Local Government Energy Audit Report

Westfield High School

October 25, 2024

Prepared for:

Westfield Board of Education
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Westfield, New Jersey 07090

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.

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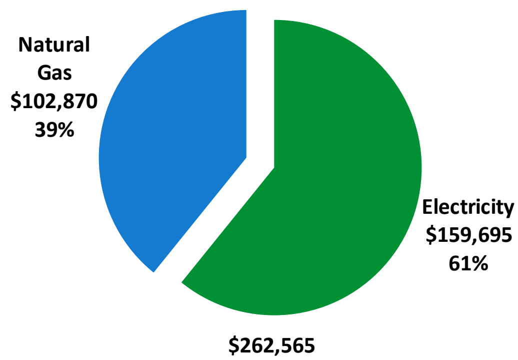
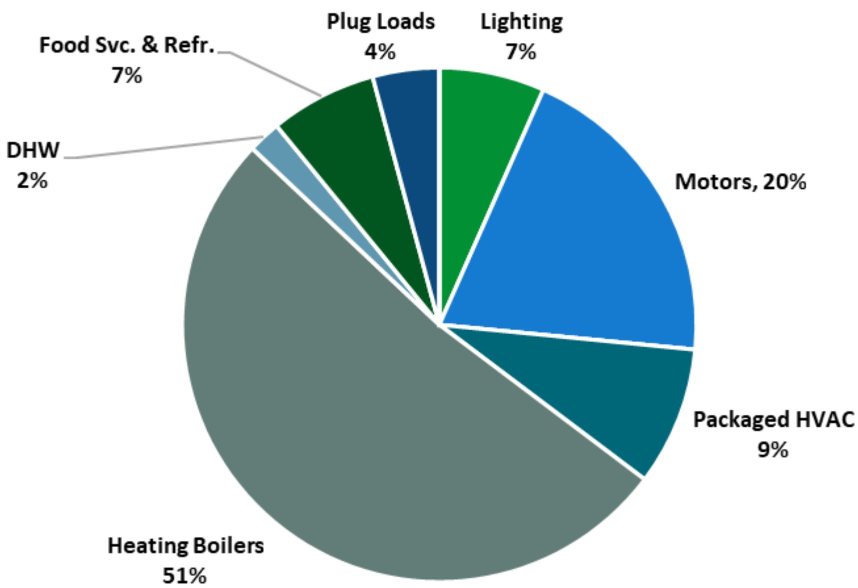
1 Executive Summary

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

BUILDING PERFORMANCE REPORT

Annual Energy Utilities	Costs: $262,565 Electricity: 1,459,330 kWh Natural Gas: 73,781 Therms	
ENERGY STAR® Benchmarking Score	86 *(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.



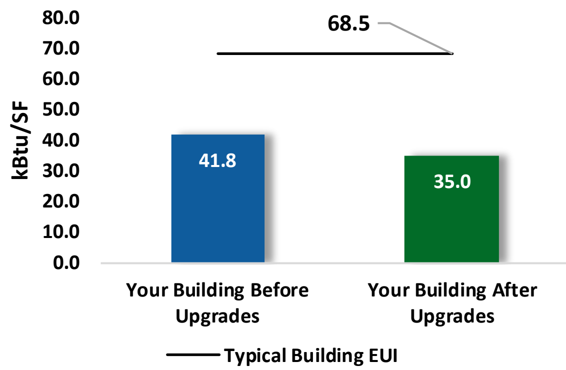
Energy Use by System

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.

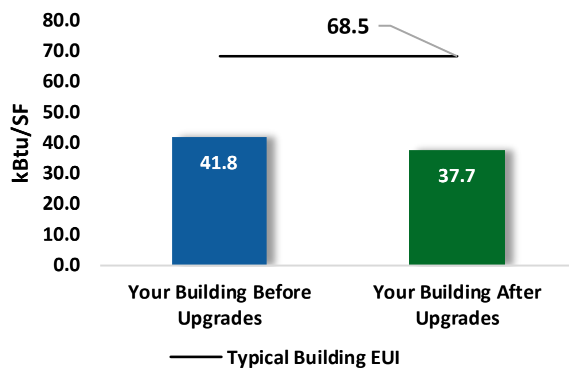
Scenario 1: Full Package (All Evaluated Measures)

Installation Cost	$1,350,940
Potential Rebates & Incentives[1]	$76,070
Annual Cost Savings	$50,964
Annual Energy Savings	Electricity: 368,529 kWh Natural Gas: 7,628 Therms
Greenhouse Gas Emission Savings	230 Tons
Simple Payback	25.0 Years
Site Energy Savings (All Utilities)	16%



Scenario 2: Cost Effective Package[2]

Installation Cost	$257,540
Potential Rebates & Incentives	$33,470
Annual Cost Savings	$35,455
Annual Energy Savings	Electricity: 295,744 kWh Natural Gas: 2,217 Therms
Greenhouse Gas Emission Savings	162 Tons
Simple Payback	6.3 Years
Site Energy Savings (all utilities)	10%



On-site Generation Potential

Photovoltaic	Low
Combined Heat and Power	None

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

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

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**25,425**	**3.8**	**-3**	**$2,735**	**$15,410**	**$430**	**$14,980**	**5.5**	**25,206**
ECM 1	Install LED Fixtures	Yes	2,505	0.0	0	$274	$2,480	$20	$2,460	9.0	2,523
ECM 2	Retrofit Fixtures with LED Lamps	Yes	12,802	3.0	-1	$1,383	$6,290	$410	$5,880	4.3	12,742
ECM 3	Install LED Exit Signs	Yes	10,118	0.8	-2	$1,078	$6,640	$0	$6,640	6.2	9,941
Lighting Control Measures			**62,422**	**16.2**	**-13**	**$6,651**	**$90,730**	**$22,400**	**$68,330**	**10.3**	**61,345**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	44,564	13.5	-9	$4,747	$69,480	$7,830	$61,650	13.0	43,784
ECM 5	Install Photocell Controls	Yes	591	0.0	0	$65	$980	$0	$980	15.1	595
ECM 6	Install High/Low Lighting Controls	Yes	17,267	2.7	-4	$1,839	$20,270	$14,570	$5,700	3.1	16,965
Motor Upgrades			**11,556**	**1.0**	**0**	**$1,265**	**$21,100**	**$0**	**$21,100**	**16.7**	**11,637**
ECM 7	Premium Efficiency Motors	No	11,556	1.0	0	$1,265	$21,100	$0	$21,100	16.7	11,637
Variable Frequency Drive (VFD) Measures			**196,579**	**31.0**	**130**	**$23,329**	**$151,200**	**$9,700**	**$141,500**	**6.1**	**213,214**
ECM 8	Install VFDs on Constant Volume (CV) Fans	Yes	164,085	24.1	0	$17,956	$101,700	$5,200	$96,500	5.4	165,233
ECM 9	Install VFDs on Heating Water Pumps	Yes	16,684	2.1	0	$1,826	$22,800	$2,200	$20,600	11.3	16,800
ECM 10	Install Boiler Draft Fan VFDs	Yes	10,061	4.5	0	$1,101	$13,400	$2,000	$11,400	10.4	10,131
ECM 11	Install VFDs on Kitchen Hood Fan Motors	Yes	3,938	0.0	130	$2,248	$3,900	$100	$3,800	1.7	19,226
ECM 12	Install VFDs on Condensate Pumps	No	1,811	0.4	0	$198	$9,400	$200	$9,200	46.4	1,824
Unitary HVAC Measures			**34,951**	**36.1**	**0**	**$3,825**	**$680,600**	**$30,000**	**$650,600**	**170.1**	**35,195**
ECM 13	Install High Efficiency Air Conditioning Units	No	34,951	36.1	0	$3,825	$680,600	$30,000	$650,600	170.1	35,195
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**75**	**$1,049**	**$131,300**	**$7,600**	**$123,700**	**117.9**	**8,813**
ECM 14	Install High Efficiency Hot Water Boilers	No	0	0.0	75	$1,049	$131,300	$7,600	$123,700	117.9	8,813
Domestic Water Heating Upgrade			**0**	**0.0**	**114**	**$1,596**	**$11,690**	**$1,390**	**$10,300**	**6.5**	**13,404**
ECM 15	Install High Efficiency Gas-Fired Water Heater	No	0	0.0	7	$94	$10,200	$700	$9,500	100.6	793
ECM 16	Install Low-Flow DHW Devices	Yes	0	0.0	108	$1,502	$1,490	$690	$800	0.5	12,611
Food Service & Refrigeration Measures			**17,198**	**1.7**	**141**	**$3,852**	**$94,110**	**$4,550**	**$89,560**	**23.3**	**33,858**
ECM 17	Food Service Equipment Replacement	No	0	0.0	60	$842	$27,200	$2,000	$25,200	29.9	7,068
ECM 18	Dishwasher Replacement	No	0	0.0	81	$1,128	$45,900	$1,500	$44,400	39.4	9,472
ECM 19	Refrigerator/Freezer Case Electrically Commutated Motors	Yes	5,271	0.7	0	$577	$1,120	$120	$1,000	1.7	5,308
ECM 20	Refrigeration Controls	Yes	5,099	0.2	0	$558	$6,180	$230	$5,950	10.7	5,135
ECM 21	Replace Refrigeration Equipment	No	4,068	0.5	0	$445	$12,900	$600	$12,300	27.6	4,097
ECM 22	Vending Machine Control	Yes	2,760	0.3	0	$302	$810	$100	$710	2.4	2,780
Custom Measures			**20,398**	**0.0**	**318**	**$6,663**	**$154,800**	**$0**	**$154,800**	**23.2**	**57,754**
ECM 23	Installation of an Energy Management System	No	20,398	0.0	318	$6,663	$154,800	$0	$154,800	23.2	57,754
TOTALS (COST EFFECTIVE MEASURES)			**295,744**	**51.8**	**222**	**$35,455**	**$257,540**	**$33,470**	**$224,070**	**6.3**	**323,773**
TOTALS (ALL MEASURES)			**368,529**	**89.7**	**763**	**$50,964**	**$1,350,940**	**$76,070**	**$1,274,870**	**25.0**	**460,426**

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

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

All Evaluated Energy Improvements[3]

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

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

1.1 Planning Your Project

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

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

Pick Your Installation Approach

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

Options from Your Utility Company

Prescriptive and Custom Rebates

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

Direct Install

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

Engineered Solutions

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

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

Options from New Jersey's Clean Energy Program

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

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

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

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

Successor Solar Incentive Program (SuSI)

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

Ongoing Electric Savings with Demand Response

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

Large Energy User Program (LEUP)

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

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

2 Existing Conditions

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

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

2.1 Site Overview

On April 15, 2024, TRC performed an energy audit at Westfield High School located in Westfield, New Jersey. TRC met with Sean McArthur to review the facility operations and help focus our investigation on specific energy-using systems.

The Westfield High School is a 295,437 square foot building built in 1952 with three-stories plus a basement. Spaces include classrooms, specialty classrooms and workshops, gymnasium, auditorium, offices, cafeteria, corridors, stairwells, commercial kitchen, storage spaces, and mechanical spaces.

Recent Improvements and Facility Concerns

Most lighting has already been converted to LED. Facility staff has expressed interest in expanding the building energy management system controls.

2.2 Building Occupancy

The facility is occupied Monday through Friday during regular business hours. Janitorial services are performed after hours.

The school is fully occupied year-round, but there is lower occupancy in July and August for summer programs and maintenance. Typical weekday occupancy is 222 staff and 1785 students during the school year. Weekend activities vary.

Building Name	Weekday/Weekend	Operating Schedule
Westfield High School	Weekday	6:00 AM - 8:00 PM
	Weekend	As Needed

Building Occupancy Schedule

2.3 Building Envelope

The walls are made of concrete masonry units (CMUs) with a brick veneer and gypsum drywall or painted CMU interior finish with drop ceilings.

The roof is flat and covered in modified bitumen and is in fair condition with patches. The site has roof mounted solar panels.

Most of the windows are double glazed and have aluminum frames. The glass-to-frame seals are in good condition. The operable window weather seals are in good condition, showing little evidence of excessive wear. Exterior doors are solid with small windows set in aluminum frames and are in good condition with undamaged door seals. Degraded window and door seals increase drafts and outside air infiltration.

Roof

Roof

Exterior

Exterior

2.4 Lighting Systems

The primary interior lighting system uses 14.5-Watt linear LED T8 lamps and LED recessed panels. There are also several 4-foot and 2-foot T8 linear fluorescent fixtures. Fixture types include 2-lamp or 4-lamp, recessed, surface mounted, or pendant fixtures. Fixtures have a mix of prismatic and parabolic lens. Typically, T8 fluorescent lamps use electronic ballasts.

Most of the linear fixtures have been converted to LED technology, with the majority of non-LED lighting being in less used spaces such as storage and mechanical rooms. However, a few are in the gymnasium and restrooms. Additionally, there are some compact fluorescent lamps (CFL), incandescent, and LED general purpose A19 lamps. The high bay fixtures in the cafeteria are manually controlled LED lamps. Exit signs are a mix of LED and incandescent units.

Most fixtures are in good condition. Interior lighting levels were generally sufficient. Interior lighting fixtures are primarily controlled by wall switches. Some restrooms have occupancy sensors.

2x4 Recessed Prismatic

2-foot x 2-foot Recessed LED

CFL Fixture

LED Tube

CFL

Exit Sign

Exterior fixtures include CFLs and LED wall packs, LED canopy lights, and LED spots.

Exterior light fixtures are controlled by a time clock.

A-bulb Canopy Fixture

Wall Pack

2.5 Air Handling Systems

Unit Ventilators

Unit ventilators and fan coil units provide heating and ventilation to classrooms and corridors. Units are equipped with supply fan motors, pneumatically controlled outside air dampers, and fan coil valves connected to the hot water or steam distribution system. Most are older Nesbit units which appear to be in good to fair operating condition.

Classroom Unit Ventilator

Unit Ventilator

Unitary Electric HVAC Equipment

Classrooms and various other spaces are generally cooled with window air conditioning (AC) units. These vary in capacity. Most unit nameplates were not accessible at audit, so capacities, efficiencies, and equipment ages were often estimated based on those that could be viewed. The units are in good condition. Some are ENERGY STAR labeled.

ENERGY STAR Window AC

Window ACs

Various spaces are cooled and heated by various ductless mini-split heat pumps and AC units. The largest unit is a heat pump with 10-ton cooling capacity with an 18 SEER cooling efficiency. It has a heating capacity of 135 MBh with an efficiency rating of 3.80 COP. The unit is in good condition. The other mini-splits systems range from 1 ton to 3 tons cooling capacities ranging from 13 SEER to 18 SEER.

There are also a wide range of the other split system DX condensing units between 1.5-ton and 6-ton cooling capacity. These serve terminal units located in spaces such as classrooms and offices. These range from 10 EER to 14 EER.

Most units are in good condition but one is beyond what is typically considered useful life, the oldest having been installed in 2002. Conditioned air is distributed by fractional hp supply fans located in the various zones. Space cooling by most of these units is controlled by local thermostats.

Refer to Appendix A for detailed information about each unit.

Split DX Condensing Units

Split DX Condensing Units

Ductless Mini-Split AC

Ductless Mini-Split AC

10 Ton Ductless Mini-Split HP

Split AC terminal unit

Unitary Heating Equipment

Various storage rooms and a few mechanical spaces are heated by pendant electric resistance or hot water fan coil unit heaters. These vary in capacity and age but are generally in good condition. Equipment is controlled by manual dial thermostats.

Electric Unit Heater

HHW Unit Heater

HHW Unit Heater–
Uninsulated Return Pipe

Packaged Units

Larger building areas are served by a number of packaged roof top units (RTU) controlled by the BAS. These units have DX cooling with either hot water or natural gas heating. Supply and return fan motors are constant speed and vary from 30 hp to 1 hp. Units did not have a visible tag number or unit label when on-site for audit. Most are in fair condition but beyond what is typically considered useful life.

Building packaged units include:

Manufacturer	Quantity	Cooling Capacity	Cooling Efficiency	Heating	Year
AAON	2	8	11.2	Hot water	2002
AAON	3	6	11.2	Hot water	2002
McQuay	1	80	10.3	Hot water	2002
McQuay	1	40	10.2	Hot water	2002
Trane	1	2	13	Natural Gas	2019

Refer to Appendix A for detailed information about each unit.

AAON RTU

AAON RTU

McQuay RTU

McQuay RTU

Air Handling Units (AHUs)

In addition to the above systems, the building is also conditioned by four air handling units. These four units are equipped with constant speed supply fan motors, hot water or steam heating coils, and a refrigerant coil for cooling. Two smaller units serve the offices but were inaccessible at audit so motor horsepower had to be estimated. AHU-2 and AHU-3, located in a secondary mechanical space, had constant speed 2 hp supply motors. These were McQuay units with original housing from 1994, but with newer sections from 2009.

In addition to the smaller split DX condensing units discussed in the previous section, building AHUs are also served by a number of larger capacity outdoor condensing units. One has a cooling capacity of 80 tons and an energy efficiency ratio of 10.3 EER. It is in fair condition but installed in 2002. Another is 60 tons with a 10 EER. Both are McQuay units and correspond to AHU-2 and AHU-3. These are a split air-conditioning (AC) system configuration. The heating coil is supplied by the hot water or steam boilers, which is described in the section that follows.

The facility also has a data center that is cooled by two split system Liebert CRAC units. They have cooling capacities of 6 tons and 12 tons, with a 13 EER. Between the two outdoor units they have five constant speed 1.5 hp supply fans. There corresponding indoor AHUs run throughout the year to cool server equipment.

The HVAC systems are a mix of pneumatically controlled and BAS controlled. Two sets of 3 hp air compressors located in the boiler room serve the pneumatic system. Each set operates in a lead/lag configuration. No air leaks were observed during the inspection. See following section for photos.

AHU-3

AHU-2

Condensing Unit

CRAC Condensing Unit

CRAC Indoor Unit

CRAC Condensing Unit

2.6 Heating Hot Water (HHW) and Steam Systems

The heating load for most of the building is served by two EASCO 6,695 MBh steam boilers. The burners are fully modulating with a nominal efficiency of 82%. The boilers are configured in an automated lead-lag control scheme. Only one boiler is required under high load conditions. Replaced in 2018, units are in good condition. The steam system is served by two, 2 hp and two, 1 hp condensate pumps, which alternate automatically, three, 0.75 boiler feed water pumps, and two, 1.5 hp vacuum pumps. Motors are constant speed and operate lead/lag.

Four AERCO condensing hot water boilers serve the rest of the building. Two, 2,337.5 MBh boilers are in good condition with efficiencies of 93.5% and are located in the main boiler room with the steam boilers. These boilers serve a distribution system with two VFD controlled 7.5 hp and two constant speed 2 hp heating hot water pumps operating in lead/lag fashion.

In another section of the school, two, 1,720 MBh boilers with 86% efficiencies. Though these are high efficiency boilers, they were installed in 2002 and are beyond their useful life. These boilers serve a distribution system with two constant speed 7.5 hp heating hot water pumps operating in lead/lag fashion.

Each boiler set is configured in an automated lead-lag control scheme. Only one boiler of each set is required under high load conditions. The hydronic distribution system is a two-pipe, heating-only system.

Steam and heating hot water terminal units include unit ventilators, fan coil units, AHUs, and radiators. Staff did not voice concerns about the state of the steam traps

HHW and steam pipes are insulated, and insulation is in good to fair condition.

Boilers and HVAC systems are primarily controlled by facilities BAS, but still many HVAC systems have pneumatic controls. There is a service contract in place for all boilers.

Condensing HHW Boiler

Steam Boiler

Steam Boiler

HHW Pumps with VFDs

HHW Pump VFD

HHW Pumps no VFD

Air Compressor

Condensate Pump

Air Compressor

2.7 Building Automation System (BAS)

The facility-wide BAS controls the boiler(s) and package units. The BAS provides equipment scheduling control and monitors and controls space temperatures, supply air temperatures, humidity, and heating water loop temperatures.

2.8 Domestic Hot Water

Hot water is produced by four units which serve different sections of the building.

The primary load is served by three, 118 gallon, 499.9 MBh gas-fired condensing storage water heaters each with an efficiency of 95%. These units were installed in 2018 and are in good condition. Four fractional hp circulation pumps distribute water to end uses. One of them operates as a spare. The circulation pumps have a Honeywell aquastat controller.

The secondary load is served by one, 100 gallon, 199.9 MBh gas-fired condensing storage water heater with an efficiency of 88%. This unit was installed in 2002 and is beyond typical useful life. One, 1/25 hp circulation pump distribute water to end uses. The circulation pump operates continuously. At the time of the site visit, the domestic water heaters were set at 125°F.

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

Condensing Hot Water Heaters

DHW Circulation Pumps

2002 Condensing Hot Water Heater

Temperature Setpoint

2.9 Food Service Equipment

The kitchen has a mix of gas and electric equipment that is used to prepare lunch for the other schools in Westfield as well as for the high school students and staff. Most cooking is done using convection gas-fired ovens. Equipment varies greatly in age. Bulk prepared foods are held in an electric holding cabinet. Equipment is not high efficiency and in fair condition.

The dishwasher is a non-ENERGY STAR low temperature, multi-tank conveyor type unit. The nameplate was not accessible at audit.

The building also has a home economics classroom equipped with five gas ranges. Both the classroom stovetops and commercial kitchen have kitchen fume hoods.

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

Commercial Dishwasher

Gas Oven–Kitchen

Gas Range–Kitchen

Oven–Classroom

Kitchen Fume Hood–Classroom

Gas Range–Classroom

2.10 Refrigeration

The kitchen has several stand-up refrigerators with either solid or glass doors. Most of the refrigerators are high efficiency Energy Star units and in good condition.

There are two walk-in coolers; each has one evaporator fan and one walk-in freezer with two evaporator fans. The fan motors are permanent split capacitor units. Compressor sizes were estimated. There are no defrost controls or evaporator fan controls.

The kitchen also has a commercial ice making head with a capacity of greater than 450 lbs./day. The unit is in good condition.

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

Walk-in

Walk-in

Walk-in

Stand-up Refrigerator

Stand-up Refrigerator

Ice Maker

2.11 Plug Load and Vending Machines

You may wish to consider paying particular attention to minimizing your plug load usage. This report makes suggestions for ECMs in this area as well as energy efficient best practices.

There are 252 computer workstations throughout the facility. Some are distributed through classrooms and offices, but there is also a designated computer lab. Plug loads include general cafe and office equipment. There are classroom typical loads such as televisions, projectors, and fans.

Some specialized classrooms have specialty equipment including two, 11 kW ceramic art kilns and multiple 3D printers.

There are several residential-style refrigerators and mini refrigerators throughout the building that are used to store snacks and lunches. These vary in condition and efficiency.

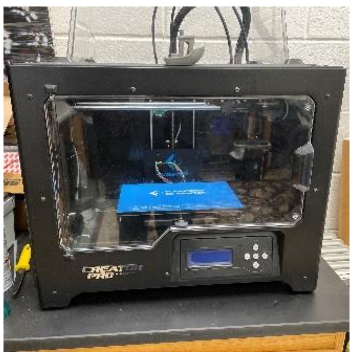
There are two glass-fronted refrigerated beverage vending machines and one non-refrigerated vending machine. Vending machines are not equipped with occupancy-based controls.

The building also has a number of other motors. There is three, 30 hp elevator motors, sump pumps, and four, 3 hp Quincy air compressors used for pneumatic HVAC controls.

Vending Machine

Coffee Maker

Computer Monitor



3D Printer

Art Kiln

Elevator Motor

2.12 Water-Using Systems

Water is provided by a municipal water supply company.

Potable water is used for drinking, cleaning, cooking, sanitary fixtures, heating hot water and steam building conditioning, and landscaping.

Water leaks were not observed/reported.

EPA WaterSense® has set maximum flow rates for sanitary fixtures. They are: 1.28 gallons per flush (gpf) for toilets, 0.5 gpf for urinals, 1.5 gallons per minute (gpm) for lavatory faucets, and 2.0 gpm for showerheads. There are approximately 20 restrooms with toilets, urinals, and sinks. Faucet flow rates are at 2.0 gpm or higher.

Girl's and boy's locker rooms are infrequently used. The showerheads are estimated at 2.8 gpm.

The site has a commercial kitchen with pre-rinse sprayers, commercial ice maker, and Non-ENERGY STAR dishwasher.

Restroom Sink

Science Classroom Faucet

Residential Dishwasher

Kitchen Sink and Dishwasher

2.13 On-Site Generation

Westfield High School has a 672-kW photovoltaic (PV) array with approximately 2,067 panels that was installed in 2017. This system provides approximately 42% of the electricity used. The solar array is owned, operated and maintained by NJR Clean Energy Ventures.

Solar Array

Solar Array

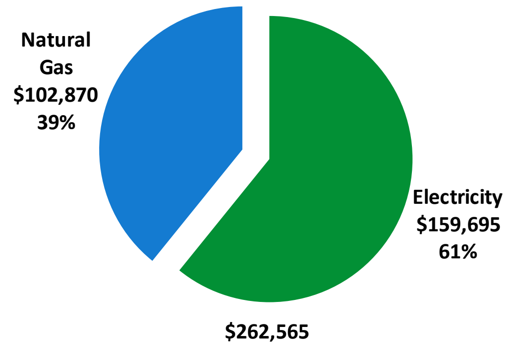
Solar Array

Satellite View

3 Energy Use and Costs

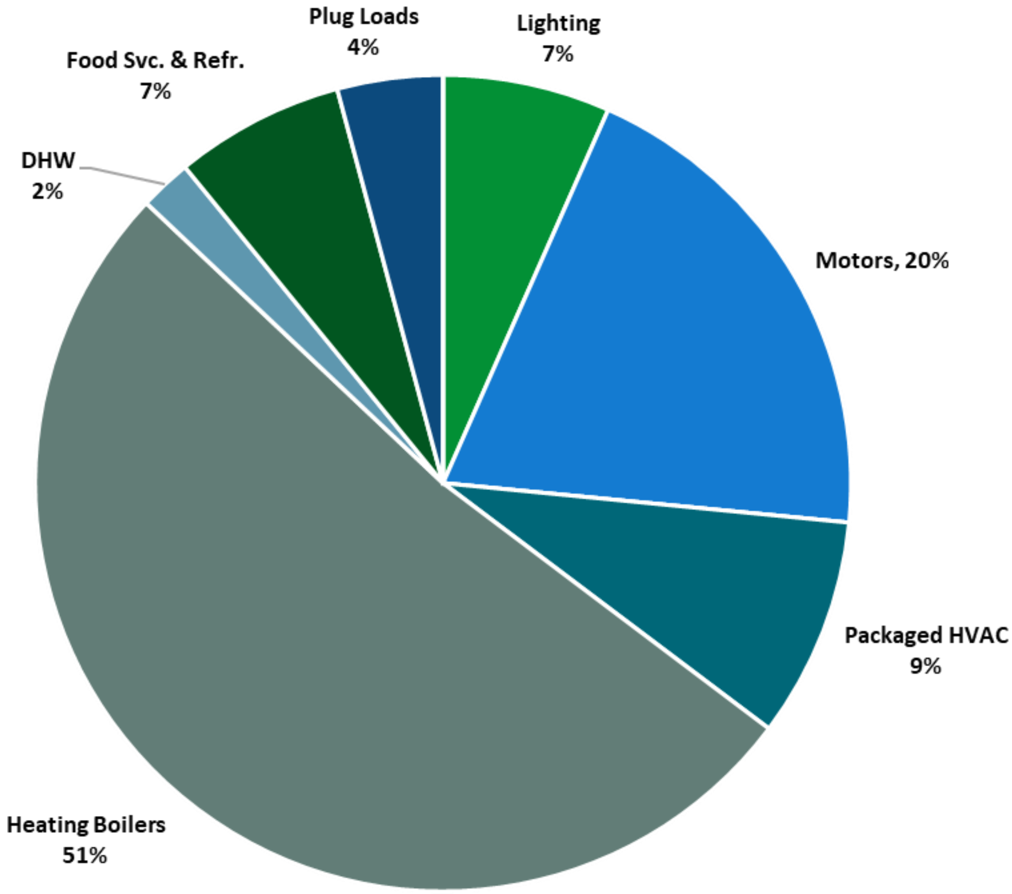
Twelve months of utility billing data are used to develop annual energy consumption and cost data. This information creates a profile of the annual energy consumption and energy costs.

Utility Summary		
Fuel	**Usage**	**Cost**
Electricity	1,459,330 kWh	$159,695
Natural Gas	73,781 Therms	$102,870
Total		**$262,565**



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

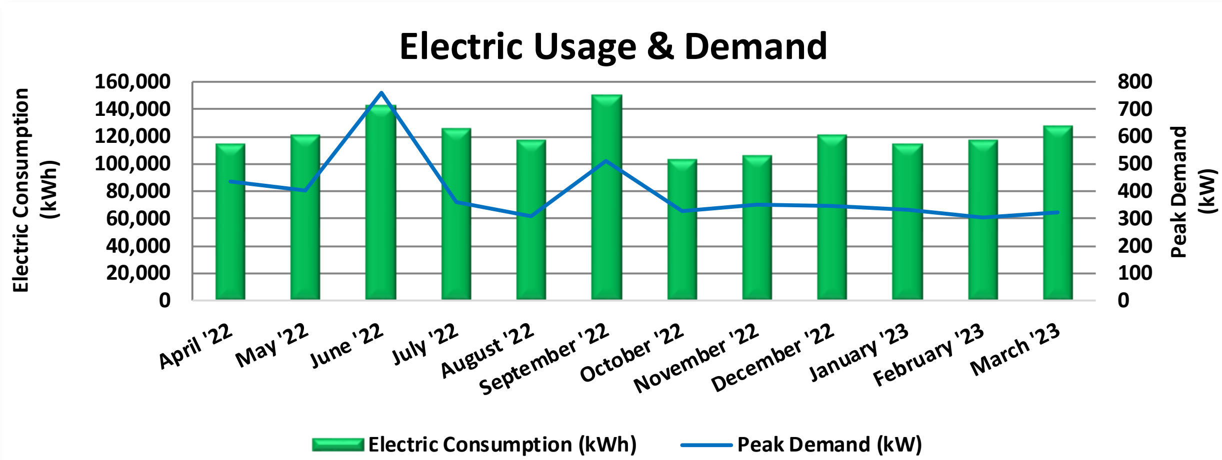
The energy auditor collects information regarding equipment operating hours, capacity, efficiency, and other operational parameters from facility staff, drawings, and on-site observations. This information is used as the inputs to calculate the existing conditions energy use for the site. The calculated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



Energy Balance by System

3.1 Electricity

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



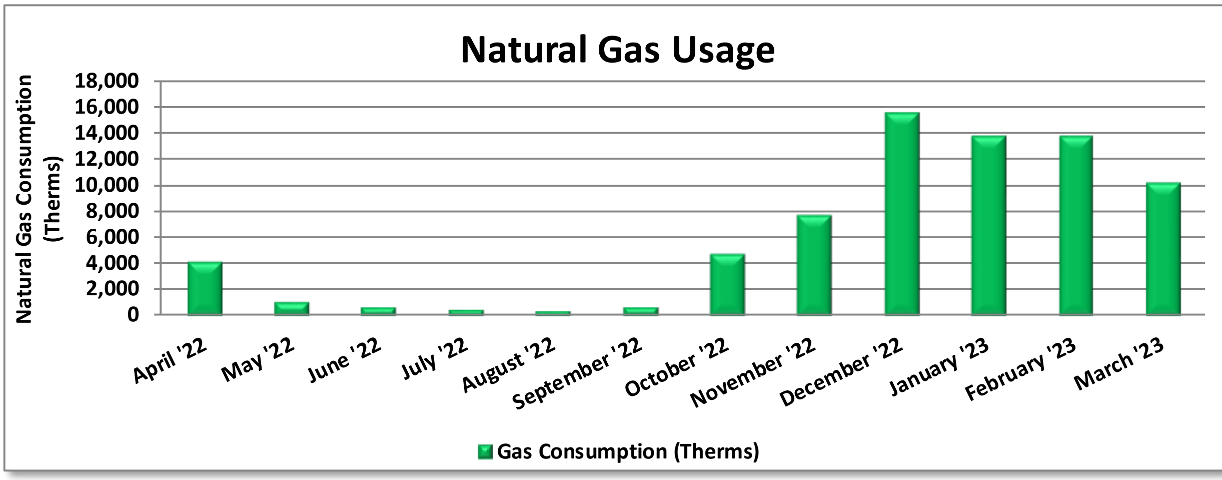
Electric Billing Data					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
4/26/22	32	115,213	434	$1,300	$11,227
5/24/22	28	121,401	403	$1,524	$11,642
6/24/22	31	143,640	759	$6,006	$17,481
7/26/22	32	125,890	363	$4,911	$16,343
8/24/22	29	117,743	307	$4,236	$14,216
9/23/22	30	151,263	510	$6,911	$19,007
10/24/22	31	103,261	327	$1,461	$10,292
11/22/22	29	106,140	350	$1,566	$10,608
12/23/22	31	121,579	345	$1,539	$12,816
1/25/23	33	114,643	334	$1,489	$12,164
2/24/23	30	118,229	306	$1,368	$11,986
3/27/23	31	128,325	324	$1,449	$12,790
Totals	**367**	**1,467,327**	**759**	**$33,761**	**$160,570**
Annual	**365**	**1,459,330**	**759**	**$33,577**	**$159,695**

Notes:

- Peak demand of 759 kW occurred in June '22.
- Average demand over the past 12 months was 397 kW.
- The average electric cost over the past 12 months was $0.109/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.
- On-site generation solar array is owned, operated and maintained by NJR Clean Energy Ventures. All of the electricity generated on-site is used on-site. Some of the electricity generated on-site is used on-site and the remainder is exported to the grid.
- As site use drops slightly in the summer, electricity does not due to cooling equipment. The building gets continual use through both cooling and heating season.

3.2 Natural Gas

Elizabethtown Gas delivers natural gas under rate class General Delivery Service - Transportation (GDSINTVF), 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
4/30/22	30	4,172	$5,889
5/31/22	31	1,066	$2,737
6/30/22	30	661	$2,656
7/31/22	31	456	$1,938
8/31/22	31	425	$1,690
9/30/22	30	660	$2,667
10/31/22	31	4,787	$7,602
11/30/22	30	7,728	$10,120
12/31/22	31	15,638	$21,342
1/31/23	31	13,837	$17,762
2/28/23	28	13,876	$16,858
3/30/23	30	10,273	$11,327
Totals	**364**	**73,579**	**$102,588**
Annual	**365**	**73,781**	**$102,870**

Notes:

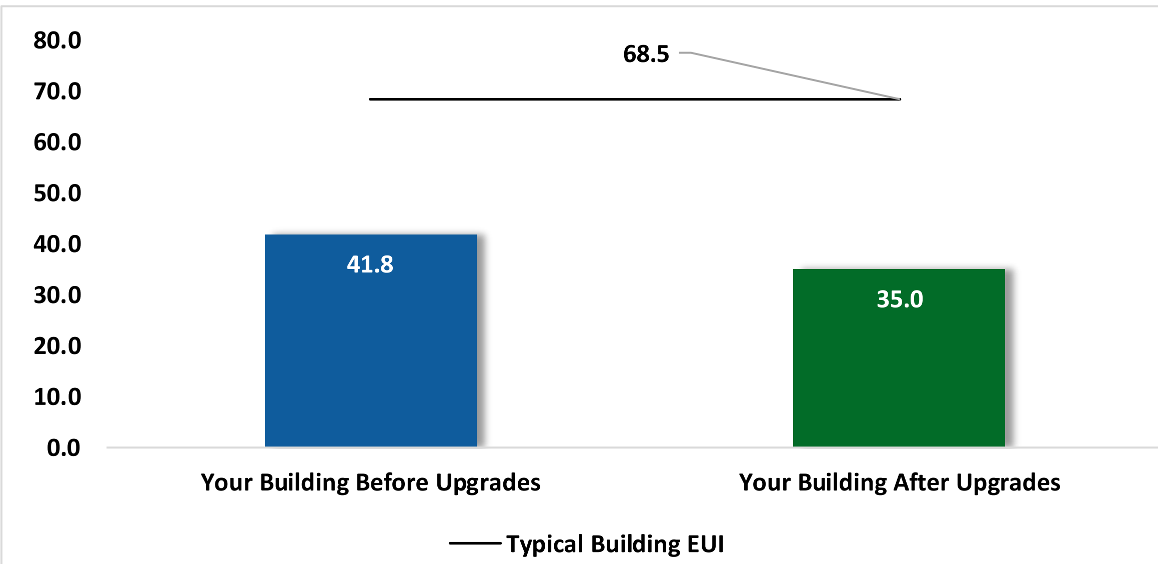
- The average gas cost for the past 12 months is $1.394/therm, which is the blended rate used throughout the analysis.
- Therms usage is estimated for the month of June.

3.3 Benchmarking

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

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

Benchmarking Score	86



Energy Use Intensity Comparison[4]

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.

[4] Based on all evaluated ECMs

Tracking your Energy Performance

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

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

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

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

3.4 Understanding Your Utility Bills

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

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

Why Utility Bills Vary

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

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

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

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

4 ENERGY CONSERVATION MEASURES

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

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

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

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

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

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**25,425**	**3.8**	**-3**	**$2,735**	**$15,410**	**$430**	**$14,980**	**5.5**	**25,206**
ECM 1	Install LED Fixtures	Yes	2,505	0.0	0	$274	$2,480	$20	$2,460	9.0	2,523
ECM 2	Retrofit Fixtures with LED Lamps	Yes	12,802	3.0	-1	$1,383	$6,290	$410	$5,880	4.3	12,742
ECM 3	Install LED Exit Signs	Yes	10,118	0.8	-2	$1,078	$6,640	$0	$6,640	6.2	9,941
Lighting Control Measures			**62,422**	**16.2**	**-13**	**$6,651**	**$90,730**	**$22,400**	**$68,330**	**10.3**	**61,345**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	44,564	13.5	-9	$4,747	$69,480	$7,830	$61,650	13.0	43,784
ECM 5	Install Photocell Controls	Yes	591	0.0	0	$65	$980	$0	$980	15.1	595
ECM 6	Install High/Low Lighting Controls	Yes	17,267	2.7	-4	$1,839	$20,270	$14,570	$5,700	3.1	16,965
Motor Upgrades			**11,556**	**1.0**	**0**	**$1,265**	**$21,100**	**$0**	**$21,100**	**16.7**	**11,637**
ECM 7	Premium Efficiency Motors	No	11,556	1.0	0	$1,265	$21,100	$0	$21,100	16.7	11,637
Variable Frequency Drive (VFD) Measures			**196,579**	**31.0**	**130**	**$23,329**	**$151,200**	**$9,700**	**$141,500**	**6.1**	**213,214**
ECM 8	Install VFDs on Constant Volume (CV) Fans	Yes	164,085	24.1	0	$17,956	$101,700	$5,200	$96,500	5.4	165,233
ECM 9	Install VFDs on Heating Water Pumps	Yes	16,684	2.1	0	$1,826	$22,800	$2,200	$20,600	11.3	16,800
ECM 10	Install Boiler Draft Fan VFDs	Yes	10,061	4.5	0	$1,101	$13,400	$2,000	$11,400	10.4	10,131
ECM 11	Install VFDs on Kitchen Hood Fan Motors	Yes	3,938	0.0	130	$2,248	$3,900	$100	$3,800	1.7	19,226
ECM 12	Install VFDs on Condensate Pumps	No	1,811	0.4	0	$198	$9,400	$200	$9,200	46.4	1,824
Unitary HVAC Measures			**34,951**	**36.1**	**0**	**$3,825**	**$680,600**	**$30,000**	**$650,600**	**170.1**	**35,195**
ECM 13	Install High Efficiency Air Conditioning Units	No	34,951	36.1	0	$3,825	$680,600	$30,000	$650,600	170.1	35,195
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**75**	**$1,049**	**$131,300**	**$7,600**	**$123,700**	**117.9**	**8,813**
ECM 14	Install High Efficiency Hot Water Boilers	No	0	0.0	75	$1,049	$131,300	$7,600	$123,700	117.9	8,813
Domestic Water Heating Upgrade			**0**	**0.0**	**114**	**$1,596**	**$11,690**	**$1,390**	**$10,300**	**6.5**	**13,404**
ECM 15	Install High Efficiency Gas-Fired Water Heater	No	0	0.0	7	$94	$10,200	$700	$9,500	100.6	793
ECM 16	Install Low-Flow DHW Devices	Yes	0	0.0	108	$1,502	$1,490	$690	$800	0.5	12,611
Food Service & Refrigeration Measures			**17,198**	**1.7**	**141**	**$3,852**	**$94,110**	**$4,550**	**$89,560**	**23.3**	**33,858**
ECM 17	Food Service Equipment Replacement	No	0	0.0	60	$842	$27,200	$2,000	$25,200	29.9	7,068
ECM 18	Dishwasher Replacement	No	0	0.0	81	$1,128	$45,900	$1,500	$44,400	39.4	9,472
ECM 19	Refrigerator/Freezer Case Electrically Commutated Motors	Yes	5,271	0.7	0	$577	$1,120	$120	$1,000	1.7	5,308
ECM 20	Refrigeration Controls	Yes	5,099	0.2	0	$558	$6,180	$230	$5,950	10.7	5,135
ECM 21	Replace Refrigeration Equipment	No	4,068	0.5	0	$445	$12,900	$600	$12,300	27.6	4,097
ECM 22	Vending Machine Control	Yes	2,760	0.3	0	$302	$810	$100	$710	2.4	2,780
Custom Measures			**20,398**	**0.0**	**318**	**$6,663**	**$154,800**	**$0**	**$154,800**	**23.2**	**57,754**
ECM 23	Installation of an Energy Management System	No	20,398	0.0	318	$6,663	$154,800	$0	$154,800	23.2	57,754
TOTALS			**368,529**	**89.7**	**763**	**$50,964**	**$1,350,940**	**$76,070**	**$1,274,870**	**25.0**	**460,426**

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

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

All Evaluated ECMs

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**25,425**	**3.8**	**-3**	**$2,735**	**$15,410**	**$430**	**$14,980**	**5.5**	**25,206**
ECM 1	Install LED Fixtures	2,505	0.0	0	$274	$2,480	$20	$2,460	9.0	2,523
ECM 2	Retrofit Fixtures with LED Lamps	12,802	3.0	-1	$1,383	$6,290	$410	$5,880	4.3	12,742
ECM 3	Install LED Exit Signs	10,118	0.8	-2	$1,078	$6,640	$0	$6,640	6.2	9,941
Lighting Control Measures		**62,422**	**16.2**	**-13**	**$6,651**	**$90,730**	**$22,400**	**$68,330**	**10.3**	**61,345**
ECM 4	Install Occupancy Sensor Lighting Controls	44,564	13.5	-9	$4,747	$69,480	$7,830	$61,650	13.0	43,784
ECM 5	Install Photocell Controls	591	0.0	0	$65	$980	$0	$980	15.1	595
ECM 6	Install High/Low Lighting Controls	17,267	2.7	-4	$1,839	$20,270	$14,570	$5,700	3.1	16,965
Variable Frequency Drive (VFD) Measures		**194,767**	**30.6**	**130**	**$23,131**	**$141,800**	**$9,500**	**$132,300**	**5.7**	**211,390**
ECM 8	Install VFDs on Constant Volume (CV) Fans	164,085	24.1	0	$17,956	$101,700	$5,200	$96,500	5.4	165,233
ECM 9	Install VFDs on Heating Water Pumps	16,684	2.1	0	$1,826	$22,800	$2,200	$20,600	11.3	16,800
ECM 10	Install Boiler Draft Fan VFDs	10,061	4.5	0	$1,101	$13,400	$2,000	$11,400	10.4	10,131
ECM 11	Install VFDs on Kitchen Hood Fan Motors	3,938	0.0	130	$2,248	$3,900	$100	$3,800	1.7	19,226
Domestic Water Heating Upgrade		**0**	**0.0**	**108**	**$1,502**	**$1,490**	**$690**	**$800**	**0.5**	**12,611**
ECM 16	Install Low-Flow DHW Devices	0	0.0	108	$1,502	$1,490	$690	$800	0.5	12,611
Food Service & Refrigeration Measures		**13,130**	**1.2**	**0**	**$1,437**	**$8,110**	**$450**	**$7,660**	**5.3**	**13,222**
ECM 19	Refrigerator/Freezer Case Electrically Commutated Motors	5,271	0.7	0	$577	$1,120	$120	$1,000	1.7	5,308
ECM 20	Refrigeration Controls	5,099	0.2	0	$558	$6,180	$230	$5,950	10.7	5,135
ECM 22	Vending Machine Control	2,760	0.3	0	$302	$810	$100	$710	2.4	2,780
TOTALS		**295,744**	**51.8**	**222**	**$35,455**	**$257,540**	**$33,470**	**$224,070**	**6.3**	**323,773**

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

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

Cost Effective ECMs

4.1 Lighting

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**25,425**	**3.8**	**-3**	**$2,735**	**$15,410**	**$430**	**$14,980**	**5.5**	**25,206**
ECM 1	Install LED Fixtures	2,505	0.0	0	$274	$2,480	$20	$2,460	9.0	2,523
ECM 2	Retrofit Fixtures with LED Lamps	12,802	3.0	-1	$1,383	$6,290	$410	$5,880	4.3	12,742
ECM 3	Install LED Exit Signs	10,118	0.8	-2	$1,078	$6,640	$0	$6,640	6.2	9,941

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 fixture(s).

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

Affected Building Areas: exterior HID fixtures

ECM 2: Retrofit Fixtures with LED Lamps

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

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

Affected Building Areas: all areas with fluorescent fixtures with T8 tubes and CFLs (storage rooms, mechanical spaces, auditorium, gymnasium, library, restrooms), and exterior incandescent canopy lights

ECM 3: Install LED Exit Signs

Replace incandescent or compact fluorescent exit signs with LED exit signs. LED exit signs require virtually no maintenance and have a life expectancy of at least 20 years. This measure saves energy by installing LED fixtures, which use less power than other technologies with an equivalent lighting output. Maintenance savings and improved reliability may also be achieved, as the longer-lasting LED lamps will not need to be replaced as often as the existing lamps.

4.2 Lighting Controls

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**62,422**	**16.2**	**-13**	**$6,651**	**$90,730**	**$22,400**	**$68,330**	**10.3**	**61,345**
ECM 4	Install Occupancy Sensor Lighting Controls	44,564	13.5	-9	$4,747	$69,480	$7,830	$61,650	13.0	43,784
ECM 5	Install Photocell Controls	591	0.0	0	$65	$980	$0	$980	15.1	595
ECM 6	Install High/Low Lighting Controls	17,267	2.7	-4	$1,839	$20,270	$14,570	$5,700	3.1	16,965

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 4: 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: storage spaces, restrooms, offices, cafeteria, auditorium, and gymnasium

ECM 5: Install Photocell Controls

Install photocells to eliminate exterior lighting use during daytime periods.

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

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

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

Affected Building Areas: exterior canopy fixtures

ECM 6: 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 Motors

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades		**11,556**	**1.0**	**0**	**$1,265**	**$21,100**	**$0**	**$21,100**	**16.7**	**11,637**
ECM 7	Premium Efficiency Motors	11,556	1.0	0	$1,265	$21,100	$0	$21,100	16.7	11,637

ECM 7: Premium Efficiency Motors

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

The school district is considering replacing most of the old fan coil units at this site. The primary savings from replacing fan coil units will be from improved fan motor efficiency; however, those savings are unlikely to justify replacing the fan coils. The next potential savings would be from installing fan coils that provide for more optimal use of outside air than the existing fan coil units.

The potential savings from installing new fan coils with electronically commutated (EC) motors was evaluated. EC motors are generally more efficient than other fractional hp motors and have the capability of operating at variable speeds. In general, replacing the fan coils should be considered a capital improvement measure that has the potential to provide energy savings and improve occupant comfort.

Affected Motors:

Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Additional Motor Description
Various Classrooms	Various Classrooms	46	Fan Coil Unit	0.2	Unit Ventilators
Auditorium	Auditorium	1	Fan Coil Unit	0.2	Unit Ventilator
Dining Area 1	Dining Area 1	2	Fan Coil Unit	0.2	Unit Ventilators
Gymnasium 1	Gymnasium 1	1	Fan Coil Unit	0.2	Unit Ventilator
Various Stairs	Various Stairs	8	Fan Coil Unit	0.2	Fan Coil Units
Student center	Student center	1	Fan Coil Unit	0.2	Unit Ventilator
Library	Library	8	Fan Coil Unit	0.2	Unit Ventilators

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

4.4 Variable Frequency Drives (VFD)

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**196,579**	**31.0**	**130**	**$23,329**	**$151,200**	**$9,700**	**$141,500**	**6.1**	**213,214**
ECM 8	Install VFDs on Constant Volume (CV) Fans	164,085	24.1	0	$17,956	$101,700	$5,200	$96,500	5.4	165,233
ECM 9	Install VFDs on Heating Water Pumps	16,684	2.1	0	$1,826	$22,800	$2,200	$20,600	11.3	16,800
ECM 10	Install Boiler Draft Fan VFDs	10,061	4.5	0	$1,101	$13,400	$2,000	$11,400	10.4	10,131
ECM 11	Install VFDs on Kitchen Hood Fan Motors	3,938	0.0	130	$2,248	$3,900	$100	$3,800	1.7	19,226
ECM 12	Install VFDs on Condensate Pumps	1,811	0.4	0	$198	$9,400	$200	$9,200	46.4	1,824

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 8: Install VFDs on Constant Volume (CV) Fans

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

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

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

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

Affected Air Handlers: AHU-2, AHU-3, H&V units, and RTUs

ECM 9: Install VFDs on Heating Water Pumps

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

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

Affected Pumps: HHW pump currently without VFDs

ECM 10: Install Boiler Draft Fan VFDs

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

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

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

Affected Boilers: steam boilers

ECM 11: Install VFDs on Kitchen Hood Fan Motors

Install VFDs and sensors to control the kitchen hood fan motor(s). The air flow of the hood is varied based on two key inputs: temperature and smoke/cooking fumes. The VFD controls the amount of exhaust (and kitchen make-up air) based on temperature—the lower the temperature the lower the flow. If the optic sensor is triggered by smoke or cooking fumes, the speed of the fan ramps up to 100%.

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

Affected Units: commercial kitchen (not classrooms)

ECM 12: Install VFDs on Condensate Pumps

We evaluated installation of VFDs to control the condensate return pump(s). The condensate pump flow will have to be controlled to work in conjunction with the boiler feed water pump. The VFD control feedback should be based on a pressure transducer located in the main steam header. Before implementing this measure co-ordinate with the pump and boiler manufacturer.

Energy savings result from reducing the pump motor speed (and power) at reduced condensate flow from the condensate receiver. The magnitude of energy savings is based on the estimated amount of time that the pumping system will operate at reduced load.

Affected Pumps: 2 hp pump set of condensate pumps

4.5 Unitary HVAC

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Unitary HVAC Measures		**34,951**	**36.1**	**0**	**$3,825**	**$680,600**	**$30,000**	**$650,600**	**170.1**	**35,195**
ECM 13	Install High Efficiency Air Conditioning Units	34,951	36.1	0	$3,825	$680,600	$30,000	$650,600	170.1	35,195

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 packaged units and split systems are eventually replaced, consider purchasing equipment that exceeds the minimum efficiency required by building codes.

ECM 13: Install High Efficiency Air Conditioning Units

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

Affected Units: AAON RTUs, McQuay RTUs, York split system air conditioner, and various older split system condensing units

4.6 Gas-Fired Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**75**	**$1,049**	**$131,300**	**$7,600**	**$123,700**	**117.9**	**8,813**
ECM 14	Install High Efficiency Hot Water Boilers	0	0.0	75	$1,049	$131,300	$7,600	$123,700	117.9	8,813

ECM 14: Install High Efficiency Hot Water Boilers

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

The most notable efficiency improvement is condensing hydronic boilers that can achieve over 90% efficiency under the proper conditions. Condensing hydronic boilers typically operate at efficiencies between 85% and 87% (comparable to other high efficiency boilers) when the return water temperature is above 130°F. The boiler efficiency increases as the return water temperature drops below 130°F. Therefore, condensing hydronic boilers are evaluated when the return water temperature is less than 130°F during most of the operating hours.

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

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

Affected Boilers: AERCO BMK2.0 model BTU

4.7 Domestic Water Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**114**	**$1,596**	**$11,690**	**$1,390**	**$10,300**	**6.5**	**13,404**
ECM 15	Install High Efficiency Gas-Fired Water Heater	0	0.0	7	$94	$10,200	$700	$9,500	100.6	793
ECM 16	Install Low-Flow DHW Devices	0	0.0	108	$1,502	$1,490	$690	$800	0.5	12,611

ECM 15: Install High Efficiency Gas-Fired Water Heater

We evaluated replacing the existing tank water heater with a high efficiency condensing tank water heater. Energy savings result from the increased efficiency of the unit, which uses less gas to heat water, and fewer operating hours to maintain the tank water temperature. The current unit is a condensing unit but nearing the end of what is typically considered its useful life.

Affected Boilers: A.O. Smith model BTH-199 970

ECM 16: Install Low-Flow DHW Devices

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

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

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

4.8 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		**17,198**	**1.7**	**141**	**$3,852**	**$94,110**	**$4,550**	**$89,560**	**23.3**	**33,858**
ECM 17	Food Service Equipment Replacement	0	0.0	60	$842	$27,200	$2,000	$25,200	29.9	7,068
ECM 18	Dishwasher Replacement	0	0.0	81	$1,128	$45,900	$1,500	$44,400	39.4	9,472
ECM 19	Refrigerator/Freezer Case Electrically Commutated Motors	5,271	0.7	0	$577	$1,120	$120	$1,000	1.7	5,308
ECM 20	Refrigeration Controls	5,099	0.2	0	$558	$6,180	$230	$5,950	10.7	5,135
ECM 21	Replace Refrigeration Equipment	4,068	0.5	0	$445	$12,900	$600	$12,300	27.6	4,097
ECM 22	Vending Machine Control	2,760	0.3	0	$302	$810	$100	$710	2.4	2,780

ECM 17: Food Service Equipment Replacement

Buildings that use a lot of food service equipment are often among the most energy-intensive commercial buildings. We evaluated replacing existing food service equipment with new, high-efficiency equipment. Consider replacing the following equipment with high efficiency or ENERGY STAR labeled versions:

Location	Quantity	Equipment Type	Manufacturer	Model
Dining Area 1	2	Gas Convection Oven (Full Size)	Blodgett	
Dining Area 1	1	Gas Rack Oven (Single)	Vulcan	

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

ECM 18: Dishwasher Replacement

We evaluated replacing existing dishwashers with new energy-efficient multi-rack conveyor dishwashers. New high efficiency models often use an average of 40% less energy and water, compared to current standard efficiency equipment.

Affected System: non-ENERGY STAR low temperature and multi-tank conveyor dishwasher

ECM 19: Refrigerator/Freezer Case Electrically Commutated Motors

Replace shaded pole or permanent split capacitor (PSC) motors with electronically commutated (EC) motors in walk-in coolers and freezers. Fractional horsepower EC motors are significantly more efficient than mechanically commutated, brushed motors, particularly at low speeds or partial load. By using variable-speed technology, EC motors can optimize fan usage. Because these motors are brushless and use DC power, losses due to friction and phase shifting are eliminated.

Savings for this measure consider both the increased efficiency of the motor as well as the reduction in refrigeration load due to motor heat loss.

Affected Systems: walk-in freezer and walk-in coolers

ECM 20: Refrigeration Controls

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

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

Many walk-in coolers and freezers have evaporator fans that run continuously. The measure adds a control system feature to automatically shut off evaporator fans when not needed.

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

Affected Systems: walk-in freezer and walk-in coolers

ECM 21: Replace Refrigeration Equipment

Replace existing commercial stand-up solid door refrigerators with new ENERGY STAR rated equipment. The energy savings associated with this measure come from reduced energy usage, due to more efficient technology, and reduced run times.

ECM 22: Vending Machine Control

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

Affected Systems: two glass front refrigerated vending machines and one non-refrigerated

4.9 Custom Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Custom Measures		**20,398**	**0.0**	**318**	**$6,663**	**$154,800**	**$0**	**$154,800**	**23.2**	**57,754**
ECM 23	Installation of an Energy Management System	20,398	0.0	318	$6,663	$154,800	$0	$154,800	23.2	57,754

ECM 23: Installation of an Energy Management System

We evaluated expanding the control of the building automation system (BAS). Most larger facilities have some type of BAS, which provides for centralized, remote control and monitoring of HVAC equipment, and sometimes lighting or other building systems. A BAS utilizes a system of temperature and pressure sensors that obtain feedback about field conditions and provide signals to control systems that adjust HVAC system operation for optimal functioning. Thirty years ago, most control systems were pneumatic systems driven by compressed air, with pneumatic thermostats and air driven actuators for valves and dampers. Pneumatic controls have largely been replaced by direct digital control (DDC) systems, but many pneumatic systems remain. Contemporary DDC systems afford tighter controls and enhanced monitoring and trending capabilities as compared to the older systems.

Often smaller facilities are not equipped with central controls. For many small sites, it has been less costly to install distributed local controls, such as programmable thermostats and timeclocks, rather than centralized DDC. Local controls do a reasonably good job of scheduling equipment and maintaining operating conditions by relying on controls integral to HVAC units, such as logic for compressor staging, to manage the equipment operating algorithms.

Even for smaller sites, inefficiencies arise when temperature sensors and thermostat schedules are not maintained, when there are separate systems for heating and cooling, and especially when equipment is added, or the facility is reconfigured or repurposed.

Based on our survey, it appears that the installation of a BAS at your site could increase the efficiency of your building HVAC system operation.

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

It is recommended that an HVAC engineer or contractor who specializes in BAS be contacted for a detailed evaluation and implementation costs. For the purposes of this report, the potential energy savings and measure costs were estimated based on industry standards and previous project experience. Further analysis should be conducted for the feasibility of this measure. This is not an investment grade analysis nor should be used as a basis for design and construction.

A high-level evaluation of potential savings and costs is provided for demonstration purposes only. It is a screening evaluation for the potential in installing a BAS. Based on industry standards and previous project experience, the potential energy savings may be up to 20% of existing HVAC energy use. We estimate the cost for installing a BAS is approximately $2.00 per square foot. Actual savings and costs will need to be outlined by the specific contractor engaged to implement the system. For the purposes of this report, we have conservatively estimated savings to be 3.2% of the HVAC energy consumption baseline.

4.10 Measures for Future Consideration

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

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

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

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

Upgrade/Replace Building Automation System

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

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

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

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

Heating System Conversion from Steam to Hot Water

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

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

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

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

Upgrade to a Heat Pump System

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:[5]

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.

Implement Data Center Energy Efficiency Measures

Data centers are responsible for about one percent of all electricity consumed worldwide, or about 250 terawatt-hours (TWh) in 2019. More than 40% of that energy is consumed by cooling and ventilation systems required to offset the heat generated by servers and storage drives.

Many data centers afford opportunity for energy savings. Good candidates include older data centers (which tend to have less efficient server racks and inefficient cooling systems), and data centers located in spaces converted from other uses (which may be less optimized for air flow).

We encourage you to conduct a study to investigate options for reducing data center energy use. We recommend that your study team include a Data Center Energy Practitioner (DCEP), who is qualified to identify and evaluate energy efficiency opportunities in data centers and address energy opportunities in electrical systems, air management, HVAC, and IT equipment. As stakeholders, your facility HVAC service team and IT department will want to be key participants in this effort.

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

A DCEP led study will first benchmark the facility by calculating the Power Usage Effectiveness (PUE), which is the total energy entering the datacenter / Energy used by IT equipment inside the datacenter. Benchmarking will enable you to understand the current level of efficiency in your data center, and as you implement additional efficiency best practices, it helps you gauge the effectiveness of those efficiency efforts.

Energy savings opportunities typically fall into three main categories: those related to the IT equipment, airflow management strategies, and HVAC adjustments. Often, they are used in conjunction. In brief:

- "IT Opportunities" involved how servers and equipment are configured as well as purchased and upgrades for older inefficient units.
- "Airflow Management Strategies" seek to eliminate the mixing of cold ("supply") air and hot exhaust air, leading to higher allowable data center temperatures. Higher temperatures save energy because fan speeds can be lowered, chilled water temperatures can be raised, and free cooling can be utilized more often.
- "HVAC Adjustments" pertain to optimization of setting temperature, relative humidity, and economizer operations.

The following table provides a brief description of 12 common energy efficiency strategies for data centers. The project team should evaluate the strategies that pertain to your facility.

Measure Category	Measure	Measure Description
IT Opportunities	Server Virtualization	A way to consolidate servers by allowing you to run multiple different workloads on one physical host server
	Decommissioning of Unused Servers	Surveys have found that 8 to 10% of servers with no use are still running
	Consolidation of Lightly Utilized Servers	Two or three lightly utilized file servers can often be consolidated onto one machine. Strategies include "clustering" and "downsizing".
	Better Management of Data Storage	Data compression, de-duplication, are two of several approaches
	Purchasing More Energy-Efficient Equipment	Currently available servers, uninterruptable power supplies, and power distribution units are markedly more efficient than older equipment, provide status information, and often incorporate local targeted cooling systems.
Airflow Management Strategies	Hot Aisle/Cold Aisle Layout	Consider orienting server rows so the cool air intake sides (server fronts) face each other to create a "cold" aisle while the air exhaust (back) sides create a hot aisle.
	Containment/Enclosures	Containment augments hot aisle/cold aisle strategies with physical barriers to further prevent air from mixing
	Variable Speed Fan Drives (VSD)	Many CRAC (computer room air conditioning) unit fans operate at a single uniform speed. Equipped with VSD, air movement can be better tailored to cooling needs.
	Properly Deployed Airflow Management Devices	Optimize airflow with diffusers, blanking panels, vented tiles, and other means so supply air is directed to equipment that required cooling.

Measure Category	Measure	Measure Description
HVAC Adjustments	Server Inlet Temperature and Humidity Adjustments	Review relatively humidity and temperature settings against current standards and adjust.
	Air-Side Economizer	Install or adjust air-side economizer to take advantage of free cooling.
	Water-Side Economizer	Uses the evaporative cooling capacity of the cooling tower to produce chilled water instead of the chiller during the winter months.

ENERGY STAR has issued guidance on measures that can be taken to improve energy use in data centers, which can be accessed here: https://www.energystar.gov/products/low_carbon_it_campaign/12_ways_save_energy_data_center

Replacing vs. Repairing a Built-up Air Handler

The facility staff asked for guidance regarding replacing versus continuing to repair the old built-up air handling units (AHUs) at this site.

All equipment will eventually reach the end of its useful life (EUL) at which time it will need to be replaced. The difficulty is determining when a built-up AHU, which is basically multiple independent components in one housing, has reached its EUL. Three indications that an AHU has reached its EUL are:

- Replacement parts are no longer available or require custom orders.
- Critical parts of the AHU can no longer be repaired.
- If there is significant corrosion in the frames or walls of the AHU. Indications may be visible holes in pressurized portions of the AHU, difficulty repairing structural members due to physical degradation, or corrosion is impacting the quality of the airstream.

Some external factors that may weigh in favor of replacing an AHU rather than repairing or replacing the components are:

- Conditions within the space or the use of the space served by the AHU have changed and the AHU can no longer meet the ventilation or thermal requirements.
- The AHU can longer meet current code requirements, particularly for indoor air quality.
- The life cycle cost of replacing the AHU is less than the life cycle cost of continuing to repair and replace components of the AHU.

Replacing an AHU often involves more than just the physical unit. Some potential complications of replacing an AHU include:

- Required electrical infrastructure upgrades.
- Control system upgrades to fully utilize expanded onboard features.
- Structural supports if the new unit is heavier.
- For roof mounted units, reconfiguration of roof penetrations and associated roof repairs if the new unit footprint differs from the original.
- For interior units, difficulties in physically removing and/or installing the units due to space constraints.
- Duct testing may be required for new units. New transitional ductwork may be required and additional repairs to existing ductwork may be warranted.
- Replacing an AHU typically requires a longer shut-down period than just repairing or replacing components of an AHU.

Repair Strategies

If the decision is made to replace AHU components, we recommend considering the following:

- If fans need to be replaced, consider using a plenum style fan array which consists of multiple fans in the cross section of the AHU. A fan array provides built in redundancy since there are multiple fans rather than a single fan and can provide more even flow across heating and cooling coils which will improve the effectiveness of the coils. Fan arrays also typically use direct drive fans with sealed bearings, greatly diminishing fan maintenance requirements.
- Consider replacing coils with more effective coils and drip pans.
- Where possible improve access to the components to facilitate maintenance.
- While making repairs, consider replacing other components which are at or beyond their useful life.

Code Compliance

New Jersey uses the ASHRAE Standard 90.1-2019 as the state energy code for commercial buildings (https://www.energycodes.gov/status/states/new-jersey). Section 6.1.1.3.1 of Standard 90.1-2019 addresses replacement of HVAC equipment and incorporates key electrical safety and air quality elements. Additional federal, state, and local codes may apply. In summary, ASHRAE compliance requirements are notable with expanded requirements for controls and fan efficiency as compared to prior code versions. While many of the unit code requirements are met at the point of purchase, expanded external controls may be required to fully meet code performance metrics.

The Standard excludes code compliance requirements for repairs or modifications as noted:

1. for *equipment* that is being modified or repaired but not replaced, provided that such modifications and/or *repairs* will not result in an increase in the annual *energy* consumption of the *equipment* using the same *energy* type;
2. where a replacement or *alteration of equipment* requires extensive revisions to other *systems, equipment*, or elements of a *building*, and such replaced or altered *equipment* is a like-for-like replacement;
3. for a refrigerant change of *existing equipment*;
4. for the relocation of *existing equipment*;
5. for ducts and *pipin*g where there is insufficient *space* or access to meet these requirements.

Therefore, in general if an air handler or a component of an air handler is being replaced it must meet the current energy code. Regarding air handlers Standard 90.1-2019 specifically addresses fans, fan control, motors, economizers, furnaces, duct furnaces, exhaust air energy recovery, controls, ductwork and piping but does not specifically address coils or control valves.

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

Weatherization

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

Doors and Windows

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

Lighting Maintenance

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

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

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

Motor Maintenance

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

Fans to Reduce Cooling Load

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

Thermostat Schedules and Temperature Resets

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

Economizer Maintenance

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

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

AC System Evaporator/Condenser Coil Cleaning

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

HVAC Filter Cleaning and Replacement

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

Ductwork Maintenance

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

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

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

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

Steam Trap Repair and Replacement

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

Boiler Maintenance

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

Label HVAC Equipment

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

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

Optimize HVAC Equipment Schedules

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

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

Water Heater Maintenance

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

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

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

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.

Computer Monitor Replacement

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

Procurement Strategies

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

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[7]. 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[8].

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[9] or download a copy of EPA's "WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities"[10] 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

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

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

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

[10] 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.

Commercial Kitchen Equipment

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

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

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

Dishwashers range in type and include undercounter, stationary/hood, conveyor, and flight-type models. Only run dishwashers when they are full, and fill racks to maximum capacity. Be sure to replace damaged dishwasher racks. Educate staff to scrape dishes prior to loading. Ensure that final rinse pressure and water temperature are within the manufacturer's recommendations. Operate the dishwasher close to or at the minimum flow rate and set rinse cycle time to the manufacturer's minimum recommended settings. Make sure that manual fill valves close completely after the wash tank is filled. Find and repair any leaks. Inspect valves and rinse nozzles for proper operation and repair worn nozzles. Look for ENERGY STAR qualified models when purchasing or leasing a new commercial dishwasher or replacing an existing unit. Consider your kitchen throughput to select an appropriately sized commercial dishwasher since an oversized dishwasher will waste water if the machine is not loaded to capacity.

Ice Machines

Commercial ice machines use refrigeration units to freeze water into ice. Ice machines typically use water for two purposes: cooling the refrigeration unit and making ice. Because the ice-making process generates a significant amount of heat, either water or air is used to remove this waste heat from the ice machine's refrigeration unit.

Water-cooled ice machines generally pass water through the machine once to cool it and then dispose of the single-pass water down the drain. Water-cooled systems can use less water by recirculating the cooling water through a chiller or a cooling tower to lower the temperature, returning the water to the machine for reuse. To eliminate using water to cool the refrigeration unit altogether, air can be used to cool the unit. Air-cooled ice machines use motor-driven fans or centrifugal blowers to move air through the refrigeration unit to remove heat. In general, water-cooled units are more energy efficient than air-cooled units but use more water. Commercial ice machines that are ENERGY STAR qualified are, on average, 15% more energy-efficient and 10% more water-efficient than standard air-cooled models.

For optimal ice machine efficiency, consider the following:

- Clean the ice machine to remove lime and scale buildup; sanitize it to kill bacteria and fungi. Run the self-cleaning sequence if available. For machines without a self-cleaning mode, shut down the machine, empty the bin of ice, add cleaning or sanitizing solution to the machine, switch it to cleaning mode, and then switch it to ice production mode. For health and safety purposes, create and discard several batches of ice to remove residual cleaning solution.
- Keep the ice machine's coils clean to ensure the heat exchange process is running efficiently.
- Keep the lid closed to preserve cool air and maintain the appropriate temperature.
- Install a timer to shift ice production to off-peak hours to decrease peak energy demand.
- Work with the manufacturer to ensure that the ice machine's rinse cycle is set to the lowest possible frequency that still provides sufficient ice quality and meets local water quality and site requirements.
- Follow the manufacturer's use and care instructions for the specific ice machine model.
- Train users to report leaking or otherwise improperly operating ice machines to the appropriate personnel.

If the machine is cooled using single-pass water, modify the machine to operate on a closed loop that recirculates the cooling water through a cooling tower or heat exchanger, if possible.

When replacing an ice machine or installing a new one, ensure that the new model is sized appropriately to fit the facility's need. Choose an ice machine that is appropriate for the quality of ice needed. Producing ice of higher quality than required will use water unnecessarily. Look for ENERGY STAR qualified models, all of which are air-cooled. Also consider air- or water-cooled ice machines that meet the efficiency specifications outlined by the Consortium for Energy Efficiency. If feasible, consider selecting air-cooled flake or nugget ice machines, which use less water and energy than cubed ice machines.

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.

Landscaping and Irrigation

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

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

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

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

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

7 On-Site Generation

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

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

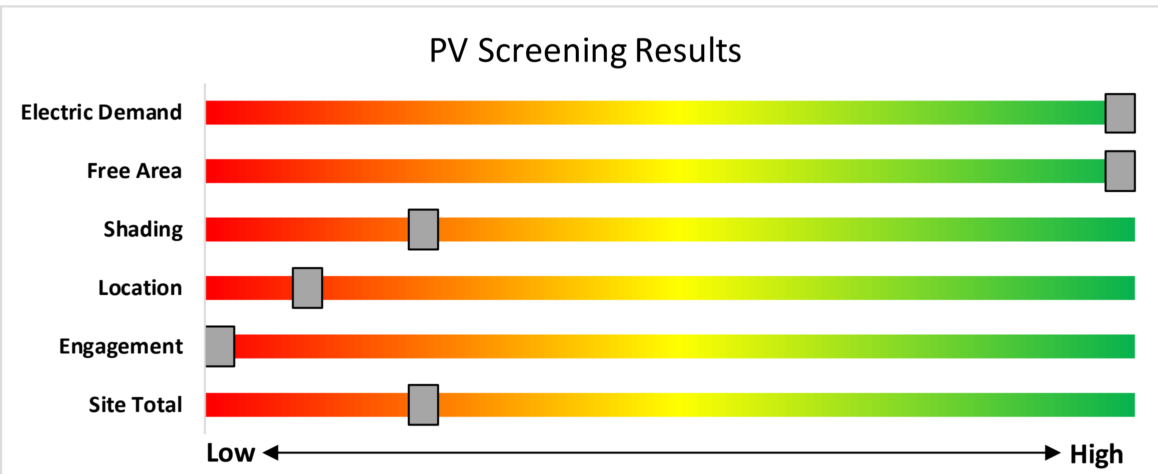
7.1 Solar Photovoltaic

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

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

This facility does not appear to meet the minimum criteria for a cost-effective solar expansion to the existing PV installation. To be cost-effective, a solar PV array needs certain minimum criteria, such as sufficient and sustained electric demand and sufficient flat or south-facing rooftop or other unshaded space on which to place the PV panels.

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



Photovoltaic Screening

Successor Solar Incentive Program (SuSI)

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

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

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

7.2 Combined Heat and Power

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

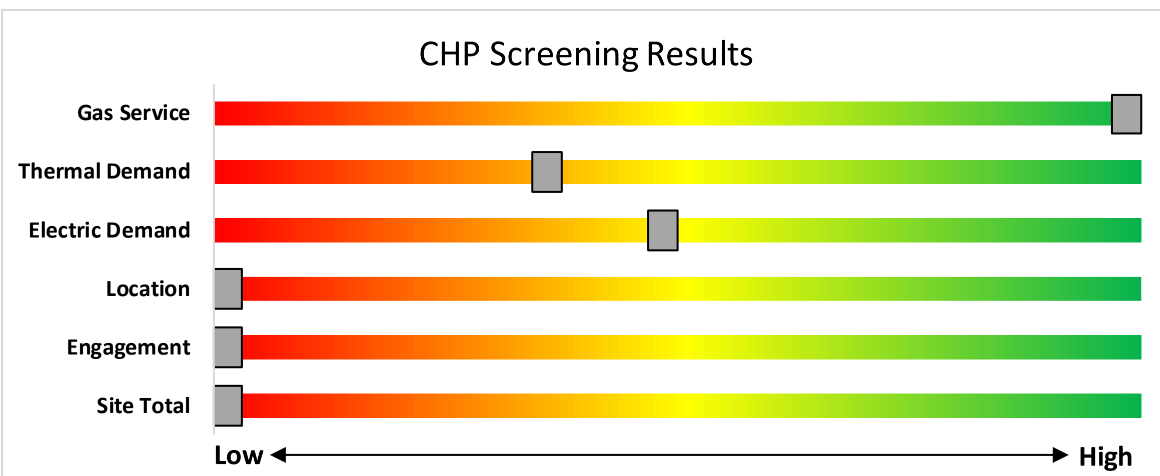
CHP systems typically produce a portion of the electric power used on-site, with the balance of electric power needs supplied by the local utility company. The heat is used to supplement (or replace) existing boilers and provide space heating and/or domestic hot water heating. Waste heat can also be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

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

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

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

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



Combined Heat and Power Screening

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

8 Electric Vehicles

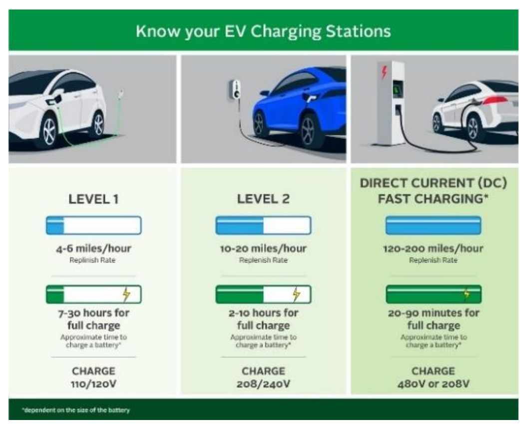
All electric vehicles (EVs) have an electric motor instead of an internal combustion engine. EVs function by plugging into a charge point, taking electricity from the grid, and then storing it in rechargeable batteries. Although electricity production may contribute to air pollution, the U.S. EPA categorizes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

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

8.1 EV Charging

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

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



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

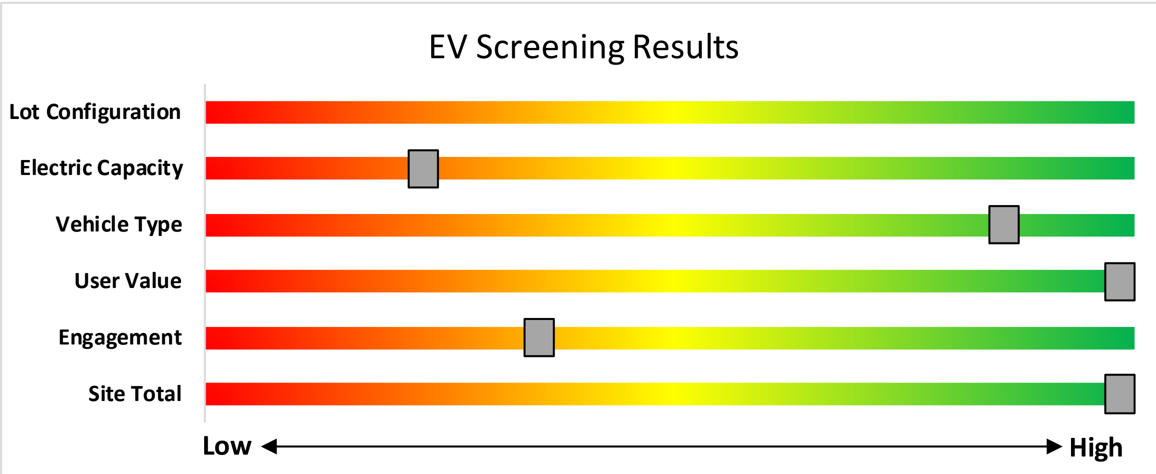
The primary costs associated with installing EV charging are the charger hardware and the cost to extend power from the facility to parking spaces. This may include upgrades to electric panels to serve increased loads.

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

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

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

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



EV Charger Screening

Electric Vehicle Programs Available

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

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

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

9 Project Funding and Incentives

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

NJBPU and NJCEP Administered Programs

New Jersey's cleanenergy program™

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

*State facilities are also eligible for utility programs

Utility Administered Programs

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

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

9.1 New Jersey's Clean Energy Program

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

Large Energy Users

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

Incentives

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

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

How to Participate

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

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

Combined Heat and Power

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

Incentives[11]

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

11

[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[12]. 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[13].

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.

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

[13] 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.

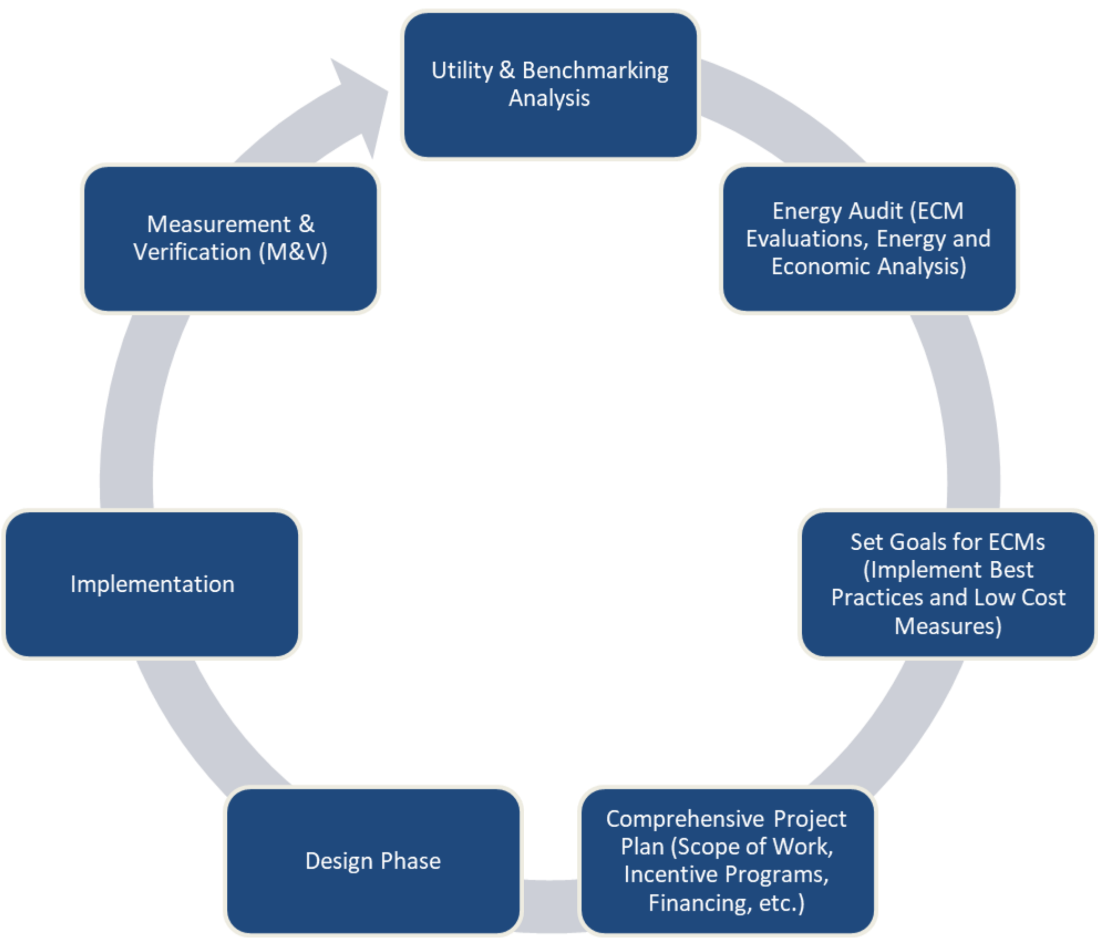
Engineered Solutions

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[14].

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[15].

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

[15] 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
Basement space	1	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	135	0	$14	$90	$0	6.3
Basement space	1	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch	S	60	600	2	Relamp	No	1	LED Lamps: A19 Lamps	Wall Switch	9	600	0.0	34	0	$4	$30	$0	8.4
Basement space	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	600		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	600	0.0	0	0	$0	$0	$0	0.0
Basement space	70	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,000	4	None	Yes	70	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	690	0.5	692	0	$74	$1,650	$180	19.9
111	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
113	8	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	45	2,400	4	None	Yes	8	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	45	1,656	0.1	295	0	$31	$330	$40	9.2
115	8	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	45	2,400	4	None	Yes	8	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	45	1,656	0.1	295	0	$31	$330	$40	9.2
117	8	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	45	2,400	4	None	Yes	8	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	45	1,656	0.1	295	0	$31	$330	$40	9.2
119	8	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	45	2,400	4	None	Yes	8	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	45	1,656	0.1	295	0	$31	$330	$40	9.2
120	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	285	0	$30	$330	$40	9.6
123	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	95	0	$10	$150	$20	12.9
130	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
131	16	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	16	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
132	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	285	0	$30	$330	$40	9.6
136	17	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	17	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	403	0	$43	$660	$70	13.7
137	38	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	38	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	902	0	$96	$990	$110	9.2
140	16	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	45	2,400	4	None	Yes	16	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	45	1,656	0.2	589	0	$63	$660	$70	9.4
141	24	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400	4	None	Yes	24	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,656	0.1	285	0	$30	$660	$70	19.4
143	32	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400	4	None	Yes	32	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,656	0.1	380	0	$40	$990	$110	21.8
145	32	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400	4	None	Yes	32	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,656	0.1	380	0	$40	$990	$110	21.8
147	27	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400	4	None	Yes	27	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,656	0.1	320	0	$34	$660	$70	17.3
150	6	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	6	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
151	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
152	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
153	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	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**
154	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
155	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
156	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
157	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
159	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
160	21	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400	4	None	Yes	21	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,656	0.1	249	0	$27	$660	$70	22.2
161	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
163	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
164	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
165	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400		None	No	18	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,400	0.0	0	0	$0	$0	$0	0.0
166	21	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400	4	None	Yes	21	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,656	0.1	249	0	$27	$660	$70	22.2
167	24	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400	4	None	Yes	24	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,656	0.1	285	0	$30	$660	$70	19.4
180	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	356	0	$38	$330	$40	7.6
182	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	356	0	$38	$330	$40	7.6
184	24	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	570	0	$61	$660	$70	9.7
186	24	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	570	0	$61	$660	$70	9.7
188	29	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	29	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	688	0	$73	$660	$70	8.0
190	24	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	570	0	$61	$660	$70	9.7
192	29	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	29	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	688	0	$73	$660	$70	8.0
Athletics Office	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	690	0.0	49	0	$5	$150	$20	24.7
Auditorium	83	Compact Fluorescent: (2) 28W Triple Biaxial Plug-In Lamps	Wall Switch	S	56	1,500	2, 4	Relamp	Yes	83	LED Lamps: GX23 (Plug-In) Lamps	Occupancy Sensor	40	1,035	1.7	3,889	-1	$414	$5,130	$380	11.5
Auditorium	17	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	17	LED Exit Signs: 2 W Lamp	None	6	8,760	0.2	2,293	0	$244	$1,500	$0	6.1
Auditorium	32	Incandescent: (1) 75W A19 Screw-In Lamp	Wall Switch	S	75	1,000	2, 4	Relamp	Yes	32	LED Lamps: A19 Lamps	Occupancy Sensor	12	690	1.5	2,349	0	$250	$1,800	$140	6.6
Auditorium	31	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	31	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.2	613	0	$65	$990	$110	13.5
Auditorium	12	Linear Fluorescent - T8: 4' T8 (32W) - 1L	Wall Switch	S	32	2,000	2, 4	Relamp	Yes	12	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,380	0.2	581	0	$62	$630	$100	8.6

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Corridor 3	19	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	19	LED Exit Signs: 2 W Lamp	None	6	8,760	0.2	2,563	-1	$273	$1,680	$0	6.2
Corridor 3	172	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	4,380	6	None	Yes	172	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	3,022	1.1	7,450	-2	$794	$8,170	$6,020	2.7
Dining Area 1	6	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	6	LED Exit Signs: 2 W Lamp	None	6	8,760	0.1	809	0	$86	$530	$0	6.1
Dining Area 1	14	LED - Fixtures: High-Bay	Wall Switch	S	75	2,200		None	No	14	LED - Fixtures: High-Bay	Wall Switch	75	2,200	0.0	0	0	$0	$0	$0	0.0
Dining Area 1	109	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,200	4	None	Yes	109	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,518	0.4	1,186	0	$126	$2,650	$280	18.8
Dining Area 1	40	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,200	4	None	Yes	40	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,518	0.3	870	0	$93	$990	$110	9.5
Exterior 1	15	Incandescent: (1) 60W A19 Screw-In Lamp	Wall Switch		60	8,760	2, 5	Relamp	Yes	15	LED Lamps: A19 Lamps	Photocell	9	4,380	0.0	7,293	0	$798	$1,360	$20	1.7
Exterior 1	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch		45	8,760		None	No	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	45	8,760	0.0	0	0	$0	$0	$0	0.0
Exterior 1	8	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock		20	4,380		None	No	8	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock	20	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	19	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock		15	4,380		None	No	19	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock	15	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior 1	4	High-Pressure Sodium: (1) 150W Lamp	Timeclock		188	4,380	1	Fixture Replacement	No	4	LED - Fixtures: Outdoor Porch Wall Mount	Timeclock	45	4,380	0.0	2,505	0	$274	$2,480	$20	9.0
Gym entrance	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
Gym entrance	20	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	3,500	6	None	Yes	20	LED Lamps: (1) 10W A19 Screw-In Lamp	High/Low Control	10	2,415	0.0	239	0	$25	$1,130	$700	16.9
Gymnasium 1	5	Compact Fluorescent: (3) 13W Biaxial Plug-In Lamps	Wall Switch	S	39	2,000	2, 4	Relamp	Yes	5	LED Lamps: GX23 (Plug-In) Lamps	Occupancy Sensor	28	1,380	0.1	216	0	$23	$580	$60	22.6
Gymnasium 1	4	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	4	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	540	0	$57	$350	$0	6.1
Gymnasium 1	91	LED - Fixtures: Ambient 1x4 Fixture	Wall Switch	S	45	2,500		None	No	91	LED - Fixtures: Ambient 1x4 Fixture	Wall Switch	45	2,500	0.0	0	0	$0	$0	$0	0.0
Gymnasium 1	16	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	S	17	2,500	4	None	Yes	16	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,725	0.1	232	0	$25	$660	$70	23.9
Gymnasium 1	106	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,500	4	None	Yes	106	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,725	0.3	1,310	0	$140	$2,650	$280	17.0
Gymnasium 1	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	2, 4	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	277	0	$30	$480	$70	13.9
Health Office	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	178	0	$19	$330	$40	15.3
Mechanical 1	2	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	270	0	$29	$180	$0	6.3
Mechanical 1	6	LED - Fixtures: Ambient 1x4 Fixture	Wall Switch	S	25	1,000	4	None	Yes	6	LED - Fixtures: Ambient 1x4 Fixture	Occupancy Sensor	25	690	0.0	51	0	$5	$330	$40	53.2
Mechanical 1	11	LED - Fixtures: High-Bay	Wall Switch	S	75	1,000		None	No	11	LED - Fixtures: High-Bay	Wall Switch	75	1,000	0.0	0	0	$0	$0	$0	0.0
Mechanical 4	2	Compact Fluorescent: (3) 13W Biaxial Plug-In Lamps	Wall Switch	S	39	600	2	Relamp	No	2	LED Lamps: GX23 (Plug-In) Lamps	Wall Switch	28	600	0.0	15	0	$2	$100	$10	58.2
Mechanical 5	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	600		None	No	2	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	600	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
Multipurpose 2	19	LED - Fixtures: Ambient 1x4 Fixture	Wall Switch	S	20	2,000	4	None	Yes	19	LED - Fixtures: Ambient 1x4 Fixture	Occupancy Sensor	20	1,380	0.1	259	0	$28	$660	$70	21.4
Multipurpose 2	10	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	45	2,000	4	None	Yes	10	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	45	1,380	0.1	307	0	$33	$330	$40	8.9
Office - Open Plan 1	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
Office - Open Plan 1	2	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	2,400		None	No	2	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	2,400	0.0	0	0	$0	$0	$0	0.0
Office - Open Plan 1	31	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	31	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	736	0	$78	$990	$110	11.2
Office - Open Plan 2	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
Office - Open Plan 2	62	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	62	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.4	1,471	0	$157	$1,650	$180	9.4
Office 3	20	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,920	4	None	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,325	0.1	380	0	$40	$660	$70	14.6
Restroom - Female 5	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.0	148	0	$16	$330	$40	18.4
Restroom - Female 6	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.1	237	0	$25	$330	$40	11.5
Restroom - Female 7	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.1	237	0	$25	$330	$40	11.5
Restroom - Female 8	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	3,000		None	No	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,000	0.0	0	0	$0	$0	$0	0.0
Restroom - Male 6	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.0	148	0	$16	$330	$40	18.4
Restroom - Male 7	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.1	237	0	$25	$330	$40	11.5
Restroom - Male 8	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.1	237	0	$25	$330	$40	11.5
Restroom - Male 9	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	S	29	3,000		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	3,000	0.0	0	0	$0	$0	$0	0.0
Server Room 1	8	LED - Fixtures: Ambient 1x4 Fixture	Wall Switch	S	25	1,000	4	None	Yes	8	LED - Fixtures: Ambient 1x4 Fixture	Occupancy Sensor	25	690	0.0	68	0	$7	$330	$40	39.9
Stairs 1	1	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	135	0	$14	$90	$0	6.3
Stairs 1	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	6	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,415	0.0	208	0	$22	$280	$210	3.2
Stairs 2	2	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	2	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	270	0	$29	$180	$0	6.3
Stairs 2	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	6	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,415	0.1	277	0	$29	$560	$280	9.5
Stairs 3	1	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	135	0	$14	$90	$0	6.3
Stairs 3	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	6	None	Yes	4	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,415	0.0	138	0	$15	$280	$140	9.5
Stairs 4	1	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	135	0	$14	$90	$0	6.3
Stairs 4	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	6	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,415	0.0	208	0	$22	$280	$210	3.2

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Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Stairs 5	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	6	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,415	0.0	173	0	$18	$280	$180	5.4
Stairs 6	1	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	135	0	$14	$90	$0	6.3
Stairs 6	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	6	None	Yes	15	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,415	0.1	519	0	$55	$280	$280	0.0
Stairs 7	1	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	135	0	$14	$90	$0	6.3
Stairs 7	20	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	6	None	Yes	20	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,415	0.1	692	0	$74	$560	$560	0.0
Stairs 8	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	6	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,415	0.0	173	0	$18	$280	$180	5.4
Storage 19	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	600	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	414	0.0	36	0	$4	$150	$20	34.3
Storage 20	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	500		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	500	0.0	0	0	$0	$0	$0	0.0
Storage 21	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	0	0	$0	$0	$0	0.0
Storage 22	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	500		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	500	0.0	0	0	$0	$0	$0	0.0
Storage 23	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	0	0	$0	$0	$0	0.0
Storage 24	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	0	0	$0	$0	$0	0.0
Storage 25	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	500		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	500	0.0	0	0	$0	$0	$0	0.0
Storage 26	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	500		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	500	0.0	0	0	$0	$0	$0	0.0
Storage 27	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	500		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	500	0.0	0	0	$0	$0	$0	0.0
Storage 28	3	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	500		None	No	3	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	500	0.0	0	0	$0	$0	$0	0.0
Storage 29	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	0	0	$0	$0	$0	0.0
Storage 30	3	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	500		None	No	3	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	500	0.0	0	0	$0	$0	$0	0.0
Storage 32	2	Compact Fluorescent: (1) 26W Spiral Plug-In Lamp	Wall Switch	S	26	500	2	Relamp	No	2	LED Lamps: A19 Lamps	Wall Switch	19	500	0.0	8	0	$1	$50	$0	61.0
Storage 32	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	500	0.0	0	0	$0	$0	$0	0.0
Storage 33	2	Compact Fluorescent: (1) 26W Spiral Plug-In Lamp	Wall Switch	S	26	500	2	Relamp	No	2	LED Lamps: A19 Lamps	Wall Switch	19	500	0.0	8	0	$1	$50	$0	61.0
Storage 34	2	Compact Fluorescent: (1) 26W Spiral Plug-In Lamp	Wall Switch	S	26	500	2	Relamp	No	2	LED Lamps: A19 Lamps	Wall Switch	19	500	0.0	8	0	$1	$50	$0	61.0
Storage 35	2	Compact Fluorescent: (1) 26W Spiral Plug-In Lamp	Wall Switch	S	26	500	2	Relamp	No	2	LED Lamps: A19 Lamps	Wall Switch	19	500	0.0	8	0	$1	$50	$0	61.0
Student center	1	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	135	0	$14	$90	$0	6.3
Student center	30	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	4	None	Yes	30	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.2	1,038	0	$111	$660	$70	5.3

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220	24	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400	4	None	Yes	24	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,656	0.1	285	0	$30	$660	$70	19.4
222	8	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	2,400	4	None	Yes	8	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	1,656	0.0	95	0	$10	$330	$40	28.7
223	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	95	0	$10	$150	$20	12.9
224	35	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	35	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	831	0	$88	$990	$110	9.9
231	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1
232	36	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	36	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	854	0	$91	$990	$110	9.7
233	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	356	0	$38	$330	$40	7.6
234	36	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	36	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	854	0	$91	$990	$110	9.7
235	18	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	427	0	$46	$660	$70	13.0
237	21	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	21	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	498	0	$53	$660	$70	11.1
238	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	166	0	$18	$330	$40	16.4
238F	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
239	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	285	0	$30	$330	$40	9.6
240	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	166	0	$18	$330	$40	16.4
242	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	356	0	$38	$330	$40	7.6
243	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	285	0	$30	$330	$40	9.6
244	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	285	0	$30	$330	$40	9.6
246	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
247	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
248	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
249	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
250	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	71	0	$8	$150	$20	17.1
251	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1
252	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1
253	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1

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254	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1
255	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1
256	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1
257	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1
258	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,000		None	No	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	0	0	$0	$0	$0	0.0
259	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1
260	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	142	0	$15	$330	$40	19.1
261	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
262	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
263	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
264	7	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.0	166	0	$18	$330	$40	16.4
265	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
266	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
267	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	214	0	$23	$330	$40	12.7
280	16	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	16	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.1	380	0	$40	$660	$70	14.6
282	29	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	29	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	688	0	$73	$660	$70	8.0
284	24	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	570	0	$61	$660	$70	9.7
286	29	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	29	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	688	0	$73	$660	$70	8.0
288	24	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	570	0	$61	$660	$70	9.7
290	29	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,400	4	None	Yes	29	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,656	0.2	688	0	$73	$660	$70	8.0
Corridor 2	14	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	14	LED Exit Signs: 2 W Lamp	None	6	8,760	0.1	1,889	0	$201	$1,240	$0	6.2
Corridor 2	140	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	4,380	6	None	Yes	140	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	3,022	0.9	6,064	-1	$646	$6,760	$4,900	2.9
Counselor	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,500	4	None	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,035	0.0	59	0	$6	$150	$20	20.6
Counselor 2	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,500		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,500	0.0	0	0	$0	$0	$0	0.0
Faculty room	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,500	4	None	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,035	0.1	148	0	$16	$330	$40	18.4

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Library 1	1	Compact Fluorescent: (1) 26W Spiral Plug-In Lamp	Wall Switch	S	26	2,000	2	Relamp	No	1	LED Lamps: A19 Lamps	Wall Switch	19	2,000	0.0	15	0	$2	$30	$0	18.3
Library 1	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Library 1	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	S	10	2,000		None	No	1	LED Lamps: (1) 10W A19 Screw-In Lamp	Wall Switch	10	2,000	0.0	0	0	$0	$0	$0	0.0
Library 1	144	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	25	2,000	4	None	Yes	144	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	25	1,380	0.8	2,455	-1	$262	$3,310	$350	11.3
Library 1	38	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	45	2,000	4	None	Yes	38	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	45	1,380	0.4	1,166	0	$124	$990	$110	7.1
Library 1	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,000	2, 4	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	185	0	$20	$250	$40	10.7
Mechanical 2	6	Compact Fluorescent: (1) 32W Biaxial Plug-In Lamp	Wall Switch	S	32	1,000	2	Relamp	No	6	LED Lamps: GX23 (Plug-In) Lamps	Wall Switch	23	1,000	0.0	59	0	$6	$80	$10	11.1
Mechanical 3	11	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	1,000	4	None	Yes	11	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	690	0.0	54	0	$6	$330	$40	50.1
Restroom - Female 2	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.0	148	0	$16	$330	$40	18.4
Restroom - Female 3	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.0	148	0	$16	$330	$40	18.4
Restroom - Female 4	3	Compact Fluorescent: (3) 13W Biaxial Plug-In Lamps	Wall Switch	S	39	3,000	2, 4	Relamp	Yes	3	LED Lamps: GX23 (Plug-In) Lamps	Occupancy Sensor	28	2,070	0.0	195	0	$21	$480	$50	20.7
Restroom - Female 4	3	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	S	22	3,000	2, 4	Relamp	Yes	3	LED - Linear Tubes: (1) 2' Lamp	Occupancy Sensor	9	2,070	0.0	160	0	$17	$410	$50	21.2
Restroom - Male 2	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.0	148	0	$16	$330	$40	18.4
Restroom - Male 3	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.0	148	0	$16	$330	$40	18.4
Restroom - Male 4	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,070	0.0	148	0	$16	$330	$40	18.4
Restroom - Male 5	4	Compact Fluorescent: (3) 13W Biaxial Plug-In Lamps	Wall Switch	S	39	3,000	2, 4	Relamp	Yes	4	LED Lamps: GX23 (Plug-In) Lamps	Occupancy Sensor	28	2,070	0.1	260	0	$28	$530	$50	17.3
Restroom - Male 5	3	Linear Fluorescent - T8: 2' T8 (17W) - 1L	Wall Switch	S	22	3,000	2, 4	Relamp	Yes	3	LED - Linear Tubes: (1) 2' Lamp	Occupancy Sensor	9	2,070	0.0	160	0	$17	$410	$50	21.2
Restroom - Unisex 2	1	Compact Fluorescent: (3) 13W Biaxial Plug-In Lamps	Wall Switch	S	39	1,000	2	Relamp	No	1	LED Lamps: GX23 (Plug-In) Lamps	Wall Switch	28	1,000	0.0	12	0	$1	$50	$0	38.8
Storage 10	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Storage 11	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500	4	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	345	0.1	40	0	$4	$330	$40	68.8
Storage 12	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Storage 13	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Storage 14	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500	4	None	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	345	0.0	20	0	$2	$150	$20	61.7
Storage 15	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Storage 16	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0

	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
Storage 17	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Storage 18	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500	4	None	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	345	0.0	20	0	$2	$150	$20	61.7
Storage 31	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Storage 5	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Storage 6	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	345	0.1	45	0	$5	$330	$40	61.2
Storage 7	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	345	0.0	30	0	$3	$150	$20	41.1
Storage 8	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Storage 9	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200	4	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	138	0.1	16	0	$2	$150	$20	77.1
380	15	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	15	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	297	0	$32	$330	$40	9.2
382	24	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.2	475	0	$51	$660	$70	11.7
384F	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	198	0	$21	$330	$40	13.8
386	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.1	198	0	$21	$330	$40	13.8
388	24	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.2	475	0	$51	$660	$70	11.7
390	29	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	29	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.2	574	0	$61	$660	$70	9.7
392	24	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.2	475	0	$51	$660	$70	11.7
394	29	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	29	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.2	574	0	$61	$660	$70	9.7
Corridor 1	4	Exit Signs: Incandescent	None		20	8,760	3	Fixture Replacement	No	4	LED Exit Signs: 2 W Lamp	None	6	8,760	0.0	540	0	$57	$350	$0	6.1
Corridor 1	26	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	4,380	6	None	Yes	26	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	3,022	0.2	1,126	0	$120	$1,410	$910	4.2
Office - Enclosed 1	4	Compact Fluorescent: (1) 26W Spiral Plug-In Lamp	Wall Switch	S	26	1,500	2	Relamp	No	4	LED Lamps: A19 Lamps	Wall Switch	19	1,500	0.0	46	0	$5	$100	$0	20.3
Restroom - Female 1	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.0	99	0	$11	$330	$40	27.5
Restroom - Male 1	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	2,000	4	None	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,380	0.0	99	0	$11	$330	$40	27.5
Restroom - Unisex 1	1	Compact Fluorescent: (3) 13W Biaxial Plug-In Lamps	Wall Switch	S	39	1,000	2	Relamp	No	1	LED Lamps: GX23 (Plug-In) Lamps	Wall Switch	28	1,000	0.0	12	0	$1	$50	$0	38.8
Storage 1	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0
Storage 2	9	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500	4	None	Yes	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	345	0.1	45	0	$5	$330	$40	61.2
Storage 3	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	500	4	None	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	345	0.0	30	0	$3	$150	$20	41.1

	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
Storage 4	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	200		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	200	0.0	0	0	$0	$0	$0	0.0

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 1	Pneumatic Controls	2	Air Compressor	3.00	81.5%	No	Marathon	UVJ 182TTDR7026DF	B	1,000		No	81.5%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 1	Pneumatic Controls	2	Air Compressor	3.00	82.5%	No	Baldor	35L101T729	W	1,000		No	82.5%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 1	Boilers	3	Boiler Feed Water Pump	0.75	81.1%	No	US Motors	P63ELC-5016	W	1,400		No	81.1%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 1	Steam Boilers	2	Combustion Air Fan	7.50	88.5%	No	Marathon	TVE184TTD	W	2,080	10	No	89.5%	Yes	2	4.5	10,061	0	$1,101	$13,400	$2,000	10.4
Mechanical 1	Steam Heating System	2	Condensate Pump	2.00	86.5%	No	Baldor	VEM3558T	W	1,400	12	No	86.5%	Yes	2	0.4	1,811	0	$198	$9,400	$200	46.4
Mechanical 1	Steam Heating System	2	Condensate Pump	1.00	85.5%	No	US Motors	P63ELD-5017	W	1,400		No	85.5%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 1	Vacuum Pumps	2	Process Pump	1.50	86.5%	No	US Motors	P63TLH-4853	W	1,200		No	86.5%	No		0.0	0	0	$0	$0	$0	0.0
136, 137	136, 137	2	Exhaust Fan	0.25	69.5%	No			W	1,000		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Exterior 1	Ventilation	18	Exhaust Fan	0.25	69.5%	No			W	8,760		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Exterior 1	Lab Ventilation	9	Exhaust Fan	0.75	80.0%	No			W	800		No	80.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 1	Aerco Boilers 2500	2	Heating Hot Water Pump	7.50	88.5%	Yes	WEG	0736OT3E184	W	2,600		No	88.5%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 1	HHW system	1	Heating Hot Water Pump	2.00	80.0%	No	US Motors	G154	B	2,600	9	No	86.5%	Yes	1	0.3	2,064	0	$226	$4,700	$100	20.4
Mechanical 1	HHW system	1	Heating Hot Water Pump	2.00	86.5%	No	Baldor	EJMM3558T	W	2,600	9	No	86.5%	Yes	1	0.2	1,682	0	$184	$4,700	$100	25.0
Mechanical 3	Aerco Boilers 2000	2	Heating Hot Water Pump	7.50	88.5%	No	US Motors	AD79A	W	2,600	9	No	91.0%	Yes	2	1.6	12,938	0	$1,416	$13,400	$2,000	8.1
136	Classroom Stove Ventilation	3	Kitchen Hood Exhaust Fan	0.25	69.5%	No			W	500		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Basement space, Mechanical 5, Other	Elevators	3	Other	30.00	74.0%	No	US Motors	EZ30S1	W	100		No	74.0%	No		0.0	0	0	$0	$0	$0	0.0
137	Air Purifiers	4	Ventilation Fan	0.50	76.0%	No			W	1,000		No	76.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 1	Sump Pump	2	Process Pump	1.00	85.5%	No			W	400		No	85.5%	No		0.0	0	0	$0	$0	$0	0.0
Gymnasium 1	Large Ceiling Fan	1	Ventilation Fan	0.50	78.2%	No			W	2,000		No	78.2%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 4	Heating and Ventilation	2	Ventilation Fan	1.00	85.0%	No			B	8,760		No	85.0%	No		0.0	0	0	$0	$0	$0	0.0

		Existing Conditions									Proposed Conditions					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Manufacturer	Model	Remaining Useful Life	Annual Operating Hours	ECM #	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical 4	Heating and Ventilation	2	Ventilation Fan	2.00	86.0%	No			B	8,760	8	No	86.5%	Yes	2	1.2	7,271	0	$796	$9,400	$200	11.6
Mechanical 1	DHW system, BTH-500A	3	DHW Circulation Pump	0.17	60.0%	No	Bell & Gossett	PL45B 1BL004	W	3,300		No	60.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 3	DHW system, BTH-199	1	DHW Circulation Pump	0.04	60.0%	No	Taco	007-SF5	B	8,760		No	60.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 1	DHW system, BTH-500A	1	DHW Circulation Pump	0.17	60.0%	No	Grundfos		W	100		No	60.0%	No		0.0	0	0	$0	$0	$0	0.0
Kitchen	Kitchen Hood	1	Kitchen Hood Exhaust Fan	1.00	85.5%	No			W	1,500	11	No	85.5%	Yes	1	0.0	3,938	130	$2,248	$3,900	$100	1.7
Office - Open Plan 1	Offices heating and cooling	1	Supply Fan	0.25	69.5%	No			W	8,760		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Office - Open Plan 2	Offices heating and cooling	1	Supply Fan	0.25	69.5%	No			W	8,760		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical 2	Various, Heating and Cooling	2	Supply Fan	2.00	86.5%	No			W	8,760	8	No	86.5%	Yes	2	1.1	8,132	0	$890	$9,400	$200	10.3
Exterior 1	Various, Heating and Cooling	2	Supply Fan	2.00	86.0%	No			B	8,760	8	No	86.5%	Yes	2	1.2	8,251	0	$903	$9,400	$200	10.2
Exterior 1	Various, Heating and Cooling	2	Exhaust Fan	1.00	85.0%	No			B	8,760	8	No	85.5%	Yes	2	0.6	3,637	0	$398	$7,900	$200	19.3
Exterior 1	Various, Heating and Cooling	3	Supply Fan	1.00	85.0%	No			B	8,760	8	No	85.5%	Yes	3	0.9	6,190	0	$677	$11,800	$200	17.1
Exterior 1	Various, Heating and Cooling	3	Exhaust Fan	1.00	85.0%	No			B	8,760	8	No	85.5%	Yes	3	0.9	5,455	0	$597	$11,800	$200	19.4
Exterior 1	Large Space, Heating and Cooling	1	Supply Fan	30.00	93.0%	No			B	8,760	8	No	94.1%	Yes	1	8.7	62,653	0	$6,856	$16,700	$1,500	2.2
Exterior 1	Large Space, Heating and Cooling	1	Return Fan	15.00	92.0%	No			B	8,760	8	No	93.0%	Yes	1	4.5	27,593	0	$3,020	$10,300	$1,200	3.0
Exterior 1	cooling	40	Supply Fan	0.08	65.0%	No			W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Exterior 1	Large Space, Heating and Cooling	1	Supply Fan	15.00	92.0%	No			B	8,760	8	No	93.0%	Yes	1	4.4	31,268	0	$3,422	$10,300	$1,200	2.7
Exterior 1	Large Space, Heating and Cooling	1	Return Fan	2.00	86.0%	No			B	8,760	8	No	86.5%	Yes	1	0.6	3,635	0	$398	$4,700	$100	11.6
Corridor 3	Corridor 3, electric heat	1	Fan Coil Unit	0.25	69.5%	No			W	400		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Dining Area 1	Dining Area 1, HHW	1	Fan Coil Unit	0.25	69.5%	No			W	400		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0

		Existing Conditions									Proposed Conditions					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Manufacturer	Model	Remaining Useful Life	Annual Operating Hours	ECM #	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical 3	Mechanical 3, HHW	1	Fan Coil Unit	0.25	69.5%	No			W	400		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Various Storage Rooms	Various Storage Rooms, HHW	12	Fan Coil Unit	0.25	69.5%	No			W	200		No	69.5%	No		0.0	0	0	$0	$0	$0	0.0
Various Classrooms	Various Classrooms	46	Fan Coil Unit	0.17	64.0%	No			W	8,760	7	Yes	74.0%	No		0.7	7,934	0	$868	$14,600	$0	16.8
Auditorium	Auditorium	1	Fan Coil Unit	0.17	64.0%	No			W	8,760	7	Yes	74.0%	No		0.0	172	0	$19	$300	$0	15.9
Dining Area 1	Dining Area 1	2	Fan Coil Unit	0.17	64.0%	No			W	8,760	7	Yes	74.0%	No		0.0	345	0	$38	$600	$0	15.9
Gymnasium 1	Gymnasium 1	1	Fan Coil Unit	0.17	64.0%	No			W	8,760	7	Yes	74.0%	No		0.0	172	0	$19	$300	$0	15.9
Various Stairs	Various Stairs	8	Fan Coil Unit	0.17	64.0%	No			W	8,760	7	Yes	74.0%	No		0.1	1,380	0	$151	$2,500	$0	16.6
Student center	Student center	1	Fan Coil Unit	0.17	64.0%	No			W	8,760	7	Yes	74.0%	No		0.0	172	0	$19	$300	$0	15.9
Library	Library	8	Fan Coil Unit	0.17	64.0%	No			W	8,760	7	Yes	74.0%	No		0.1	1,380	0	$151	$2,500	$0	16.6
Exterior 1	CRAC outdoor units	1	Supply Fan	1.50	86.5%	Yes			W	4,000		No	86.5%	No		0.0	0	0	$0	$0	$0	0.0
Exterior 1	CRAC outdoor units	4	Supply Fan	1.50	86.5%	No			W	4,000		No	86.5%	No		0.0	0	0	$0	$0	$0	0.0
Exterior 1	CRAC indoor units	3	Fan Coil Unit	0.50	80.0%	No			W	4,000		No	80.0%	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
Exterior 1	Heating and Cooling	2	Package Unit	8.00	27.30	11.20		Aaon	RK-08-2-E0-760	B	13	Yes	2	Package Unit	8.00	27.30	14.00		1.7	1,474	0	$161	$34,900	$1,300	208.3
Exterior 1	Heating and Cooling	3	Package Unit	6.00	20.47	11.20		Aaon	RK-06-2-E0-33M	B	13	Yes	3	Package Unit	6.00	20.47	14.00		1.9	1,659	0	$181	$43,800	$1,400	233.6
Exterior 1	Large Space, Heating and Cooling	1	Package Unit	80.00	249.00	10.30		McQuay	RFS080CSW	B	13	Yes	1	Package Unit	80.00	249.00	12.00		6.6	5,678	0	$621	$145,000	$6,200	223.4
Exterior 1	Large Space, Cooling	1	Split-System	80.00		10.30		McQuay	RCS080CYY	B	13	Yes	1	Split-System	80.00		12.00		6.6	5,678	0	$621	$134,600	$6,200	206.7
Exterior 1	Large Space, Heating and Cooling	1	Package Unit	40.00	125.00	10.20		McQuay	RPS040CLW	B	13	Yes	1	Package Unit	40.00	125.00	12.50		4.3	3,464	0	$379	$68,600	$3,400	172.0
Exterior 1	Classroom	1	Package Unit	2.00	48.60	13.00	0.81 AFUE	Trane	4YCC4024A1060AC	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Corridor 3	1	Unit Heater		25.59		1 COP	Dayton		W		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Classroom	1	Split-System	5.00		14.00		Guardian	GAW14L60C22SA	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Classroom	1	Split-System	5.00		10.00		York	HABA-T060SG	B	13	Yes	1	Split-System	5.00		16.00		1.1	900	0	$98	$10,800	$500	104.6
Exterior 1	Classrooms	2	Split-System	3.00		13.00		Guardian	GCGD36S21S2C	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Classrooms	6	Split-System	3.00		12.50		Lennox	HS26-036-3P	B		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	CRAC units	1	Split-System	6.00		13.00		Liebert - Vertiv	MCL055E1YDQ953	W	13	Yes	1	Split-System	6.00		14.00		0.2	1,582	0	$173	$12,000	$500	66.4
Exterior 1	Classrooms	9	Split-System	1.50		11.80		Lennox	HS26-018-4P	B		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	CRAC units	1	Split-System	12.00		13.00			PSA	W	13	Yes	1	Split-System	12.00		14.00		0.4	3,165	0	$346	$20,200	$1,100	55.1
Exterior 1	Classroom	1	Split-System	3.00		14.00		Trane	TSC036E1R0A06H	B		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Classrooms	4	Split-System	3.00		13.00		Thermal Zone	TZAA-336-2N	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Cooling	2	Split-System	25.00		10.00		McQuay	RCS025CYY	W	13	Yes	2	Split-System	25.00		12.50		6.0	5,160	0	$565	$104,900	$4,300	178.2
Exterior 1	Classroom	1	Split-System	3.00		13.00		ICP	NAC036GKC3	B		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Cooling	1	Split-System	60.00		10.00		McQuay	RCS060DYY	W	13	Yes	1	Split-System	60.00		12.50		7.2	6,192	0	$678	$105,800	$5,100	148.6
Exterior 1	Classroom	1	Split-System	4.00		12.50		Lennox	HS26-048-4P	B		No							0.0	0	0	$0	$0	$0	0.0

		Existing Conditions									Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Manufacturer	Model	Remaining Useful Life	ECM #	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (kBtu/hr)	Cooling Mode Efficiency (SEER/EER)	Heating Mode Efficiency	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Exterior 1	Classroom	2	Ductless Mini-Split AC	2.02		18.00		Futjitsu	AOU24CL	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Classroom	4	Ductless Mini-Split AC	3.00		13.00		Daikin	RZQ36MVJU	B		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Various, Room 231	1	Ductless Mini-Split HP	1.50	19.00	19.00	3.8 COP	Mitsubishi Electric	PUZ-A19NKA7	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Classroom	1	Ductless Mini-Split AC	1.00		16.00		Daikin	RK12NMVJU	W		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Classroom	1	Ductless Mini-Split AC	2.56		15.00		Futjitsu	AOU30CLx	B		No							0.0	0	0	$0	$0	$0	0.0
Exterior 1	Heating and Cooling	1	Ductless Mini-Split HP	10.00	135.00	18.00	3.8 COP	Daikin	REYQ120XATJU	W		No							0.0	0	0	$0	$0	$0	0.0
Basement space	Basement space	2	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
First Floor Classrooms	First Floor Classrooms	33	Window AC	1.00		11.20		Various		W		No							0.0	0	0	$0	$0	$0	0.0
Dining Area 1	Dining Area 1	2	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Gymnasium 1	Gymnasium 1	1	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Office - Open Plan 1	Office - Open Plan 1	3	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Office - Open Plan 2	Office - Open Plan 2	3	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Server Room 1	Server Room 1	1	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Student center	Student center	1	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Second Floor Classrooms	Second Floor Classrooms	20	Window AC	1.00		11.20		Various		W		No							0.0	0	0	$0	$0	$0	0.0
Counselor	Counselor	1	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Counselor 2	Counselor 2	1	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Library 1	Library 1	1	Window AC	1.00		11.20		Friedrich		W		No							0.0	0	0	$0	$0	$0	0.0
Third Floor Classrooms	Third Floor Classrooms	4	Window AC	1.00		10.50		Various		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 1	Main Building	2	Condensing Hot Water Boiler	2,338	Aerco	BMK 2500	W		No						0.0	0	0	$0	$0	$0	0.0
Mechanical 3	Main Building	2	Condensing Hot Water Boiler	1,720	Aerco	BMK2.0 BTU 201177	B	14	Yes	2	Condensing Hot Water Boiler	1,720	93.00%	Et	0.0	0	75	$1,049	$131,300	$7,600	117.9
Mechanical 1	Main Building	2	Forced Draft Steam Boiler	6,695	Easco Boiler Corp.	FPS200-S015	W		No						0.0	0	0	$0	$0	$0	0.0

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 1	Main Building	3	Storage Tank Water Heater (> 50 Gal)	A.O. Smith	BTH-500A 300	W		No						0.0	0	0	$0	$0	$0	0.0
Mechanical 3	Main Building	1	Storage Tank Water Heater (> 50 Gal)	A.O. Smith	BTH-199 970	B	15	Yes	1	Storage Tank Water Heater (> 50 Gal)	Natural Gas	93.00%	Et	0.0	0	7	$94	$10,200	$700	100.6

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
Restrooms	16	59	Faucet Aerator (Lavatory)	2.20	0.50	0.0	0	56	$781	$500	$240	0.3
Restrooms	16	21	Faucet Aerator (Lavatory)	1.50	0.50	0.0	0	12	$163	$180	$80	0.6
Classrooms	16	70	Faucet Aerator (Lavatory)	2.00	0.50	0.0	0	29	$409	$590	$280	0.8
Offices	16	12	Faucet Aerator (Lavatory)	2.00	0.50	0.0	0	5	$70	$100	$50	0.7
Dining Area 1	16	5	Faucet Aerator (Kitchen)	2.20	1.50	0.0	0	2	$27	$40	$10	1.1
Faculty room	16	1	Faucet Aerator (Kitchen)	2.20	1.50	0.0	0	0	$3	$10	$0	3.7
Library 1	16	1	Faucet Aerator (Kitchen)	2.20	1.50	0.0	0	0	$3	$10	$0	3.7
Basement, Storage Spaces	16	7	Faucet Aerator (Lavatory)	2.20	0.50	0.0	0	3	$46	$60	$30	0.6

Walk-In Cooler/Freezer Inventory & Recommendations

	Existing Conditions				Proposed Conditions				Energy Impact & Financial Analysis						
Location	Cooler/ Freezer Quantity	Case Type/Temperature	Manufacturer	Model	ECM #	Install EC Evaporator Fan Motors?	Install Electric Defrost Control?	Install Evaporator Fan Control?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Dining Area 1	2	Cooler (35F to 55F)	Trenton		19, 20	Yes	No	Yes	0.4	5,141	0	$563	$4,490	$190	7.6
Dining Area 1	1	Low Temp Freezer (-35F to -5F)	Trenton		19, 20	Yes	No	Yes	0.4	5,229	0	$572	$2,810	$160	4.6

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
Dining Area 1	1	Stand-Up Refrigerator, Glass Door (31 - 50 cu. ft.)			No		No	0.0	0	0	$0	$0	$0	0.0
Dining Area 1	3	Stand-Up Refrigerator, Solid Door (16 - 30 cu. ft.)	NSF	VRIS-ID-S3	No	21	Yes	0.1	1,273	0	$139	$4,800	$200	33.0
Dining Area 1	3	Stand-Up Refrigerator, Solid Door (31 - 50 cu. ft.)	Traulsen	G20014P	No	21	Yes	0.3	2,795	0	$306	$8,100	$400	25.2

Commercial Ice Maker Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Ice Maker 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
Dining Area 1	1	Ice Making Head (≥450 lbs/day), Batch	Blue Air		No		No	0.0	0	0	$0	$0	$0	0.0

Cooking Equipment Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	Manufacturer	Model	High Efficiency Equipement?	ECM #	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Dining Area 1	2	Gas Convection Oven (Full Size)	Blodgett		No	17	Yes	0.0	0	30	$420	$21,600	$1,000	49.1
Dining Area 1	1	Gas Convection Oven (Full Size)	Garland		No		No	0.0	0	0	$0	$0	$0	0.0
136	5	Gas Convection Oven (Full Size)	Pitco		No		No	0.0	0	0	$0	$0	$0	0.0
Dining Area 1	1	Gas Combination Oven/Steam Cooker (15 - 28 Pans)			No		No	0.0	0	0	$0	$0	$0	0.0
Dining Area 1	1	Gas Rack Oven (Single)	Vulcan		No	17	Yes	0.0	0	30	$422	$5,600	$1,000	10.9
Dining Area 1	1	Insulated Food Holding Cabinet (3/4 Size)	FEW		No		No	0.0	0	0	$0	$0	$0	0.0
Dining Area 1	1	Gas Griddle (3 Feet Width)	Garland		No		No	0.0	0	0	$0	$0	$0	0.0
136	5	Gas Griddle (3 Feet Width)	Pitco		No		No	0.0	0	0	$0	$0	$0	0.0

Dishwasher Inventory & Recommendations

	Existing Conditions							Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Dishwasher Type	Manufacturer	Model	Water Heater Fuel Type	Booster Heater Fuel Type	ENERGY STAR Qualified?	ECM #	Install ENERGY STAR Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Payback w/ Incentives in Years
Dining Area 1	1	Multi-Tank Conveyor (Low Temp)			Natural Gas	None	No	18	Yes	0.0	0	81	$1,128	$45,900	$1,500	39.4

Plug Load Inventory

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
136	1	Clothes Dryer	500	No		
Dining Area 1	1	Clothes Dryer	500	No		
136	1	Clothes Washer	500	No		
Dining Area 1	1	Clothes Washer	500	No		
Basement space	2	Coffee Machine	1,200	No		
111	1	Coffee Machine	900	No		
150	1	Coffee Machine	900	No		
188	1	Coffee Machine	900	No		
192	1	Coffee Machine	900	No		
Athletics Office	1	Coffee Machine	900	No		
Dining Area 1	2	Coffee Machine	900	No		
Office - Open Plan 1	2	Coffee Machine	900	No		
Office - Open Plan 2	1	Coffee Machine	900	No		
Office 3	1	Coffee Machine	900	No		
258	1	Coffee Machine	900	No		
282	1	Coffee Machine	900	No		
286	1	Coffee Machine	900	No		
290	1	Coffee Machine	900	No		
Faculty room	1	Coffee Machine	900	No		
Library 1	3	Coffee Machine	900	No		
384F	1	Coffee Machine	900	No		
390	1	Coffee Machine	900	No		
394	1	Coffee Machine	900	No		
Basement space	6	Desktop	260	No		
Various Classrooms	133	Desktop	260	No		
Computer Lab 131	29	Desktop	260	No		
Athletics Office	4	Desktop	260	No		
Dining Area 1	3	Desktop	200	No		
Gymnasium 1	3	Desktop	260	No		
Health Office	3	Desktop	260	No		
Multipurpose 2	12	Desktop	260	No		
Office - Open Plan 1	6	Desktop	260	No		
Office - Open Plan 2	30	Desktop	260	No		
Office 3	7	Desktop	260	No		
Counselor 2	1	Desktop	260	No		

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Library 1	15	Desktop	260	No		
Basement space	3	Microwave	1,500	No		
Various	16	Microwave	1,500	No		
Dining Area 1	1	Microwave	1,500	No		
Gymnasium 1	3	Microwave	1,500	No		
Office - Open Plan 1	1	Microwave	1,500	No		
Office - Open Plan 2	1	Microwave	1,500	No		
Office 3	1	Microwave	1,500	No		
Faculty room	1	Microwave	1,500	No		
Library 1	3	Microwave	1,500	No		
Office - Enclosed 3rd floor	3	Microwave	1,500	No		
136	1	Electric oven	1,000	No		
140	2	3D printers	1,200	No		
237	2	Kiln	11,000	No		
384F	1	3D printer	1,200	No		
Health Office	1	Paper Shredder	200	No		
Office - Open Plan 1	1	Paper Shredder	200	No		
Office - Open Plan 2	1	Paper Shredder	200	No		
384F	1	Paper Shredder	200	No		
Various	80	Printer (Medium/Small)	150	No		
Health Office	1	Printer/Copier (Large)	1,200	No		
Office - Open Plan 1	3	Printer/Copier (Large)	1,200	No		
Office - Open Plan 2	2	Printer/Copier (Large)	1,200	No		
Office 3	1	Printer/Copier (Large)	1,200	No		
Faculty room	2	Printer/Copier (Large)	1,200	No		
384F	1	Printer/Copier (Large)	1,200	No		
Various Classrooms	86	Projector	220	No		
Library 1	3	Projector	220	No		
Various	30	Refrigerator (Mini)	180	No		
Various	14	Refrigerator (Residential)	380	No		
Basement space	1	Television	200	No		
167	1	Television	200	No		
Auditorium	1	Television	220	No		
Dining Area 1	2	Television	220	No		
Gym entrance	1	Television	220	No		

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Gymnasium 1	3	Television	220	No		
Multipurpose 2	2	Television	220	No		
Office - Open Plan 1	1	Television	200	No		
Office - Open Plan 1	1	Television	200	No		
Office - Open Plan 2	1	Television	200	No		
224	1	Television	200	No		
232	1	Television	200	No		
234	1	Television	200	No		
235	1	Television	200	No		
Library 1	1	Television	120	No		
Dining Area 1	1	Toaster	1,000	No		
Gymnasium 1	1	Toaster	1,000	No		
Basement space	2	Toaster Oven	1,500	No		
188	1	Toaster Oven	1,500	No		
192	1	Toaster Oven	1,500	No		
Office 3	1	Toaster Oven	1,500	No		
282	1	Toaster Oven	1,500	No		
286	1	Toaster Oven	1,500	No		
290	1	Toaster Oven	1,500	No		
Faculty room	1	Toaster Oven	1,500	No		
Library 1	1	Toaster Oven	1,500	No		
390	1	Toaster Oven	1,500	No		
394	1	Toaster Oven	1,500	No		
Basement space	1	Water Cooler	500	No		
160	1	Water Cooler	500	No		
Athletics Office	1	Water Cooler	500	No		
Health Office	1	Water Cooler	500	No		
Office - Open Plan 1	1	Water Cooler	500	No		
Office 3	1	Water Cooler	500	No		
Library 1	2	Water Cooler	500	No		
Various	10	Water Foundtains	500	No		
286	1	Dishwasher (Undercounter)	300	No		
Server Room	1	Server Equipment	5,000	No		

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	ECM #	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Dining Area 1	1	Glass Fronted Refrigerated	22	Yes	0.1	1,209	0	$132	$270	$50	1.7
Student center	1	Glass Fronted Refrigerated	22	Yes	0.1	1,209	0	$132	$270	$50	1.7
Dining Area 1	1	Non-Refrigerated	22	Yes	0.0	343	0	$37	$270	$0	7.2

Custom (High Level) Measure Analysis

Installation of an Energy Management System

Building Square Footage	265,893	**Fuel Utility Rate**	$13.943 MMBtu
Percent of Conditioned Area Impacted	25%	**Blended Electric Utility Rate**	$0.109 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
Limited/No HVAC Controls	HVAC Equipment & Systems	15	713,811	306,082	6,357	Installation of an Energy Management System	2%	2%	5%	$2.00	0.00	20,398	318	$6,663	$154,800	$0	$0	$0	$154,800	23.23	23.23

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.

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

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ENERGY STAR® Score[1]

Westfield High School

Primary Property Type: K-12 School
Gross Floor Area (ft²): 295,437
Built: 1952

For Year Ending: February 28, 2023
Date Generated: May 19, 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
Westfield High School Dorian Road Westfield, New Jersey 07090	Westfield Board of Education 302 Elm Street Westfield, NJ 07090 (908) 789-4400	Sean McArthur 302 Elm Street Westfield, NJ 07090 (908) 789-4460 smcarthur@westfieldnjk12.org

Property ID: 4163451

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
42.6 kBtu/ft²

Source EUI
65.5 kBtu/ft²

Annual Energy by Fuel

Natural Gas (kBtu)	7,590,915 (60%)
Electric - Solar (kBtu)	1,449,143 (12%)
Electric - Grid (kBtu)	3,549,926 (28%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	68.5
National Median Source EUI (kBtu/ft²)	105.3
% Diff from National Median Source EUI	-38%

Annual Emissions

Total (Location-Based) GHG Emissions (Metric Tons CO2e/year)	852

Signature & Stamp of Verifying Professional

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

LP Signature: ______________________Date: ___________

Licensed Professional

____ ________
,
(____)____-______
____

Professional Engineer or Registered Architect Stamp
(if applicable)

Appendix C: Glossary

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

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

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