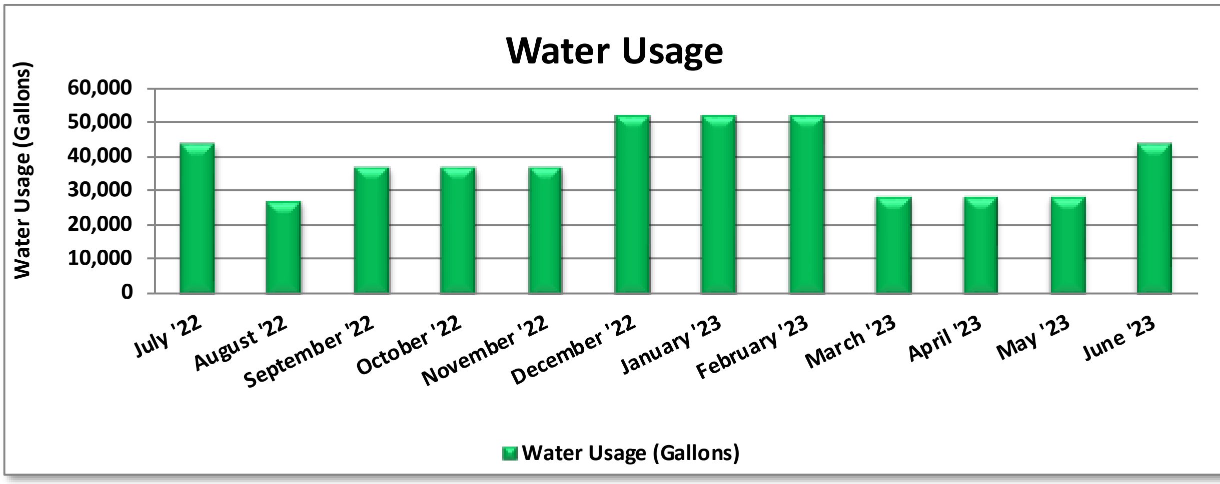
Gas Billing Data			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
8/18/22	29	105	$311
9/19/22	32	119	$321
10/18/22	29	876	$1,195
11/16/22	29	2,222	$3,488
12/19/22	33	5,172	$6,745
1/20/23	32	5,754	$7,392
2/17/23	28	4,812	$5,688
3/21/23	32	5,007	$5,596
4/20/23	30	1,839	$1,662
5/19/23	29	1,128	$1,034
6/21/23	33	264	$356
7/21/23	30	114	$260
Totals	**366**	**27,409**	**$34,048**
Annual	**365**	**27,335**	**$33,955**

Notes:

- The average gas cost for the past 12 months is $1.242/therm, which is the blended rate used throughout the analysis.

3.3 Water

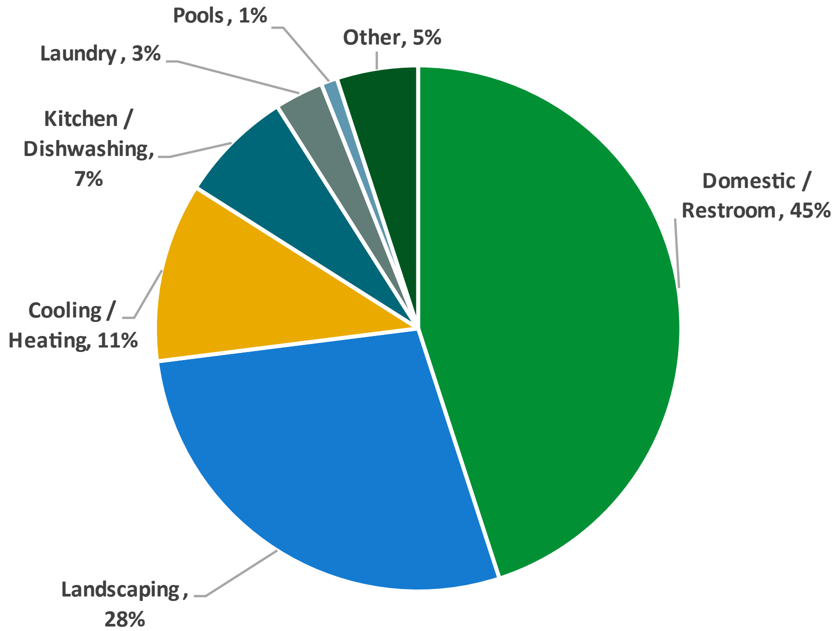
Southeast Morris County Municipal Utilities Authority delivers water to the project site.



Water Billing Data			
Period Ending	**Days in Period**	**Water Usage (gallons)**	**Water Cost**
8/1/22	30	43,387	$653
9/1/22	31	26,930	$1,003
10/1/22	30	36,655	$397
11/1/22	31	36,655	$397
12/1/22	30	36,655	$397
1/1/23	31	51,616	$584
2/1/23	31	51,616	$584
3/1/23	28	51,616	$584
4/1/23	31	27,927	$396
5/1/23	30	27,927	$396
6/1/23	31	27,927	$396
7/1/23	30	43,387	$653
Totals	**364**	**462,296**	**$6,441**
Annual	**365**	**463,566**	**$6,459**

Notes:

- The average cost of water for the past 12 months is $0.0139/gal.



Typical Education Water End Use[4]

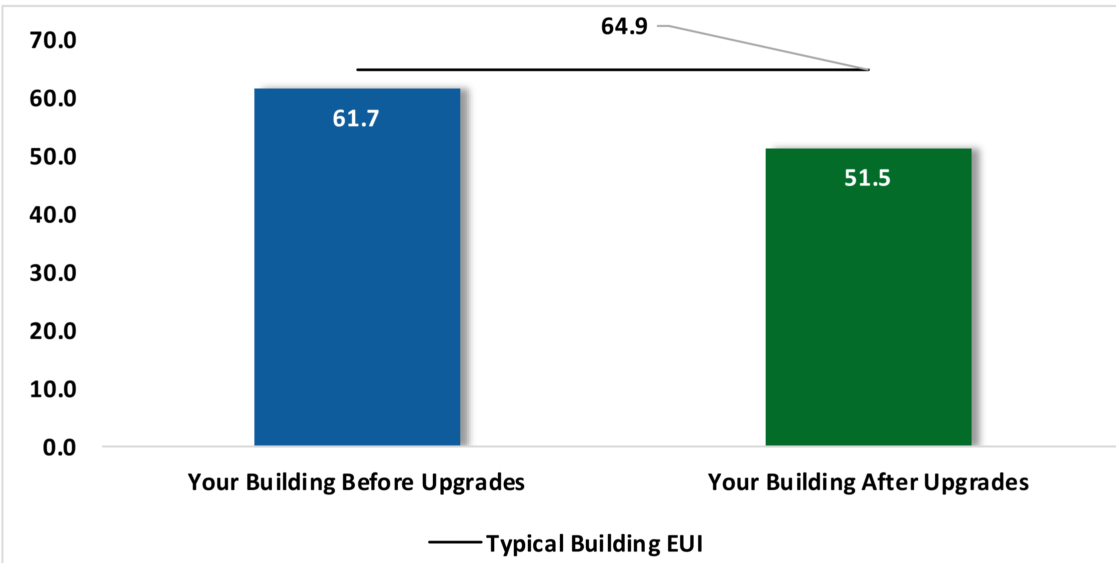
[4] Chart is of typical water end use and not specific to the facility.

3.4 Benchmarking

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

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

Benchmarking Score	55

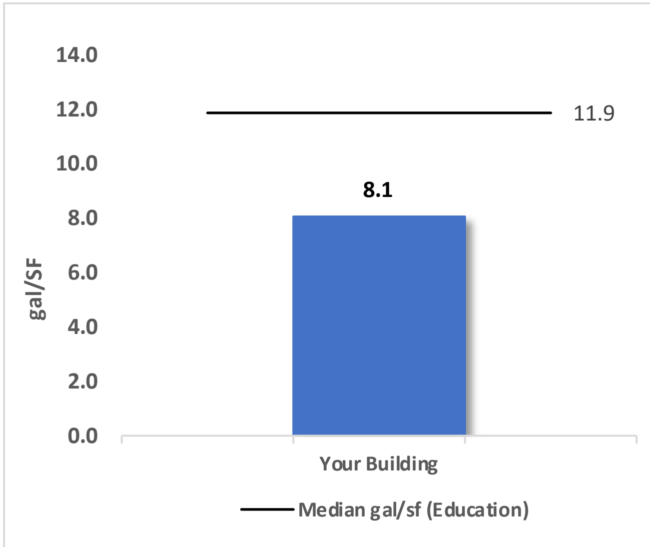


Energy Use Intensity Comparison[5]

Congratulations, your building performs better than the national average. This report has suggestions about how to keep your building running efficiently, further improve performance, and lower your energy bills even more.

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

[5] Based on all evaluated ECMs



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

Tracking your Energy Performance

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

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

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

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

3.5 Understanding Your Utility Bills

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

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

Why Utility Bills Vary

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

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

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

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

4 Energy Conservation Measures

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

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

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

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

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

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**13,862**	**0.1**	**0**	**$1,964**	**$13,390**	**$1,180**	**$12,210**	**6.2**	**13,937**
ECM 1	Install LED Fixtures	Yes	13,046	0.0	0	$1,850	$12,900	$1,100	$11,800	6.4	13,137
ECM 2	Retrofit Fixtures with LED Lamps	Yes	816	0.1	0	$113	$490	$80	$410	3.6	800
Lighting Control Measures			**13,914**	**2.9**	**-3**	**$1,934**	**$22,560**	**$5,730**	**$16,830**	**8.7**	**13,636**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	10,419	2.3	-2	$1,448	$16,830	$1,980	$14,850	10.3	10,212
ECM 4	Install Daylight Dimming Controls	Yes	919	0.2	0	$128	$1,230	$1,120	$110	0.9	900
ECM 5	Install High/Low Lighting Controls	Yes	2,576	0.3	-1	$358	$4,500	$2,630	$1,870	5.2	2,524
Variable Frequency Drive (VFD) Measures			**26,657**	**8.9**	**0**	**$3,781**	**$34,300**	**$3,500**	**$30,800**	**8.1**	**26,844**
ECM 6	Install VFDs on Constant Volume (CV) Fans	Yes	26,657	8.9	0	$3,781	$34,300	$3,500	$30,800	8.1	26,844
Unitary HVAC Measures			**254**	**0.3**	**0**	**$36**	**$2,900**	**$0**	**$2,900**	**80.4**	**256**
ECM 7	Install High Efficiency Air Conditioning Units	No	254	0.3	0	$36	$2,900	$0	$2,900	80.4	256
HVAC System Improvements			**0**	**0.0**	**121**	**$1,506**	**$19,500**	**$0**	**$19,500**	**13.0**	**14,191**
ECM 8	Install Programmable Thermostats	No	0	0.0	88	$1,089	$15,100	$0	$15,100	13.9	10,263
ECM 9	Implement Demand Control Ventilation (DCV)	Yes	0	0.0	34	$417	$4,400	$0	$4,400	10.6	3,928
Domestic Water Heating Upgrade			**417**	**0.0**	**7**	**$144**	**$260**	**$110**	**$150**	**1.0**	**1,218**
ECM 10	Install Low-Flow DHW Devices	Yes	417	0.0	7	$144	$260	$110	$150	1.0	1,218
Food Service & Refrigeration Measures			**12,818**	**1.5**	**0**	**$1,818**	**$22,000**	**$1,200**	**$20,800**	**11.4**	**12,907**
ECM 11	Replace Refrigeration Equipment	No	12,818	1.5	0	$1,818	$22,000	$1,200	$20,800	11.4	12,907
Custom Measures			**-8,214**	**0.0**	**255**	**$2,001**	**$25,400**	**$0**	**$25,400**	**12.7**	**21,575**
ECM 12	Retro-Commissioning Study	Yes	3,603	0.0	129	$2,112	$20,000	$0	$20,000	9.5	18,721
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater***	No	-11,817	0.0	126	-$111	$5,400	$0	$5,400	-48.6	2,853
TOTALS			**59,708**	**13.7**	**380**	**$13,183**	**$140,310**	**$11,720**	**$128,590**	**9.8**	**104,564**

* - 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 4.8

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		**13,862**	**0.1**	**0**	**$1,964**	**$13,390**	**$1,180**	**$12,210**	**6.2**	**13,937**
ECM 1	Install LED Fixtures	13,046	0.0	0	$1,850	$12,900	$1,100	$11,800	6.4	13,137
ECM 2	Retrofit Fixtures with LED Lamps	816	0.1	0	$113	$490	$80	$410	3.6	800
Lighting Control Measures		**13,914**	**2.9**	**-3**	**$1,934**	**$22,560**	**$5,730**	**$16,830**	**8.7**	**13,636**
ECM 3	Install Occupancy Sensor Lighting Controls	10,419	2.3	-2	$1,448	$16,830	$1,980	$14,850	10.3	10,212
ECM 4	Install Daylight Dimming Controls	919	0.2	0	$128	$1,230	$1,120	$110	0.9	900
ECM 5	Install High/Low Lighting Controls	2,576	0.3	-1	$358	$4,500	$2,630	$1,870	5.2	2,524
Variable Frequency Drive (VFD) Measures		**26,657**	**8.9**	**0**	**$3,781**	**$34,300**	**$3,500**	**$30,800**	**8.1**	**26,844**
ECM 6	Install VFDs on Constant Volume (CV) Fans	26,657	8.9	0	$3,781	$34,300	$3,500	$30,800	8.1	26,844
HVAC System Improvements		**0**	**0.0**	**34**	**$417**	**$4,400**	**$0**	**$4,400**	**10.6**	**3,928**
ECM 9	Implement Demand Control Ventilation (DCV)	0	0.0	34	$417	$4,400	$0	$4,400	10.6	3,928
Domestic Water Heating Upgrade		**417**	**0.0**	**7**	**$144**	**$260**	**$110**	**$150**	**1.0**	**1,218**
ECM 10	Install Low-Flow DHW Devices	417	0.0	7	$144	$260	$110	$150	1.0	1,218
Custom Measures		**3,603**	**0.0**	**129**	**$2,112**	**$20,000**	**$0**	**$20,000**	**9.5**	**18,721**
ECM 12	Retro-Commissioning Study	3,603	0.0	129	$2,112	$20,000	$0	$20,000	9.5	18,721
TOTALS		**58,453**	**11.9**	**166**	**$10,351**	**$94,910**	**$10,520**	**$84,390**	**8.2**	**78,284**

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

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

Cost Effective ECMs

4.1 Lighting

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**13,862**	**0.1**	**0**	**$1,964**	**$13,390**	**$1,180**	**$12,210**	**6.2**	**13,937**
ECM 1	Install LED Fixtures	13,046	0.0	0	$1,850	$12,900	$1,100	$11,800	6.4	13,137
ECM 2	Retrofit Fixtures with LED Lamps	816	0.1	0	$113	$490	$80	$410	3.6	800

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

ECM 1: Install LED Fixtures

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

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

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

Affected Building Areas: exterior fixtures

ECM 2: Retrofit Fixtures with LED Lamps

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

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

Affected Building Areas: fluorescent fixtures with T8 tubes in the corridor and mechanical room; incandescent lamps in gymnasium store, girl's locker room, and main office closet

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		**13,914**	**2.9**	**-3**	**$1,934**	**$22,560**	**$5,730**	**$16,830**	**8.7**	**13,636**
ECM 3	Install Occupancy Sensor Lighting Controls	10,419	2.3	-2	$1,448	$16,830	$1,980	$14,850	10.3	10,212
ECM 4	Install Daylight Dimming Controls	919	0.2	0	$128	$1,230	$1,120	$110	0.9	900
ECM 5	Install High/Low Lighting Controls	2,576	0.3	-1	$358	$4,500	$2,630	$1,870	5.2	2,524

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, classrooms, kitchen, dining area, library, restrooms, and storage rooms

ECM 4: Install Daylight Dimming Controls

Install daylight dimming controls that use photosensors to reduce electric lighting in areas when ample daylight lighting is present. Use photosensor controls for fixtures serving areas that are lit by sunlight. As sunlight levels increase in the room, artificial lighting decreases or turns off.

This measure reduces energy use in spaces where ambient daylight provides sufficient lighting levels. Optimum light levels and the method of dimming should be determined during lighting design.

Affected Building Areas: cafeteria and lunchroom

ECM 5: Install High/Low Lighting Controls

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

Lighting fixtures with these controls operate at default low levels when the area is unoccupied to provide minimal lighting to meet security or safety code requirements for egress. Sensors detect occupancy using ultrasonic and/or infrared sensors. When an occupant enters the space, the lighting fixtures switch to full lighting levels. Fixtures automatically switch back to low level after a predefined period of vacancy.

In parking lots and parking garages with significant ambient lighting, this control can sometimes be combined with photocell controls to turn the lights off when there is sufficient daylight.

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

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

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

Affected Building Areas: hallways and stairwells

4.3 Variable Frequency Drives (VFD)

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**26,657**	**8.9**	**0**	**$3,781**	**$34,300**	**$3,500**	**$30,800**	**8.1**	**26,844**
ECM 6	Install VFDs on Constant Volume (CV) Fans	26,657	8.9	0	$3,781	$34,300	$3,500	$30,800	8.1	26,844

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.

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

Affected Air Handlers: air handlers located in kitchen, storage room, and gymnasium

4.4 Unitary HVAC

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Unitary HVAC Measures		**254**	**0.3**	**0**	**$36**	**$2,900**	**$0**	**$2,900**	**80.4**	**256**
ECM 7	Install High Efficiency Air Conditioning Units	254	0.3	0	$36	$2,900	$0	$2,900	80.4	256

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

ECM 7: Install High Efficiency Air Conditioning Units

We evaluated replacing old standard efficiency window air conditioning units with high efficiency window 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: main office window air conditioner

4.5 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**	**121**	**$1,506**	**$19,500**	**$0**	**$19,500**	**13.0**	**14,191**
ECM 8	Install Programmable Thermostats	0	0.0	88	$1,089	$15,100	$0	$15,100	13.9	10,263
ECM 9	Implement Demand Control Ventilation (DCV)	0	0.0	34	$417	$4,400	$0	$4,400	10.6	3,928

ECM 8: Install Programmable Thermostats

We evaluated replacing manual thermostats with programmable thermostats, which provide energy savings by reducing heating energy usage when a room is unoccupied. Manual thermostats are generally adjusted to a single heating and cooling setpoint and left at that setting regardless of occupancy, and they provide the same level of heating and cooling regardless of whether the space is being used. Programmable thermostats can maintain different temperature settings for different times of day and for different days of the week. By reducing heating temperature setpoints and raising cooling temperature setpoints when spaces are unoccupied, the operation of the HVAC equipment is reduced while maintaining comfortable space temperatures for building usage.

ECM 9: Implement Demand Control Ventilation (DCV)

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

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

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

Affected Building Areas: gymnasium and cafeteria

4.6 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		**417**	**0.0**	**7**	**$144**	**$260**	**$110**	**$150**	**1.0**	**1,218**
ECM 10	Install Low-Flow DHW Devices	417	0.0	7	$144	$260	$110	$150	1.0	1,218

ECM 10: Install Low-Flow DHW Devices

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

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

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

4.7 Food Service and Refrigeration Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Food Service & Refrigeration Measures		**12,818**	**1.5**	**0**	**$1,818**	**$22,000**	**$1,200**	**$20,800**	**11.4**	**12,907**
ECM 11	Replace Refrigeration Equipment	12,818	1.5	0	$1,818	$22,000	$1,200	$20,800	11.4	12,907

ECM 11: Replace Refrigeration Equipment

We evaluated replacing existing commercial refrigerators and freezers with new ENERGY STAR rated equipment. The energy savings associated with this measure come from reduced energy usage, due to more efficient technology, and reduced run times.

4.8 Custom Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Custom Measures		**-8,214**	**0.0**	**255**	**$2,001**	**$25,400**	**$0**	**$25,400**	**12.7**	**21,575**
ECM 12	Retro-Commissioning Study	3,603	0.0	129	$2,112	$20,000	$0	$20,000	9.5	18,721
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater***	-11,817	0.0	126	-$111	$5,400	$0	$5,400	-48.6	2,853

ECM 12: Retro-Commissioning Study

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

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

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

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

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

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

A high-level evaluation of potential savings and costs is provided for demonstration purposes only. It is a screening evaluation for the potential in HVAC control improvements. Based on industry standards and previous project experience, the potential energy savings may be up to 15% of existing HVAC energy use.

We estimate the cost of retro-commissioning studies and control improvements of $0.50 per square foot. Actual savings and costs will need to be outlined by the specific contractor engaged to perform the study. For the purposes of this report, we have conservatively estimated savings to be 7.9% of the HVAC energy consumption baseline.

ECM 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.*[6]

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

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

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

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

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

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

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

Affected Units: gas-fired storage water heater

4.9 Measures for Future Consideration

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

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

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

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

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

Heating System Conversion from Steam to Hot Water

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

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

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

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

Upgrade to a Heat Pump System

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

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

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

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

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

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

Replace Smooth V-Belts with Notched or Synchronous Belts

This measure is for the replacement of smooth V-belts in non-residential package and split HVAC systems with notched V-belts or for the installation of new equipment with synchronous belts instead of smooth V-belts. Typically, there is a V-belt between the motor and the supply air fan and/or return air fan in larger package and split HVAC systems.

In general, there are two styles of grooved V-belts: notched and synchronous. The U.S. Department of Energy (DOE) compares these two types as follows:[9]

Characteristic	Notched V-Belts	Synchronous Belts
Description	A notched belt has grooves or notches that run perpendicular to the belt's length, which reduces the bending resistance of the belt.	They are also called cogged, timing, positive-drive, or high-torque drive belts, and are "toothed".
Pulleys/Sprockets	Can use the same pulleys as cross-section standard V-belts	Require the installation of mating grooved sprockets.
Typical Efficiency	Run cooler, last longer, and are about 2% more efficient than standard V-belts.	Operate with a consistent efficiency of 98% and maintain their efficiency over a wide load range.
Constraints	Have a sharp reduction in efficiency at high torque due to increased slippage.	Noisier than V-belts, less suited for use on shock-loaded applications, and transfer more vibration due to their stiffness.
Other Benefits	Lower cost than synchronous belts, overall.	Require minimal maintenance and re-tensioning. Operate in wet and oily environments, and run slip-free

The DOE offers the following suggested actions with respect to investigating the applicability of notched or synchronous V belts:

- Conducted a survey of belt-driven equipment. Gather application and operating-hour data. Then determine the cost effectiveness of replacing existing V-belts with notched belts or synchronous belts and sprockets.
- Consider synchronous belts for all new installations; the price premium is minimal due to the avoidance of conventional pulley costs.
- Consider having a power transmission specialist determine the energy and cost savings potential from retrofitting all V-belt drives with synchronous belts. Synchronous belts rely on tooth grip instead of friction to efficiently transfer power and provide a constant speed ratio.
- Install notched belts where the retrofit of a synchronous belt is not cost effective.

[9] https://www.nrel.gov/docs/fy13osti/56012.pdf US DOE Motor Systems Tip Sheet #5

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[10]. Your account has already been established. Now you can continue to keep tabs on your energy performance every month.

Weatherization

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

Doors and Windows

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

Window Treatments/Coverings

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

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

Lighting Maintenance

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

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

Motor Controls

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

Motor Maintenance

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

Thermostat Schedules and Temperature Resets

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

AC System Evaporator/Condenser Coil Cleaning

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

HVAC Filter Cleaning and Replacement

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

Steam Trap Repair and Replacement

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

Boiler Maintenance

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

Optimize HVAC Equipment Schedules

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

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

Water Heater Maintenance

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

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

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

Compressed Air System Maintenance

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

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

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

Refrigeration Equipment Maintenance

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

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

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

Procurement Strategies

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

6 Water Best Practices

Getting Started

The commercial and institutional sector is the second largest consumer of publicly supplied water in the United States, accounting for 17% of the withdrawals from public water supplies[11]. 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[12].

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[13] or download a copy of EPA's "WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities"[14] 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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[11] 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)

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

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

[14] 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.

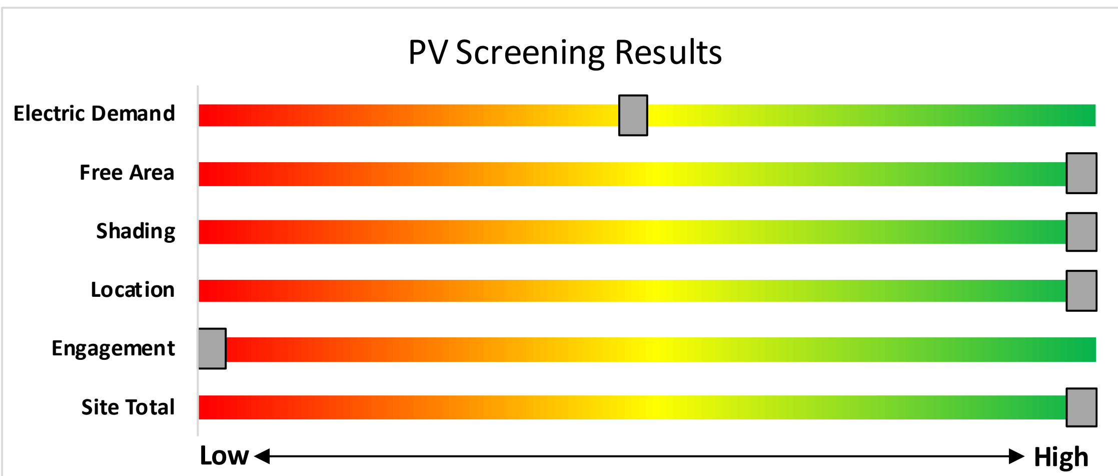
7.1 Solar Photovoltaic

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 high potential for installing a PV array.

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

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



Potential	High	
System Potential	81	kW DC STC
Electric Generation	96,501	kWh/yr
Displaced Cost	$13,690	/yr
Installed Cost	$210,600	

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

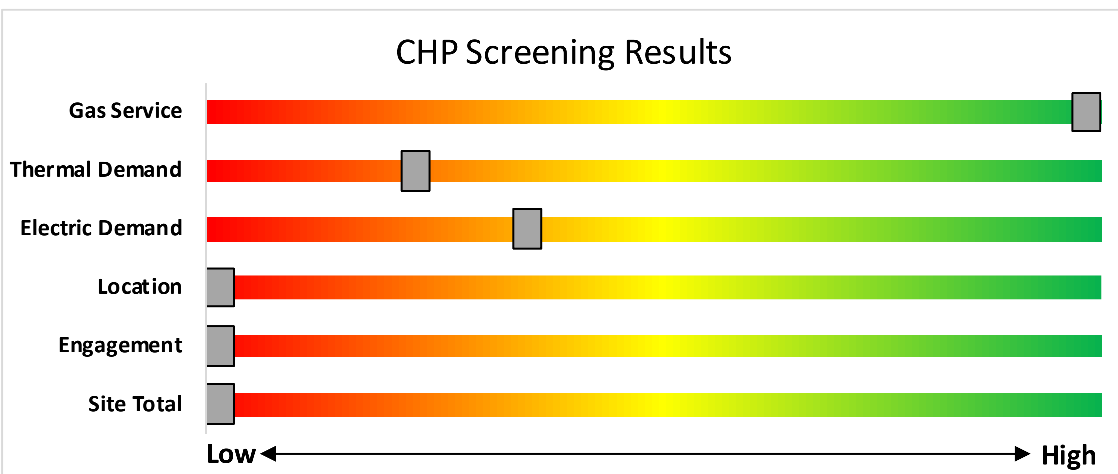
CHP systems typically produce a portion of the electric power used on-site, with the balance of electric power needs supplied by the local utility company. The heat is used to supplement (or replace) existing boilers and provide space heating and/or domestic hot water heating. Waste heat can also be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

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

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

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

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



Combined Heat and Power Screening

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

8 Electric Vehicles

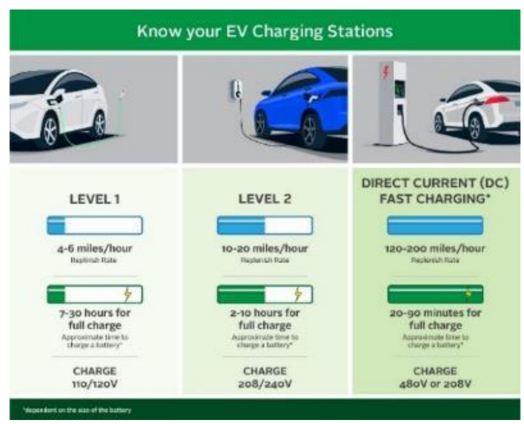
All electric vehicles (EVs) have an electric motor instead of an internal combustion engine. EVs function by plugging into a charge point, taking electricity from the grid, and then storing it in rechargeable batteries. Although electricity production may contribute to air pollution, the U.S. EPA categorizes 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.

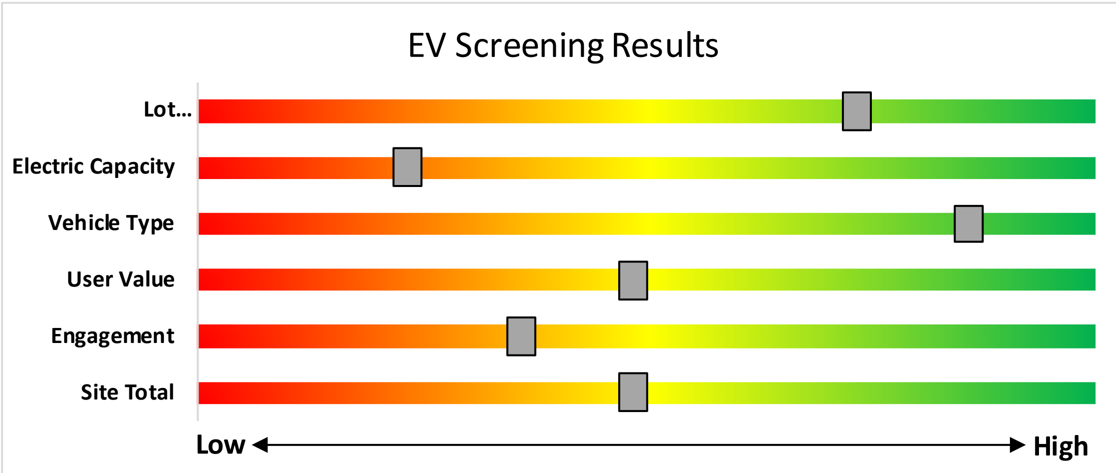
The primary costs associated with installing EV charging are the charger hardware and the cost to extend power from the facility to parking spaces. This may include upgrades to electric panels to serve increased loads.

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; PSE&G; 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[15]

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

15

[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[16]. 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[17].

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.

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

[17] 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.

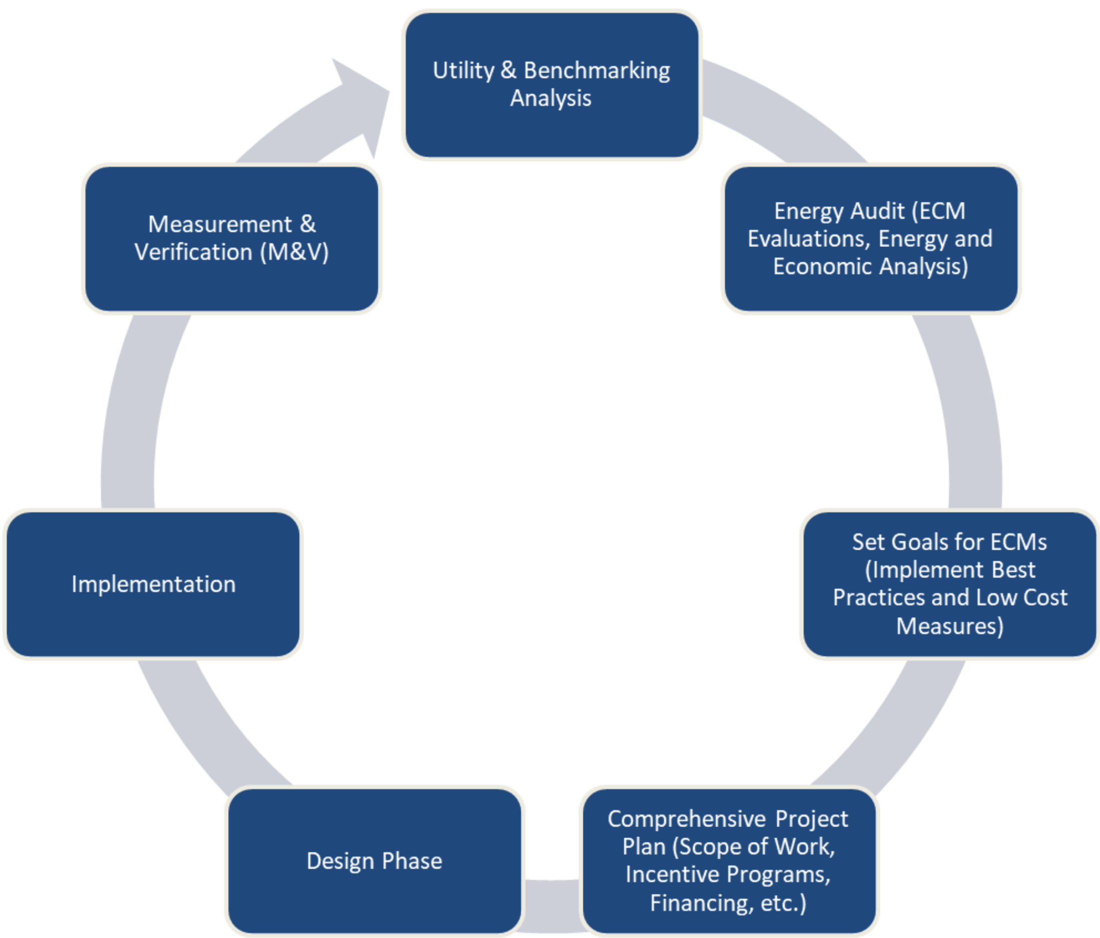
Engineered Solutions

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[18].

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[19].

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

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

APPENDIX A: EQUIPMENT INVENTORY & RECOMMENDATIONS

Lighting Inventory & Recommendations

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Classroom 100	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,100		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	2,100	0.0	0	0	$0	$0	$0	0.0
Classroom 100	1	LED Lamps: (2) 13W A19 Screw-In Lamps	Wall Switch	S	26	2,100		None	No	1	LED Lamps: (2) 13W A19 Screw-In Lamps	Wall Switch	26	2,100	0.0	0	0	$0	$0	$0	0.0
Classroom 100	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,100	3	None	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,449	0.0	19	0	$3	$0	$0	0.0
Classroom 100	12	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	12	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	340	0	$47	$330	$40	6.1
Classroom 101	1	LED Lamps: (2) 13W A19 Screw-In Lamps	Wall Switch	S	26	2,100		None	No	1	LED Lamps: (2) 13W A19 Screw-In Lamps	Wall Switch	26	2,100	0.0	0	0	$0	$0	$0	0.0
Classroom 101	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,100		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,100	0.0	0	0	$0	$0	$0	0.0
Classroom 101	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 101	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	S	33	2,100	3	None	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,449	0.0	21	0	$3	$0	$0	0.0
Classroom 102	2	LED Lamps: (2) 13W A19 Screw-In Lamps	Wall Switch	S	26	2,100		None	No	2	LED Lamps: (2) 13W A19 Screw-In Lamps	Wall Switch	26	2,100	0.0	0	0	$0	$0	$0	0.0
Classroom 102	24	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,100	3	None	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,449	0.1	453	0	$63	$660	$70	9.4
Classroom 102	2	LED - Linear Tubes: (2) U-Lamp	Wall Switch	S	33	2,100	3	None	Yes	2	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,449	0.0	43	0	$6	$0	$0	0.0
Classroom 103	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 105	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,100		None	No	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	2,100	0.0	0	0	$0	$0	$0	0.0
Classroom 105	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,100	3	None	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,449	0.0	19	0	$3	$0	$0	0.0
Classroom 105	11	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	11	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	312	0	$43	$330	$40	6.7
Classroom 106	9	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	2,100	3	None	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,449	0.1	340	0	$47	$330	$40	6.1
Classroom 107	11	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	2,100	3	None	Yes	11	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,449	0.1	415	0	$58	$330	$40	5.0
Classroom 109	9	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	2,100	3	None	Yes	9	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,449	0.1	340	0	$47	$330	$40	6.1
Classroom 111	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,100	3	None	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 112	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,100	3	None	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 113	8	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	2,100	3	None	Yes	8	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,449	0.1	302	0	$42	$330	$40	6.9
Classroom 115	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 116	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 117	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 118	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2

	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
Classroom 119	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 120	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 121	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 122	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom 123	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom CST A	4	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.0	113	0	$16	$330	$40	18.4
Classroom L1	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom L2	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$330	$40	9.2
Classroom L3	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.1	227	0	$31	$0	$0	0.0
Classroom L3	3	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.0	85	0	$12	$330	$40	24.6
Classroom lunch room	8	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,640	4	None	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Daylight Dimming	44	1,584	0.1	367	0	$51	$310	$310	0.0
Corridor 1st floor	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 1st floor	62	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,360	5	None	Yes	62	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,318	0.3	1,873	0	$260	$3,100	$2,170	3.6
Corridor 1st floor	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,360	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,360	0.0	111	0	$15	$50	$10	2.6
Corridor lower level	7	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	3,360	5	None	Yes	7	LED - Linear Tubes: (3) 4' Lamps	High/Low Control	44	2,318	0.0	317	0	$44	$560	$250	7.0
Dining Area	18	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,640	4	None	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Daylight Dimming	29	1,584	0.1	551	0	$77	$920	$810	1.4
Exterior 2	4	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell		50	4,380		None	No	4	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	50	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 2	3	LED - Fixtures: Wall Pack	Photocell		75	4,380		None	No	3	LED - Fixtures: Wall Pack	Photocell	75	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 2	8	Metal Halide: (1) 150W Lamp	Photocell		190	4,380	1	Fixture Replacement	No	8	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	57	4,380	0.0	4,660	0	$661	$4,040	$400	5.5
Exterior 2	11	Metal Halide: (1) 150W Lamp	Photocell		190	4,380	1	Fixture Replacement	No	11	LED - Fixtures: Architectural Flood/Spot Luminaire	Photocell	57	4,380	0.0	6,408	0	$909	$7,230	$550	7.3
Exterior 2	3	Metal Halide: (1) 175W Lamp	Photocell		215	4,380	1	Fixture Replacement	No	3	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Photocell	65	4,380	0.0	1,978	0	$280	$1,630	$150	5.3
Gymnasium 1	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	2,640	2	Relamp	No	1	LED Lamps: A19 Lamps	Wall Switch	9	2,640	0.0	135	0	$19	$30	$0	1.6
Gymnasium 1	17	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,640		None	No	17	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	2,640	0.0	0	0	$0	$0	$0	0.0
Gymnasium 1	5	LED - Fixtures: High-Bay	Occupancy Sensor	S	75	2,640		None	No	5	LED - Fixtures: High-Bay	Occupancy Sensor	75	2,640	0.0	0	0	$0	$0	$0	0.0
Gymnasium 1	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	2,640		None	No	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,640	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
Gymnasium 1	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	2,640		None	No	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,640	0.0	0	0	$0	$0	$0	0.0
Kitchen 1	3	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,700	3	None	Yes	3	LED Lamps: (1) 13W A19 Screw-In Lamp	Occupancy Sensor	13	1,863	0.0	33	0	$5	$330	$40	63.9
Kitchen 1	1	LED Lamps: (1) 20W A19 Screw-In Lamp	Wall Switch	S	20	2,700	3	None	Yes	1	LED Lamps: (1) 20W A19 Screw-In Lamp	Occupancy Sensor	20	1,863	0.0	17	0	$2	$330	$40	124.7
Kitchen 1	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,700	3	None	Yes	1	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,863	0.0	12	0	$2	$0	$0	0.0
Kitchen 1	20	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,700	3	None	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,863	0.1	485	0	$67	$660	$70	8.7
Library 1	53	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,100	3	None	Yes	53	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,449	0.2	1,001	0	$139	$1,320	$140	8.5
Library 1	4	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	2,100	3	None	Yes	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,449	0.0	151	0	$21	$0	$0	0.0
Locker Room Girls	1	Incandescent: (1) 75W A19 Screw-In Lamp	Wall Switch	S	75	2,100	2	Relamp	No	1	LED Lamps: A19 Lamps	Wall Switch	11	2,100	0.0	134	0	$19	$30	$0	1.6
Locker Room Girls	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,100	3	None	Yes	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Occupancy Sensor	13	1,449	0.0	17	0	$2	$330	$40	123.3
Mechanical Room	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Mechanical Room	6	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	4,000	3	None	Yes	6	LED Lamps: (1) 13W A19 Screw-In Lamp	Occupancy Sensor	13	2,760	0.0	97	0	$13	$0	$0	0.0
Mechanical Room	1	LED Lamps: (1) 20W A19 Screw-In Lamp	Wall Switch	S	20	4,000	3	None	Yes	1	LED Lamps: (1) 20W A19 Screw-In Lamp	Occupancy Sensor	20	2,760	0.0	25	0	$3	$330	$40	84.1
Mechanical Room	7	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	4,000	2, 3	Relamp	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	45	2,760	0.1	867	0	$120	$680	$110	4.7
Office - Main	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	2,640	2	Relamp	No	1	LED Lamps: A19 Lamps	Wall Switch	75	2,640	0.0	-40	0	-$6	$30	$0	-5.5
Office - Main	17	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,640	3	None	Yes	17	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,822	0.1	403	0	$56	$660	$70	10.5
Office - Main	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	2,640	3	None	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,822	0.0	95	0	$13	$330	$40	22.0
Office - Nurse	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,640	3	None	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,822	0.0	24	0	$3	$0	$0	0.0
Office - Nurse	11	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,640	3	None	Yes	11	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,822	0.1	392	0	$54	$330	$40	5.3
Restroom - adult	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	S	33	2,100	3	None	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,449	0.0	21	0	$3	$330	$40	97.1
Restroom - female	3	LED - Linear Tubes: (2) U-Lamp	Wall Switch	S	33	2,100	3	None	Yes	3	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,449	0.0	64	0	$9	$330	$40	32.4
Restroom - Female 1st floor	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	S	33	2,100	3	None	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,449	0.0	21	0	$3	$0	$0	0.0
Restroom - Female 1st floor	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,100	3	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,449	0.0	38	0	$5	$330	$40	55.3
Restroom - female L adult	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	S	33	2,100	3	None	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,449	0.0	21	0	$3	$330	$40	97.1
Restroom - Male 1st	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,100	3	None	Yes	1	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,449	0.0	19	0	$3	$330	$40	110.5
Restroom - Male 1st floor	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,100	3	None	Yes	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Occupancy Sensor	13	1,449	0.0	8	0	$1	$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
Restroom - Male 1st floor	3	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	S	44	2,100	3	None	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,449	0.0	85	0	$12	$330	$40	24.6
Restroom - Male L	4	LED - Linear Tubes: (2) U-Lamp	Wall Switch	S	33	2,100	3	None	Yes	4	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,449	0.0	86	0	$12	$330	$40	24.3
Restroom - Male L adult	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	S	33	2,100	3	None	Yes	1	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	1,449	0.0	21	0	$3	$330	$40	97.1
Restroom -Female 1st	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,100	3	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,449	0.0	38	0	$5	$330	$40	55.3
Server Room 1	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	2,640		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	2,640	0.0	0	0	$0	$0	$0	0.0
Stairs 1	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch		13	8,760		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	8,760	0.0	0	0	$0	$0	$0	0.0
Stairs 1	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	8,760	5	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	6,044	0.0	158	0	$22	$280	$70	9.6
Stairs 2	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch		13	8,760	5	None	Yes	2	LED Lamps: (1) 13W A19 Screw-In Lamp	High/Low Control	13	6,044	0.0	71	0	$10	$280	$70	21.4
Stairs 2	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	8,760	5	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	6,044	0.0	158	0	$22	$280	$70	9.6
Storage 1	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	675		None	No	2	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	675	0.0	0	0	$0	$0	$0	0.0
Storage 2	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	S	13	675		None	No	1	LED Lamps: (1) 13W A19 Screw-In Lamp	Wall Switch	13	675	0.0	0	0	$0	$0	$0	0.0
Dining Area	18	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,640	3	None	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,822	0.1	427	0	$59	$660	$70	9.9

Motor Inventory & Recommendations

		Existing Conditions									Proposed Conditions					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Manufacturer	Model	Remaining Useful Life	Annual Operating Hours	ECM #	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	DHW System	2	DHW Circulation Pump	0.08	65.0%	No	Bell & Gossett		W	8,760		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Boiler Combustion Motor	2	Combustion Air Fan	1.00	76.0%	No	Marathon	5K38PN47	W	2,608		No	76.0%	No		0.0	0	0	$0	$0	$0	0.0
Kitchen	Unit Heater	3	Supply Fan	0.25	65.0%	No			W	2,608		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Gymnasium	Exhaust Fan	1	Exhaust Fan	0.20	65.0%	No			W	2,608		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Kitchen	Air Handling Unit	1	Supply Fan	3.00	83.0%	No			W	2,608	6	No	89.5%	Yes	1	1.0	2,982	0	$423	$5,100	$200	11.6
Storage Closet	Air Handling Unit	1	Supply Fan	5.00	86.0%	No	Trane		W	2,608	6	No	89.5%	Yes	1	1.5	4,540	0	$644	$5,600	$900	7.3
Locker Room	Air Handling Unit- Gymnasium	2	Supply Fan	7.50	88.0%	No			W	2,608	6	No	91.0%	Yes	2	4.5	13,173	0	$1,868	$13,400	$2,000	6.1
Locker Room	Air Handling Unit- Gymnasium	2	Return Fan	3.00	83.0%	No			W	2,608	6	No	89.5%	Yes	2	2.0	5,963	0	$846	$10,200	$400	11.6
Mechanical Room	Pneumatic System	1	Air Compressor	0.75	70.0%	No	Dayton		W	2,250		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Feed Water Pump	3	Boiler Feed Water Pump	0.33	67.0%	No		P48J2EB7	W	2,745		No	67.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Condensate return pump	2	Condensate Pump	1.50	81.0%	No		P48N2EB7	W	2,745		No	81.0%	No		0.0	0	0	$0	$0	$0	0.0
Gymnasium	Gymnasium Curtains	1	Other	0.25	65.0%	No			W	400		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Classroom L3	Classroom Exhaust	1	Exhaust Fan	0.33	65.0%	No			W	2,608		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Exhaust Fans- Building	1	Exhaust Fan	0.33	65.0%	No			W	2,608		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Exhaust Fans- Building	1	Exhaust Fan	0.20	65.0%	No			W	2,608		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Exhaust Fans- Building	2	Exhaust Fan	0.33	65.0%	No			W	2,608		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior Rooftop	Exhaust Fans- Building	3	Exhaust Fan	0.25	65.0%	No			W	2,608		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Kitchen	Exhaust Fan kitchen	1	Exhaust Fan	0.25	65.0%	No			W	2,608		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Kitchen	Exhaust Fan kitchen	1	Exhaust Fan	0.25	65.0%	No			W	2,608		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0

Packaged HVAC Inventory & Recommendations

		Existing Conditions									Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Manufacturer	Model	Remaining Useful Life	ECM #	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Classroom 105	Cooling - Classroom 105	1	Window AC	2.34		9.80		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Classroom 106	Cooling - Classroom 106	1	Window AC	2.00		9.40		Friedrich	CP24F30	W		No							0.0	0	0	$0	$0	$0	0.0
Classroom 107	Cooling - Classroom 107	1	Window AC	2.00		9.40		Friedrich	CP24F30	W		No							0.0	0	0	$0	$0	$0	0.0
Classroom 111	Cooling - Classroom 111	1	Window AC	2.34		8.50		Heat Controller	CGRAD-283H	W		No							0.0	0	0	$0	$0	$0	0.0
Classroom 112	Cooling - Classroom 112	1	Window AC	2.00		9.40		Friedrich	CP24F30	W		No							0.0	0	0	$0	$0	$0	0.0
Classroom 116	Cooling - Classroom 116	1	Window AC	2.00		10.40				W		No							0.0	0	0	$0	$0	$0	0.0
Classroom 123	Cooling - Classroom 123	1	Window AC	2.00		10.40				W		No							0.0	0	0	$0	$0	$0	0.0
Classroom CST A	Cooling - Classroom CST A	1	Window AC	1.17		11.00		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Library 1	Cooling - Library 1	2	Window AC	2.00		8.50		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Office - Main	Cooling - Office - Main	3	Window AC	0.84		9.55		Friedrich	KS10J10-3	B	7	Yes	3	Window AC	0.84		12.00		0.3	254	0	$36	$2,900	$0	80.4
Office - Nurse	Cooling - Office - Nurse	1	Window AC	2.06		9.40		Heat Controller	CGRADS253-H	W		No							0.0	0	0	$0	$0	$0	0.0

Space Heating Boiler Inventory & Recommendations

		Existing Conditions						Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Manufacturer	Model	Remaining Useful Life	ECM #	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Heating System - Elementary School	2	Forced Draft Steam Boiler	2,513	Ao Smith	28HE-10	W		No						0.0	0	0	$0	$0	$0	0.0

Programmable Thermostat Recommendations

		Recommendation Inputs					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Affected	ECM #	Thermostat Quantity	Cooling Capacity of Controlled System (Tons)	Electric Heating Capacity of Controlled System (kBtu/hr)	Output Heating Capacity of Controlled System (MBh)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Various Locations	Heating System	8	40.00	0.00	0.00	2,513.00	0.0	0	88	$1,089	$15,100	$0	13.9

Demand Control Ventilation Recommendations

		Recommendation Inputs					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Affected	ECM #	Number of Zones	Cooling Capacity of Controlled System (Tons)	Electric Heating Capacity of Controlled System (kBtu/hr)	Output Heating Capacity of Controlled System (MBh)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Gymnasium/Multi purpose Room	Gymnasium Heating & Ventilation	9	2.00	0.00	0.00	940.00	0.0	0	24	$299	$2,900	$0	9.7
Cafeteria	Cafetria Heating & Ventilation	9	1.00	0.00	0.00	368.00	0.0	0	9	$117	$1,500	$0	12.8

DHW Inventory & Recommendations

		Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Manufacturer	Model	Remaining Useful Life	ECM #	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Elementary School	1	Storage Tank Water Heater (> 50 Gal)	Ao Smith	BTH-300A 300	W		No						0.0	0	0	$0	$0	$0	0.0
Storage Closet-Roof Access	Restrooms	1	Storage Tank Water Heater (≤ 50 Gal)	Ao Smith		W		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
Kitchen	10	5	Faucet Aerator (Kitchen)	2.50	1.50	0.0	0	1	$10	$40	$10	2.9
Various Locations	10	21	Faucet Aerator (Lavatory)	2.20	0.50	0.0	0	6	$74	$180	$80	1.3
Various Locations	10	5	Faucet Aerator (Lavatory)	2.20	0.50	0.0	417	0	$59	$40	$20	0.3

Commercial Refrigerator/Freezer Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Refrigerator/ Freezer Type	Manufacturer	Model	ENERGY STAR Qualified?	ECM #	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Refrigerator Chest	Welsh Farms		No	11	Yes	0.1	1,006	0	$143	$2,700	$0	18.9
Gymnasium	1	Freezer Chest	Frigidaire		No	11	Yes	0.3	2,675	0	$379	$2,200	$0	5.8
Kitchen	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	Beverage Air	HF2-1S	No	11	Yes	0.2	2,178	0	$309	$3,200	$300	9.4
Kitchen	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	Turbo Air	M3F47-2	No	11	Yes	0.2	1,901	0	$270	$3,000	$300	10.0
Kitchen	1	Stand-Up Freezer, Solid Door (31 - 50 cu. ft.)	TRUE	T-49F	No	11	Yes	0.3	2,507	0	$356	$3,400	$300	8.7
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Turbo Air	M3R47-2-N	Yes		No	0.0	0	0	$0	$0	$0	0.0
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Beverage Air	HR2-1S	No	11	Yes	0.1	935	0	$133	$2,700	$100	19.6
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Manitowoc	6051XL-S	No	11	Yes	0.1	681	0	$97	$2,100	$100	20.7
Kitchen	1	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	TRUE	T-49F	No	11	Yes	0.1	935	0	$133	$2,700	$100	19.6
Kitchen	1	Stand-Up Refrigerator, Glass Door (≤15 cu. ft.)	Imbera	VR12	Yes		No	0.0	0	0	$0	$0	$0	0.0

Cooking Equipment Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	Manufacturer	Model	High Efficiency Equipement?	ECM #	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Kitchen	1	Oven/Cooktop	Imperial		No		No	0.0	0	0	$0	$0	$0	0.0
Kitchen	1	Electric Convection Oven (Full Size)	Vulcan		No		No	0.0	0	0	$0	$0	$0	0.0
Kitchen	1	Non- Insulated Food Holding Cabinet (Full Size)	Vulcan	VHFA18-1	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
Various Classrooms	9	Desktops	150	No		
Various Locations	6	Microwaves	1,000	No		
Various Locations	9	Printer (Medium/Small)	200	No		
Various Locations	3	Printer/Copier (Large)	600	No		
Classrooms	3	Projector	200	No		
Various Locations	4	Refrigerator (Mini)	153	No		
Classroom lunch room	1	Refrigerator (Residential)	218	No		
Office - Nurse	1	Refrigerator (Residential)	218	No		
Various Locations	1	Serving Table (Chilled/Heated)	1,920	No		
Various Locations	25	Smart Board	235	No	Promethean	
Office - Main	1	Television	119	No		
Classroom lunch room	1	Toaster	850	No		
Classroom lunch room	1	Toaster Oven	1,200	No		
Mechanical Room	1	Coffee Machine	800	No		
Various Classrooms	37	Air purifier	95	No	Medify Air	MA-112
Mechanical Room	2	Moping Machine	400	No		
Various	380	Chromebooks	45	No		

Custom (High Level) Measure Analysis

Retro-Commissioning Study

Building Square Footage	57,180	Fuel Utility Rate	$12.422 MMBtu
Percent of Conditioned Area Impacted	100%	Blended Electric Utility Rate	$0.142 kWh

Existing Conditions						Proposed Conditions					Energy Impact & Financial Analysis										
Description	Area(s)/System(s) Served	Remaining Useful Life	Total HVAC Motor Usage kWh	Total HVAC Electric Usage kWh	Total HVAC Fuel Usage MMBtu	Description	% Savings HVAC Motor Usage kWh	% Savings HVAC Electric Usage kWh	% Savings HVAC Fuel Usage MMBtu	Estimated Cost per Sqft	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Base Incentives	Enhanced Incentives	Total Incentives	Total Net Cost	Payback w/o Incentives in Years	Simple Payback w/ Incentives in Years
HVAC Controls Not Currently Optimized	HVAC Equipment & Systems	3	72,068	12,278	2,578	Retro-Commissioning Study	5%		5%	$0.30	0.00	3,603	129	$2,112	$20,000	$0	$0	$0	$20,000	9.47	9.47

APPENDIX B: ENERGY STAR STATEMENT OF ENERGY PERFORMANCE

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

LEARN MORE AT energystar.gov

ENERGY STAR® Statement of Energy Performance

55

ENERGY STAR® Score[1]

Sussex Avenue Elementary

Primary Property Type: K-12 School
Gross Floor Area (ft²): 57,180
Built: 1954

For Year Ending: June 30, 2023
Date Generated: March 06, 2024

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

Property & Contact Information

Property Address	Property Owner	Primary Contact
Sussex Avenue Elementary 125 Sussex Avenue Morristown, New Jersey 07960	Morris School District 31 Hazel Street Morristown, NJ 07960 (973) 292-2300	Anthony Lo Franco 31 Hazel Street Morristown, NJ 07960 (973) 292-2300 x2021 Anthony.LoFranco@msdk12.net

Property ID: 32587376

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
61.3 kBtu/ft²

Source EUI
87.7 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	762,296 (22%)
Natural Gas (kBtu)	2,740,811 (78%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	64.9
National Median Source EUI (kBtu/ft²)	92.8
% Diff from National Median Source EUI	-6%

Annual Emissions

Total (Location-Based) GHG Emissions (Metric Tons CO2e/year)	214

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.