Y22

Local Government Energy Audit Report

Main Library

July 17, 2020

Prepared for:

Parsippany Troy Hills Township

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Parsippany, New Jersey 07054

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Disclaimer

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information about financial incentives that may be available. Most energy conservation measures (ECMs) 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 ECMs 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 installation costs on our experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from RS Means. Cost estimates include material and labor pricing associated with installation of primary recommended equipment only. Cost estimates do not include demolition or removal of hazardous waste. We encourage the owner of the facility to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Actual installation costs can vary widely based on individual measures and conditions. TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

New Jersey's Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. Please review all available 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 ECMs in complete conformance with all applicable local, state and federal requirements.

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Table of Contents

1 Executive Summary 1

1.1 Planning Your Project 4

Pick Your Installation Approach 4
More Options from Around the State 6

2 Existing Conditions 7

2.1 Site Overview 7
2.2 Building Occupancy 7
2.3 Building Envelope 8
2.4 Lighting Systems 10
2.5 Air Handling Systems 13

Packaged Units 14
Air Conditioners 15

2.6 Heating Hot Water Systems 16
2.7 Chilled Water Systems 18
2.8 Building Energy Management Systems (EMS) 19
2.9 Domestic Hot Water 19
2.10 Plug Load & Vending Machines 20
2.11 Water-Using Systems 21

3 Energy Use and Costs 22

3.1 Electricity 24
3.2 Natural Gas 25
3.3 Benchmarking 26

Tracking Your Energy Performance 27

4 Energy Conservation Measures 28

4.1 Lighting 31

ECM 1: Install LED Fixtures 31
ECM 2: Retrofit Fixtures with LED Lamps 31

4.2 Lighting Controls 32

ECM 3: Install Occupancy Sensor Lighting Controls 32
ECM 4: Install High/Low Lighting Controls 32

4.3 Variable Frequency Drives (VFD) 33

ECM 5: Install VFD on Variable Air Volume (VAV) Fans 33
ECM 6: Install VFDs on Constant Volume (CV) Fans 33
ECM 7: Install VFDs on Chilled Water Pumps 34
ECM 8: Install VFDs on Heating Water Pumps 34

4.4 Electric Unitary HVAC 35

ECM 9: Install High-Efficiency Air Conditioning Units 35

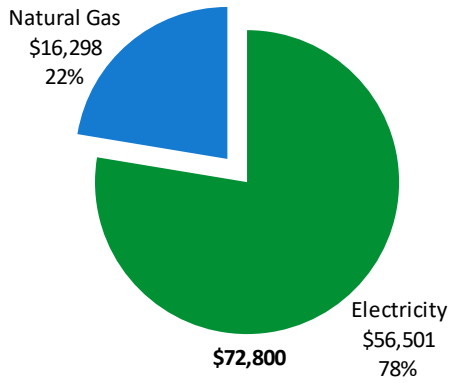
4.5 Electric Chiller 36

ECM 10: Install High-Efficiency Chiller 36
4.6 Gas-Fired Heating 37
ECM 11: Install High-Efficiency Hot Water Boiler 37
ECM 12: Install High-Efficiency Furnaces 37
4.7 HVAC Improvements 38
ECM 13: Install Pipe Insulation 38
4.8 Food Service & Refrigeration Measures 38
ECM 14: Vending Machine Control 38
5 Energy Efficient Best Practices 39
Energy Tracking with ENERGY STAR® Portfolio Manager® 39
Weatherization 39
Doors and Windows 39
Lighting Maintenance 39
Lighting Controls 40
Motor Maintenance 40
Fans to Reduce Cooling Load 40
Thermostat Schedules and Temperature Resets 40
Economizer Maintenance 40
Chiller Maintenance 40
AC System Evaporator/Condenser Coil Cleaning 41
HVAC Filter Cleaning and Replacement 41
Boiler Maintenance 41
Furnace Maintenance 41
Water Heater Maintenance 41
Plug Load Controls 42
Computer Power Management Software 42
Water Conservation 42
Procurement Strategies 43
6 On-site Generation 44
6.1 Solar Photovoltaic 45
6.2 Combined Heat and Power 46
7 Project Funding and Incentives 47
7.1 SmartStart 48
7.2 Direct Install 49
7.3 Pay for Performance - Existing Buildings 50
7.4 Combined Heat and Power 51
7.5 Energy Savings Improvement Program 52
7.6 SREC Registration Program 53
8 Energy Purchasing and Procurement Strategies 54
8.1 Retail Electric Supply Options 54
8.2 Retail Natural Gas Supply Options 54
Appendix A: Equipment Inventory & Recommendations A-1
Appendix B: ENERGY STAR® Statement of Energy Performance B-1
Appendix C: Glossary C-1

1 EXECUTIVE SUMMARY

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

BUILDING PERFORMANCE REPORT

Annual Utilities	Costs: $72,800 Electricity: 427,784 kWh Natural Gas: 13,742 Therms	
ENERGY STAR® Benchmarking Score	N/A *(1-100 scale)*	A standard energy use benchmark is not available for this facility type. This report contains suggestions about how to improve building performance and reduce energy costs.

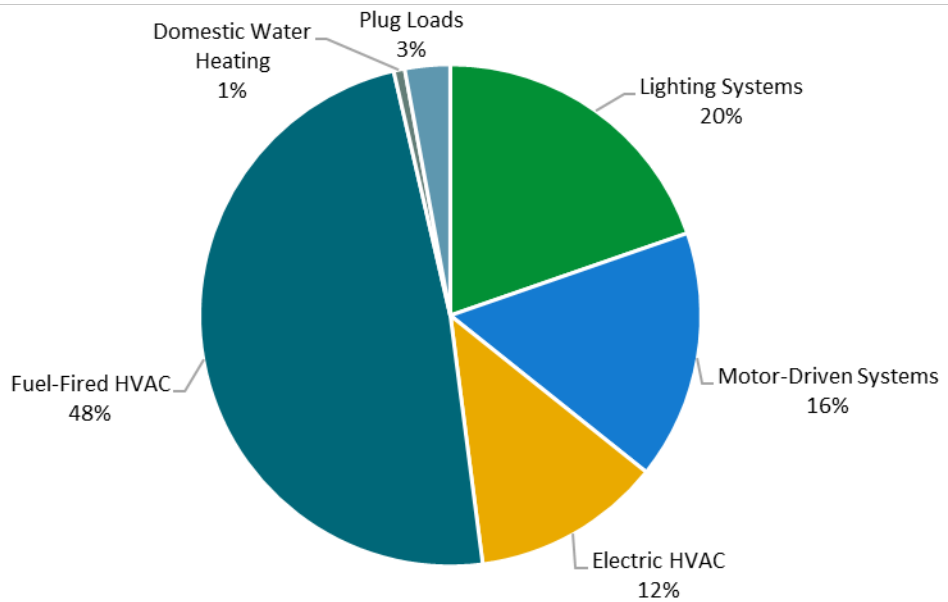


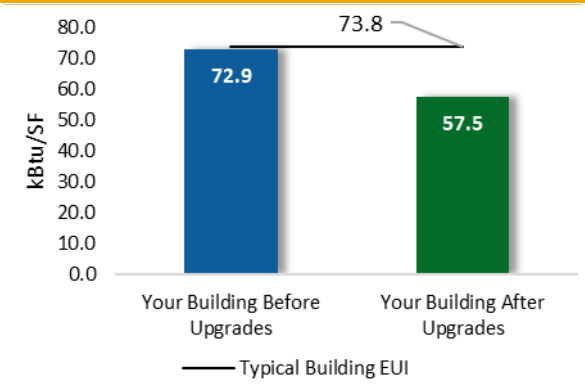
Figure 1 - Energy Use by System

POTENTIAL IMPROVEMENTS

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

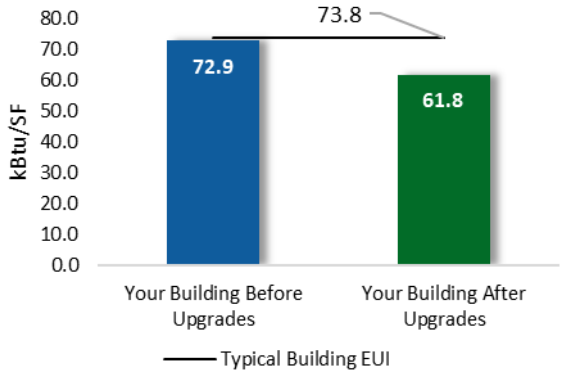
Scenario 1: Full Package (all evaluated measures)

Installation Cost	$402,535
Potential Rebates & Incentives[1]	$68,528
Annual Cost Savings	$21,122
Annual Energy Savings	Electricity: 153,240 kWh Natural Gas: 744 Therms
Greenhouse Gas Emission Savings	82 Tons
Simple Payback	15.8 Years
Site Energy Savings (all utilities)	21%



Scenario 2: Cost-Effective Package[2]

Installation Cost	$84,925
Potential Rebates & Incentives	$26,941
Annual Cost Savings	$16,706
Annual Energy Savings	Electricity: 126,635 kWh
Greenhouse Gas Emission Savings	64 Tons
Simple Payback	3.5 Years
Site Energy Savings (all utilities)	15%



On-site Generation Potential

Photovoltaic	High
Combined Heat and Power	None

[1] Incentives are based on current SmartStart Prescriptive incentives. Other program incentives 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 ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**68,854**	**16.6**	**-13**	**$8,942**	**$26,503**	**$9,018**	**$17,485**	**2.0**	**67,832**
ECM 1	Install LED Fixtures	Yes	3,811	0.0	0	$503	$3,477	$1,200	$2,277	4.5	3,837
ECM 2	Retrofit Fixtures with LED Lamps	Yes	65,044	16.6	-13	$8,439	$23,025	$7,818	$15,207	1.8	63,995
Lighting Control Measures			**21,970**	**5.6**	**-5**	**$2,846**	**$17,152**	**$6,565**	**$10,587**	**3.7**	**21,576**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	19,227	4.9	-4	$2,491	$14,002	$3,430	$10,572	4.2	18,882
ECM 4	Install High/Low Lighting Controls	Yes	2,742	0.6	-1	$355	$3,150	$3,135	$15	0.0	2,693
Variable Frequency Drive (VFD) Measures			**36,390**	**14.6**	**0**	**$4,806**	**$59,967**	**$12,350**	**$47,617**	**9.9**	**36,645**
ECM 5	Install VFD on Variable Air Volume (VAV) Fans	Yes	4,438	1.9	0	$586	$7,577	$1,950	$5,627	9.6	4,469
ECM 6	Install VFDs on Constant Volume (CV) Fans	Yes	25,524	11.2	0	$3,371	$32,581	$9,000	$23,581	7.0	25,703
ECM 7	Install VFDs on Chilled Water Pumps	No	3,774	1.1	0	$498	$7,768	$800	$6,968	14.0	3,800
ECM 8	Install VFDs on Heating Water Pumps	No	2,654	0.4	0	$351	$12,041	$600	$11,441	32.6	2,673
Electric Unitary HVAC Measures			**11,679**	**11.2**	**0**	**$1,543**	**$185,711**	**$17,681**	**$168,030**	**108.9**	**11,760**
ECM 9	Install High Efficiency Air Conditioning Units	No	11,679	11.2	0	$1,543	$185,711	$17,681	$168,030	108.9	11,760
Electric Chiller Replacement			**8,497**	**11.0**	**0**	**$1,122**	**$42,659**	**$9,000**	**$33,659**	**30.0**	**8,557**
ECM 10	Install High Efficiency Chillers	No	8,497	11.0	0	$1,122	$42,659	$9,000	$33,659	30.0	8,557
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**76**	**$902**	**$69,431**	**$13,506**	**$55,925**	**62.0**	**8,906**
ECM 11	Install High Efficiency Hot Water Boilers	No	0	0.0	29	$342	$30,845	$7,106	$23,739	69.3	3,381
ECM 12	Install High Efficiency Furnaces	No	0	0.0	47	$560	$38,585	$6,400	$32,185	57.5	5,525
HVAC System Improvements			**2,283**	**0.0**	**16**	**$489**	**$423**	**$208**	**$215**	**0.4**	**4,151**
ECM 13	Install Pipe Insulation	Yes	2,283	0.0	16	$489	$423	$208	$215	0.4	4,151
Food Service & Refrigeration Measures			**3,566**	**0.4**	**0**	**$471**	**$690**	**$200**	**$490**	**1.0**	**3,591**
ECM 14	Vending Machine Control	Yes	3,566	0.4	0	$471	$690	$200	$490	1.0	3,591
TOTALS (COST EFFECTIVE MEASURES)			**126,635**	**35.6**	**-2**	**$16,706**	**$84,925**	**$26,941**	**$57,984**	**3.5**	**127,322**
TOTALS (ALL MEASURES)			**153,240**	**59.3**	**74**	**$21,122**	**$402,535**	**$68,528**	**$334,007**	**15.8**	**163,018**

* - All incentives presented in this table are based on NJ SmartStart equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

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

Figure 2 – Evaluated Energy Improvements

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

1.1 Planning Your Project

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

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

Pick Your Installation Approach

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.

The potential ECMs identified for this building likely qualify for multiple incentive and funding programs. Based on current program rules and requirements, your measures are likely to qualify for the following programs:

Energy Conservation Measure		SmartStart	Direct Install	Pay For Performance
ECM 1	Install LED Fixtures	X	X	
ECM 2	Retrofit Fixtures with LED Lamps	X	X	
ECM 3	Install Occupancy Sensor Lighting Controls	X	X	
ECM 4	Install High/Low Lighting Controls		X	
ECM 5	Install VFD on Variable Air Volume (VAV) Fans	X	X	
ECM 6	Install VFDs on Constant Volume (CV) Fans	X		
ECM 7	Install VFDs on Chilled Water Pumps	X	X	
ECM 8	Install VFDs on Heating Water Pumps	X	X	
ECM 9	Install High Efficiency Air Conditioning Units	X	X	
ECM 10	Install High Efficiency Chillers	X	X	
ECM 11	Install High Efficiency Hot Water Boilers	X	X	
ECM 12	Install High Efficiency Furnaces	X	X	
ECM 13	Install Pipe Insulation	X	X	
ECM 14	Vending Machine Control	X	X	

Figure 3 – Funding Options

New Jersey's Clean Energy Programs At-A-Glance

	SmartStart Flexibility to install at your own pace	**Direct Install** Turnkey installation	**Pay for Performance** Whole building upgrades
Who should use it?	Buildings installing individual measures or small group of measures.	Small to mid-size facilities that can bundle multiple measures together. Average peak demand should be below 200 kW. Not suitable for significant building shell issues.	Mid to large size facilities looking to implement as many measures as possible at one time. Peak demand should be over 200 kW.
How does it work?	Use in-house staff or your preferred contractor.	Pre-approved contractors pass savings along to you via reduced material and labor costs.	Whole-building approach to energy upgrades designed to reduce energy use by at least 15%. The more you save, the higher the incentives.
What are the Incentives?	Fixed incentives for specific energy efficiency measures.	Incentives pay up to 70% of eligible costs, up to $125,000 per project. You pay the remaining 30% directly to the contractor.	Up to 25% of installation cost, calculated based on level of energy savings per square foot.
How do I participate?	Submit an application for the specific equipment to be installed.	Contact a participating contractor in your region.	Contact a pre-qualified Partner to develop your Energy Reduction Plan and set your energy savings targets.

Take the next step by visiting **www.njcleanenergy.com** for program details, applications, and to contact a qualified contractor.

Individual Measures with SmartStart

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 SmartStart 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 is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation.

Turnkey Installation with Direct Install

The Direct Install program provides turnkey installation of multiple measures through an authorized network of participating contractors. This program can provide substantially higher incentives than SmartStart, up to 70% of the cost of selected measures. Direct Install contractors will assess and verify individual measure eligibility and, in most cases, they perform the installation work. The Direct Install program is available to sites with an average peak demand of less than 200 kW.

Whole Building Approach with Pay for Performance

Pay for Performance can be a good option for medium to large sized facilities to achieve deep energy savings. Pay for Performance 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. Many facilities pursuing an Energy Savings Improvement Program (ESIP) loan also use this program. Pay for Performance works for larger customers with a peak demand over 200 kW. The minimum installed scope of work must include at least two unique measures resulting in at least 15% energy savings, where lighting cannot make up the majority of the savings.

More Options from Around the State

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

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

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

The CHP program provides incentives for combined heat and power (aka 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.

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.

2 Existing Conditions

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for Main Library. This report provides information on how the Library uses energy, identifies ECMs that can reduce your energy use, and provides information and assistance to help you implement the ECMs. This report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

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

2.1 Site Overview

On February 27, 2020, TRC performed an energy audit at the Main Library located in Parsippany, New Jersey. TRC met with John Pirny to review the Library operations and help focus our investigation on specific energy-using systems. An LGEA report was previously conducted for this site. Please refer to Section 3.

The Main Library at Parsippany Troy Hills Township is a 2-story, 38,872 square foot building built in 1980. It consists of a partially below grade basement with a first floor directly above. Spaces include a large meeting room with space for 200 participants, tutorial and small group study rooms, technology lab, teen section, large children's library and program room, and adult library. The main library staff offers extensive free educational, technological, and cultural programming for children and adults. The building also serves as the headquarters to the Parsippany Troy Hills library system.

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

2.2 Building Occupancy

The Library is occupied year-round, seven days a week, except Sundays during summer months. Typical weekday occupancy is 30 staff and a varying number of visitors.

Building Name	Weekday/Weekend	Operating Schedule
Main Library	Monday - Thursday	9:00 AM-9:00 PM
	Friday - Saturday	9:00 AM-5:00 PM
	Sunday	1:00 PM-5:00 PM (Closed in Summer)

Figure 4 - Building Occupancy Schedule

2.3 Building Envelope

The building's foundation is composed of a below grade slab floor with a perimeter footing, poured concrete foundation walls, and a slab edge with perimeter insulation. The exterior wall envelope is mostly constructed of brick veneer over structural steel. The interior primarily consists of painted gypsum wallboard. Exterior and interior wall surfaces were inspected during the field audit and were found to be in overall good condition with no signs of uncontrolled moisture or air leakage.

The flat roof is supported with steel trusses and a metal deck, finished with an insulated layer and a covering of EPDM single membrane. The roof-related flashing, gutters, and downspouts were inspected during the field audit and were reported to be in good condition.

Most of the windows are dual glazing with aluminum frames. Some windows are tinted while others are clear. The window weather seals are in good condition, showing little evidence of excessive wear. The main entrance doors are fully glass with metal frames while the exit doors are made of solid metal. All exterior doors, thresholds, related flashing, caulking, and weather-stripping were inspected for signs of moisture, air-leakage and other energy-compromising issues. Overall, the doors were found to be in good condition.

Overall, the field auditors found the building to be reasonably air-tight, considering the building's use and occupancy.

Building Walls

Building Foundation, Basement, and Exterior Door

Roof and Main Entrance Door

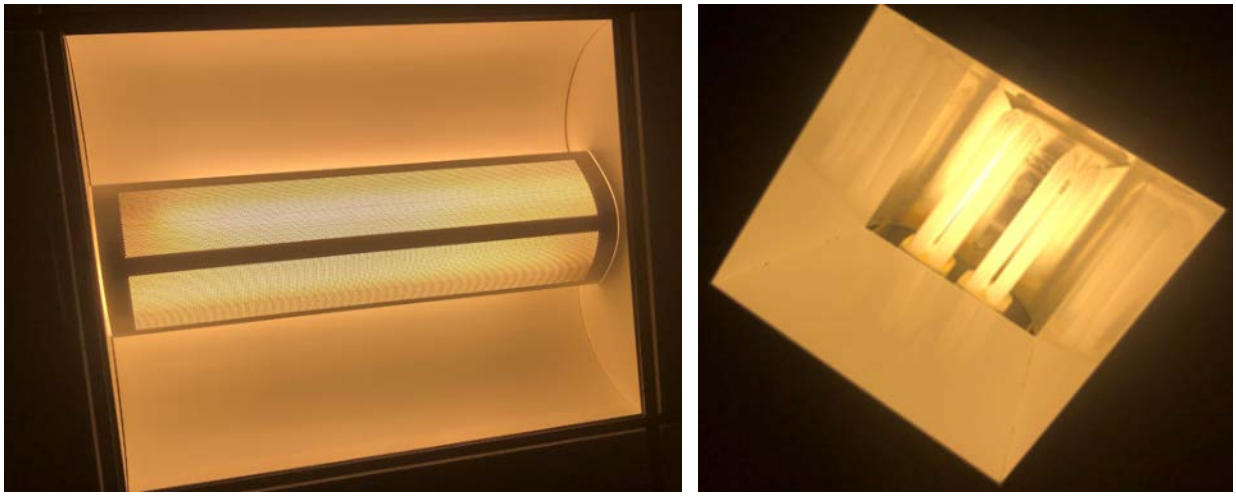
2.4 Lighting Systems

The primary interior lighting system uses both 32-Watt linear fluorescent T8 lamps and compact fluorescent fixtures. There are also LED screw-in lamps.

Fixture types include 2-, 3-, or 4-lamp, 4-foot long troffer, recessed, surface-mounted fixtures and 2-foot fixtures with U-bend linear tube lamps. Most fixtures are in good condition. All exit signs are LED. Interior lighting levels were generally sufficient. Light fixtures are controlled using either manual switches or occupancy sensors.

Exterior lighting is mainly provided by wall and parking lot pole-mounted LED fixtures. LED fixtures also provide flag and sign lighting. There are additional wall-mounted compact fluorescent and metal halide lamps. Several roof-mounted halogen incandescent flood lights provide illumination for HVAC equipment. Flag and roof lights are controlled with photocells; wall- and pole-mounted fixtures are timer-controlled.

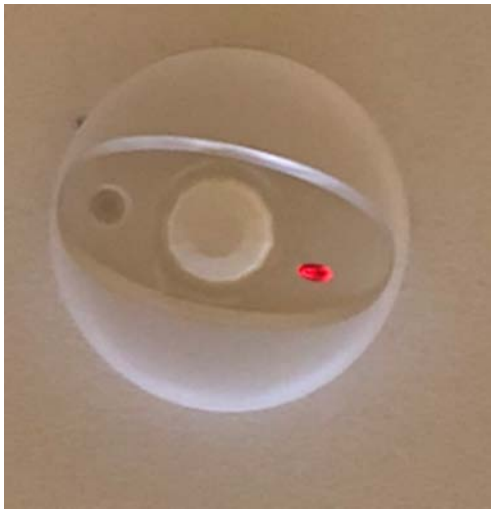
Linear T8 Fixtures



Compact Fluorescent Fixtures

T8 U-Bend and LED Exit Sign

Main Library Area Lighting



Ceiling-Mounted Occupancy Sensors

Incandescent Flood Lights and Photocell

LED Pole-Mounted Fixtures

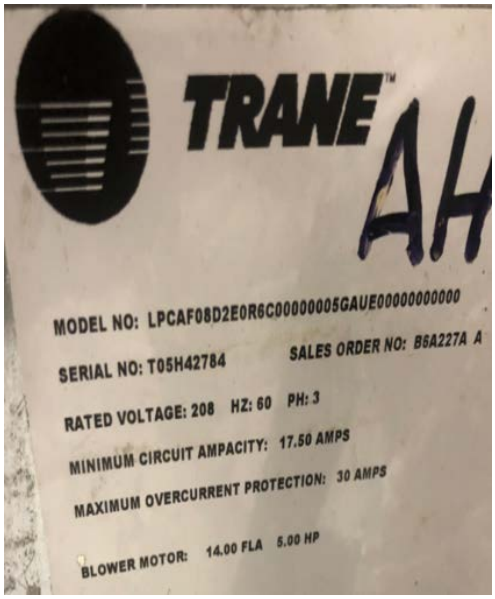
Metal Halide, CFL, and LED Fixtures

2.5 Air Handling Systems

The basement is conditioned by one large and two medium size Trane air handling units (AHUs) identified as AC-1, AC-2, and AC-3. AHUs are designed to maintain low noise levels and are equipped with hot water for heating and chilled water coils for cooling. AC-1 has a 20 hp supply fan and a 5 hp exhaust fan; both motors are equipped with variable speed drives. AC-2 and AC-3 have 5 hp and 1.5 hp constant speed supply fans, respectively, and no return fans. Variable air volume (VAV) boxes are installed in the basement ductwork and control the amount of conditioned air sent to each zone based on thermostat set point.

The AHUs are in good condition and are controlled with the building energy management (BMS).

Air Handling Unit #1 (AC-1)



Air Handling Unit #2 (AC-2)

Packaged Units

The first floor of the building is served with eight Trane packaged rooftop units (RTUs) ranging in size from 5 to 20 tons, controlled with the EMS. The RTUs use R-22 refrigerant in direct expansion coils for cooling and provide a constant volume of air flow. The ceiling serves as a return air plenum to the units, and RTUs 3 and 4 are equipped economizers to optimize the outside air for free cooling. All units are equipped with gas-fired furnace sections that have heating capacities ranging from 104 MBh to 324 MBh.

The RTUs are 15-years old, which is beyond their expected service life. They have been evaluated for replacement.

Refer to table below for the cooling and heating capacities of each unit.

Unit	Manufacturer	Cooling Capacity (Ton)	Heating Capacity (MBh)
RTU1	Trane	12.5	203
RTU2	Trane	20	324
RTU3	Trane	5	104
RTU4	Trane	5	104
RTU5	Trane	7.5	160
RTU6	Trane	20	324
RTU7	Trane	20	324
RTU8	Trane	7.5	160

Trane Packaged Units

Air Conditioners

The server room uses a one-ton Fujitsu air conditioning (AC) unit. Additionally, there is one 4-ton and one 10-ton Trane split AC unit located on the ground near the rear of the building. They provide supplemental cooling and are controlled by programmable thermostats. These units are 15-year-old, which is beyond their expected service life. They have been evaluated for replacement.

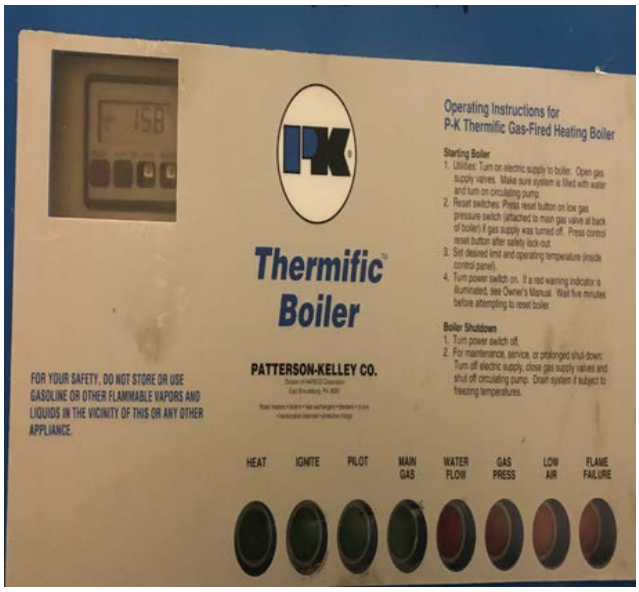
Trane Split AC Units

2.6 Heating Hot Water Systems

One Patterson Kelly 1615 MBh hot water boiler serves the basement floor heating load. The burner is non-modulating with a nominal efficiency of 85%. Installed in 1999, it appears in fair condition and has been evaluated for replacement.

The hydronic system is a 2-pipe, heating only system. Hot water is distributed to AHUs and hydronic unit heaters with four 1 hp constant speed pumps (P3, 4, 5, 6). The boiler also provides perimeter radiation heating to both floors. Baseboards are designed with electronic control valves to shut down sections of piping when temperature set points are met, reducing both thermal and electrical energy use. Sections of the hot water return pipes are not insulated.

Hot water supply temperature varies based on the outside air temperature. On the day of the site visit, the boiler was set to supply 156°F water. The hot water system is controlled with the BMS and the hydronic unit heaters are controlled with local thermostats.



Hot Water Boiler

Hot Water Pumps 3, 4, 5, and 6

Hydronic Unit Heater and Fin Tube Radiator

Local Thermostats and Uninsulated Hot Pipes

2.7 Chilled Water Systems

One 50-ton Trane air-cooled scroll chiller serves the building chilled water load. The chiller is configured in a primary distribution loop with two 3 hp constant flow pumps (P1, 2) that distribute chilled water to the AHUs. Installed in 2005, the chiller appears in fair condition and has been evaluated for replacement.

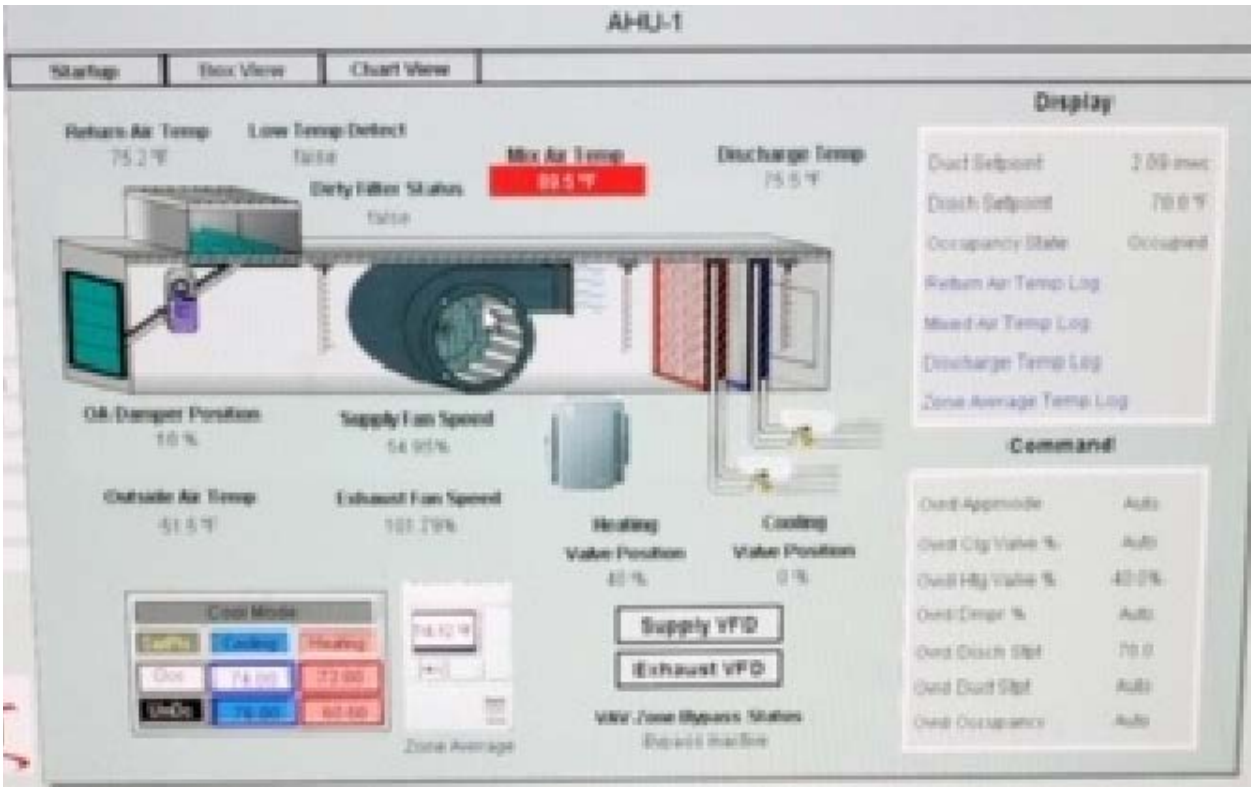
The chilled water supply temperature is reset based on outside air temperature. Chilled water is distributed at 42°F when the outside air temperature is above 60°F, and the setpoint is reset to 50°F when the outside air is below 55°F. The chiller plant is locked out when the outside air temperature is below 45°F. The chilled water system is controlled with the BMS.

Trane Air-Cooled Chiller

Chilled Water Pumps 1 and 2

2.8 Building Energy Management Systems (EMS)

The Library has a building EMS that was not accessible to the auditor during the site visit. A screenshot provided by facility staff indicates that the system controls the HVAC equipment, hot water and chilled water systems, air handlers, and packaged rooftop units. It also provides equipment scheduling control and monitors and controls space and supply air temperatures.



BMS

2.9 Domestic Hot Water

Hot water is produced with a 30-gallon 4.5 kW electric storage water heater located in the custodial closet. The water heater is in good condition. The domestic hot water pipes are not insulated.

Electric Hot Water Heater & Uninsulated Pipes

2.10 Plug Load & Vending Machines

There are approximately 72 computer workstations throughout the Library. Plug loads throughout the building include general café and office equipment.

There are several three residential-style refrigerators in the building.

There are two refrigerated beverage vending machines and one non-refrigerated vending machine. Vending machines are not equipped with occupancy-based controls. They are located in the gala area.

Typical Plug Load

Vending Machines

2.11 Water-Using Systems

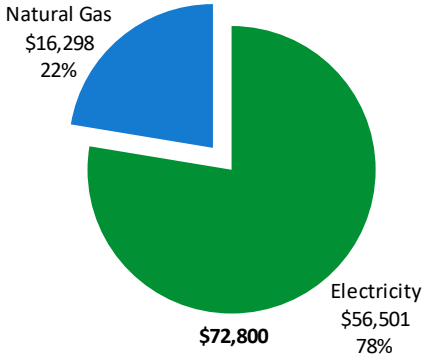
There are several restrooms with toilets, urinals, and sinks. Faucet flow are rated as low-flow.

Typical Sinks

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	427,784 kWh	$56,501
Natural Gas	13,742 Therms	$16,298
Total		**$72,800**



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.

An LGEA report was previously conducted for this site. A comparison table between the site energy usage from the 2010 legacy report and the current energy usage is provided below.

Years	*Elec Usage (kWh/yr*	*Average Demand (kW)*	*Elec Costs ($)*	*Gas Usage (Therms/yr*	*Gas Costs ($)*
2010	488,800	154	82,764	8,720	12,736
2019	427,784	119	56,501	13,742	16,298
Percentage	-12%	-23%	-32%	58%	28%

The table illustrates both decreased electricity usage and increased gas usage, plus associated costs. To our knowledge, very little has changed in the building over the last ten years. Fluctuations in weather likely explain most of the variance, although some decrease in electrical use may be due to recent exterior lighting conversions to LED.

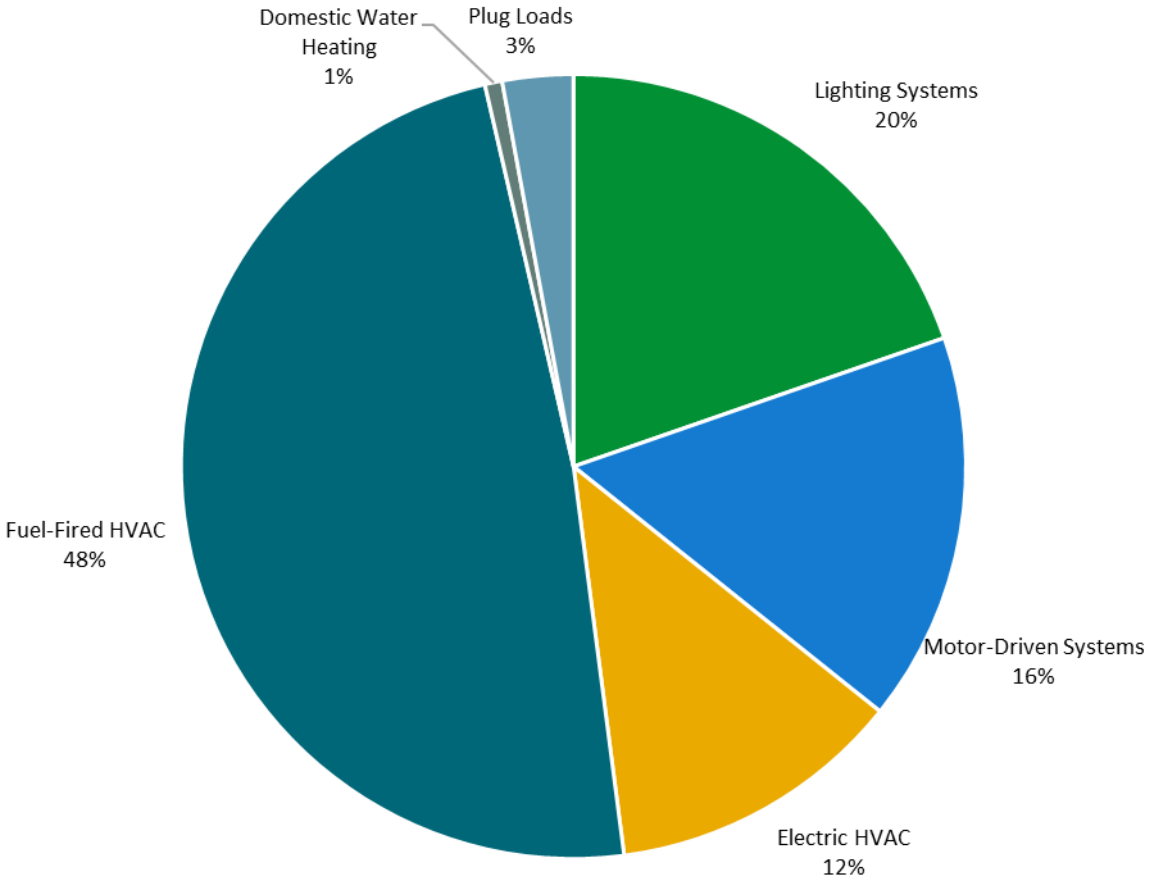
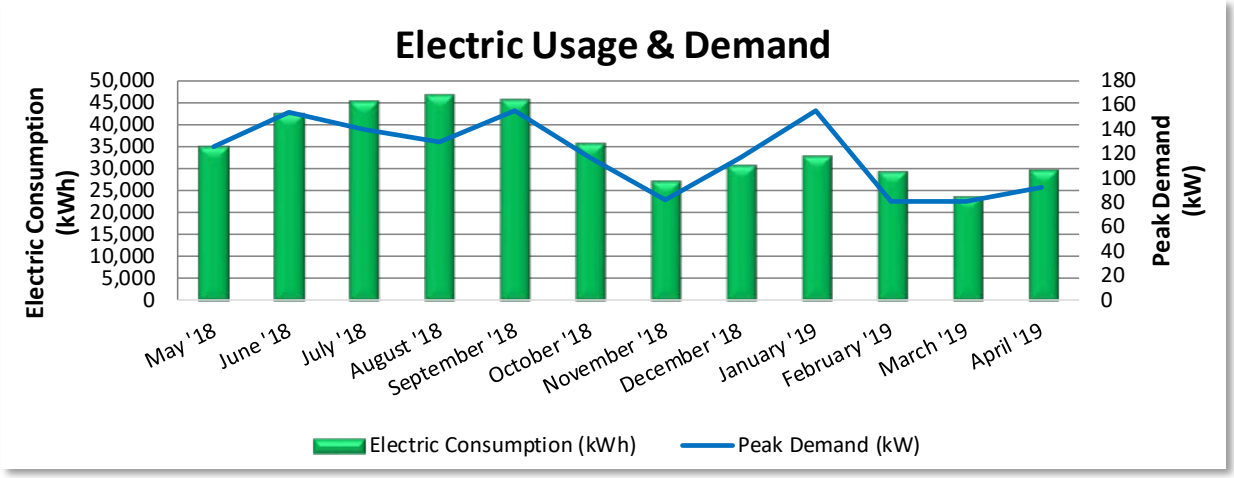


Figure 5 - Energy Balance

3.1 Electricity

JCP & L delivers electricity under rate class General Service Secondary 3-Phase.



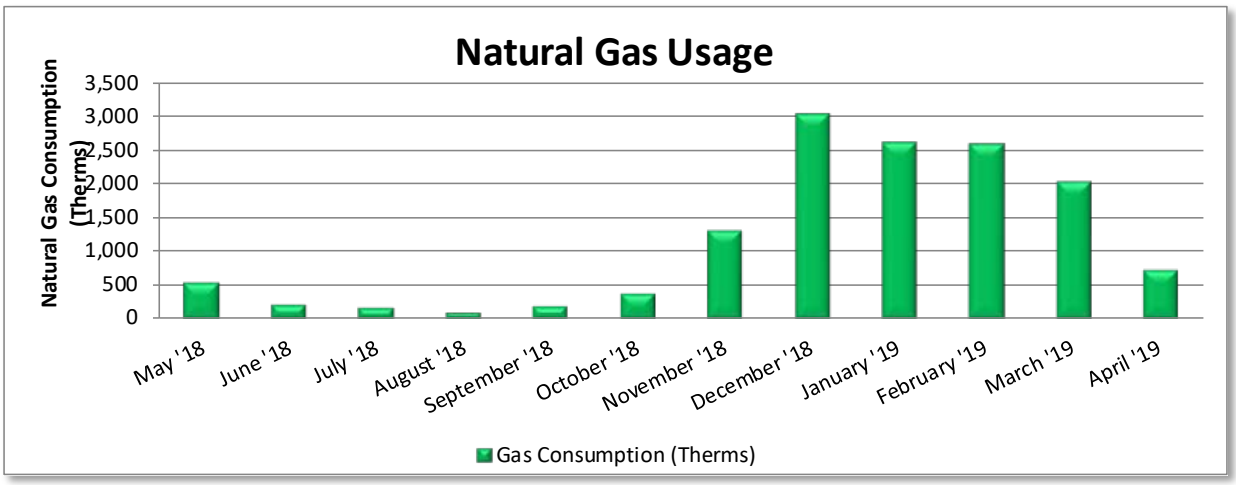
Electric Billing Data					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
5/23/18	30	35,040	125	$786	$4,856
6/22/18	31	42,720	153	$1,032	$5,553
7/23/18	31	45,280	139	$937	$5,558
8/22/18	30	46,880	130	$872	$5,655
9/22/18	30	45,760	156	$1,047	$6,169
10/23/18	30	35,680	117	$732	$4,910
11/21/18	31	27,200	82	$512	$3,688
12/20/18	31	30,880	117	$732	$4,267
1/23/19	30	33,120	156	$475	$4,220
2/21/19	29	29,280	81	$507	$3,820
3/22/19	29	23,840	81	$507	$3,337
4/22/19	31	29,760	93	$582	$4,159
Totals	**363**	**425,440**	**156**	**$8,722**	**$56,192**
Annual	**365**	**427,784**	**156**	**$8,770**	**$56,501**

Notes:

- Peak demand of 156 kW occurred in August and December '18.
- Average demand over the past 12 months was 119 kW.
- The average electric cost over the past 12 months was $0.132/kWh, which is the blended rate that includes energy supply, distribution, demand, and other charges. This report uses this blended rate to estimate energy cost savings.

3.2 Natural Gas

NJ Natural Gas delivers natural gas under rate class Monthly 007M.



Gas Billing Data			
Period Ending	**Days in Period**	**Natural Gas Usage (Therms)**	**Natural Gas Cost**
5/23/18	30	520	$736
6/22/18	31	202	$469
7/23/18	31	142	$420
8/22/18	30	77	$365
9/22/18	31	179	$454
10/23/18	30	365	$616
11/21/18	31	1,286	$1,360
12/20/18	31	3,025	$3,393
1/23/19	30	2,610	$2,848
2/21/19	29	2,585	$2,636
3/22/19	30	2,027	$2,075
4/22/19	31	724	$926
Totals	**365**	**13,742**	**$16,298**
Annual	**365**	**13,742**	**$16,298**

Notes:

- The average gas cost for the past 12 months is $1.186/therm, which is the blended rate used throughout the analysis.

3.3 Benchmarking

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

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

Benchmarking Score	N/A

Due to its unique characteristics, this building type is not able to receive a benchmarking score. This report contains suggestions about how to improve building performance and reduce energy costs.

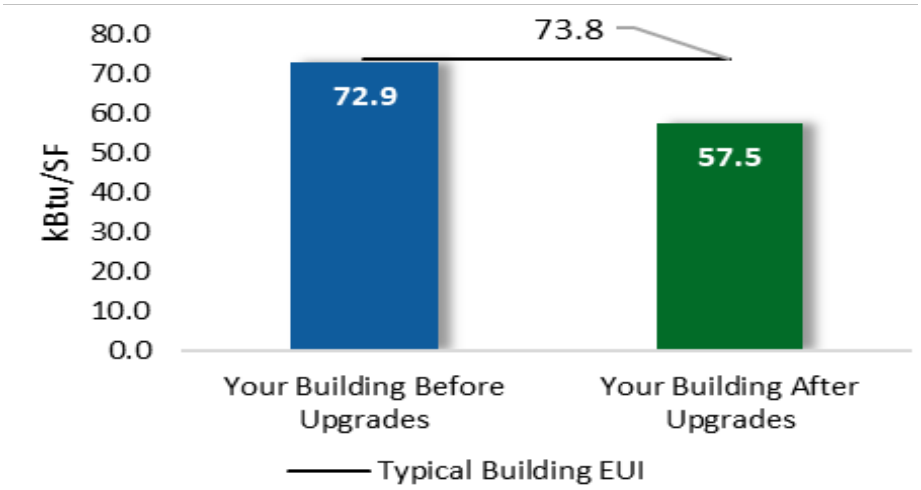


Figure 6 - Energy Use Intensity Comparison[3]

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. A number of factors can cause a building to vary from the "typical" energy usage. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and occupant behavior all contribute to a building's energy use and the benchmarking score.

[3] Based on all evaluated ECMs

TRC believes the heating systems for the Library may be oversized. This is likely due to the multiple systems in place; separate heating and cooling systems for each floor.

The combined building cooling capacity is 145 tons, including the chiller and DX cooling systems. Based on total building area, the total cooling capacity is 268 sf/ton, which is in accordance with the expected cooling design capacity range for a library.[4]

The combined heating capacity of the boiler system and gas-fired furnaces is 3,318 MBh, which calculates to 85 Btu/hr per square foot. A typical building designed[5] for this climate will require roughly 46 Btu/hr per square foot, suggesting the heating systems may be substantially oversized.

We recommend that heat load calculations be performed when designing replacement space conditioning systems at this site. Highly efficient, right-sized systems will likely be lower cost and provide savings relative to one-for one replacement based on existing capacity.

Tracking Your Energy Performance

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

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

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

For more information on ENERGY STAR® and Portfolio Manager®, visit their website[6].

[4] "Building Cooling Capacity per Square Foot" from the 2000 Means Mechanical Cost Data, Section R157 for Libraries (240 SF/ton).

[5] "Building Heating Capacity per Square Foot" from the 2000 Means Mechanical Cost Data, Section R155, assumes two-story general office building, 10' average ceiling height, design outdoor temperature of 0°F. Refer to Section:
*Btu/hr = Building Volume (cubic feet) * Loss Factor * ODT CF for ODT other than 0 °F*

[6] https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

4 Energy Conservation Measures

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

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

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

Financial incentives are based on the current NJCEP prescriptive SmartStart program. A higher level of investigation may be necessary to support any SmartStart Custom, Pay for Performance, or Direct Install incentive applications. Some measures and proposed upgrades may be eligible for higher incentives than those shown below through other NJCEP programs described in a following section of this report.

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 ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**68,854**	**16.6**	**-13**	**$8,942**	**$26,503**	**$9,018**	**$17,485**	**2.0**	**67,832**
ECM 1	Install LED Fixtures	Yes	3,811	0.0	0	$503	$3,477	$1,200	$2,277	4.5	3,837
ECM 2	Retrofit Fixtures with LED Lamps	Yes	65,044	16.6	-13	$8,439	$23,025	$7,818	$15,207	1.8	63,995
Lighting Control Measures			**21,970**	**5.6**	**-5**	**$2,846**	**$17,152**	**$6,565**	**$10,587**	**3.7**	**21,576**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	19,227	4.9	-4	$2,491	$14,002	$3,430	$10,572	4.2	18,882
ECM 4	Install High/Low Lighting Controls	Yes	2,742	0.6	-1	$355	$3,150	$3,135	$15	0.0	2,693
Variable Frequency Drive (VFD) Measures			**36,390**	**14.6**	**0**	**$4,806**	**$59,967**	**$12,350**	**$47,617**	**9.9**	**36,645**
ECM 5	Install VFD on Variable Air Volume (VAV) Fans	Yes	4,438	1.9	0	$586	$7,577	$1,950	$5,627	9.6	4,469
ECM 6	Install VFDs on Constant Volume (CV) Fans	Yes	25,524	11.2	0	$3,371	$32,581	$9,000	$23,581	7.0	25,703
ECM 7	Install VFDs on Chilled Water Pumps	No	3,774	1.1	0	$498	$7,768	$800	$6,968	14.0	3,800
ECM 8	Install VFDs on Heating Water Pumps	No	2,654	0.4	0	$351	$12,041	$600	$11,441	32.6	2,673
Electric Unitary HVAC Measures			**11,679**	**11.2**	**0**	**$1,543**	**$185,711**	**$17,681**	**$168,030**	**108.9**	**11,760**
ECM 9	Install High Efficiency Air Conditioning Units	No	11,679	11.2	0	$1,543	$185,711	$17,681	$168,030	108.9	11,760
Electric Chiller Replacement			**8,497**	**11.0**	**0**	**$1,122**	**$42,659**	**$9,000**	**$33,659**	**30.0**	**8,557**
ECM 10	Install High Efficiency Chillers	No	8,497	11.0	0	$1,122	$42,659	$9,000	$33,659	30.0	8,557
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**76**	**$902**	**$69,431**	**$13,506**	**$55,925**	**62.0**	**8,906**
ECM 11	Install High Efficiency Hot Water Boilers	No	0	0.0	29	$342	$30,845	$7,106	$23,739	69.3	3,381
ECM 12	Install High Efficiency Furnaces	No	0	0.0	47	$560	$38,585	$6,400	$32,185	57.5	5,525
HVAC System Improvements			**2,283**	**0.0**	**16**	**$489**	**$423**	**$208**	**$215**	**0.4**	**4,151**
ECM 13	Install Pipe Insulation	Yes	2,283	0.0	16	$489	$423	$208	$215	0.4	4,151
Food Service & Refrigeration Measures			**3,566**	**0.4**	**0**	**$471**	**$690**	**$200**	**$490**	**1.0**	**3,591**
ECM 14	Vending Machine Control	Yes	3,566	0.4	0	$471	$690	$200	$490	1.0	3,591
TOTALS			**153,240**	**59.3**	**74**	**$21,122**	**$402,535**	**$68,528**	**$334,007**	**15.8**	**163,018**

* - All incentives presented in this table are based on NJ SmartStart equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

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

Figure 7 – All Evaluated ECMs

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**68,854**	**16.6**	**-13**	**$8,942**	**$26,503**	**$9,018**	**$17,485**	**2.0**	**67,832**
ECM 1	Install LED Fixtures	3,811	0.0	0	$503	$3,477	$1,200	$2,277	4.5	3,837
ECM 2	Retrofit Fixtures with LED Lamps	65,044	16.6	-13	$8,439	$23,025	$7,818	$15,207	1.8	63,995
Lighting Control Measures		**21,970**	**5.6**	**-5**	**$2,846**	**$17,152**	**$6,565**	**$10,587**	**3.7**	**21,576**
ECM 3	Install Occupancy Sensor Lighting Controls	19,227	4.9	-4	$2,491	$14,002	$3,430	$10,572	4.2	18,882
ECM 4	Install High/Low Lighting Controls	2,742	0.6	-1	$355	$3,150	$3,135	$15	0.0	2,693
Variable Frequency Drive (VFD) Measures		**29,962**	**13.1**	**0**	**$3,957**	**$40,158**	**$10,950**	**$29,208**	**7.4**	**30,172**
ECM 5	Install VFD on Variable Air Volume (VAV) Fans	4,438	1.9	0	$586	$7,577	$1,950	$5,627	9.6	4,469
ECM 6	Install VFDs on Constant Volume (CV) Fans	25,524	11.2	0	$3,371	$32,581	$9,000	$23,581	7.0	25,703
HVAC System Improvements		**2,283**	**0.0**	**16**	**$489**	**$423**	**$208**	**$215**	**0.4**	**4,151**
ECM 13	Install Pipe Insulation	2,283	0.0	16	$489	$423	$208	$215	0.4	4,151
Food Service & Refrigeration Measures		**3,566**	**0.4**	**0**	**$471**	**$690**	**$200**	**$490**	**1.0**	**3,591**
ECM 14	Vending Machine Control	3,566	0.4	0	$471	$690	$200	$490	1.0	3,591
TOTALS		**126,635**	**35.6**	**-2**	**$16,706**	**$84,925**	**$26,941**	**$57,984**	**3.5**	**127,322**

* - All incentives presented in this table are based on NJ SmartStart equipment incentives and assume proposed equipment meets minimum performance criteria for that program.

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

Figure 8 – 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 ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**68,854**	**16.6**	**-13**	**$8,942**	**$26,503**	**$9,018**	**$17,485**	**2.0**	**67,832**
ECM 1	Install LED Fixtures	3,811	0.0	0	$503	$3,477	$1,200	$2,277	4.5	3,837
ECM 2	Retrofit Fixtures with LED Lamps	65,044	16.6	-13	$8,439	$23,025	$7,818	$15,207	1.8	63,995

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 are 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 Library, which should help reduce future maintenance costs.

ECM 1: Install LED Fixtures

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

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

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

Affected building areas: exterior fixtures.

ECM 2: Retrofit Fixtures with LED Lamps

Replace fluorescent, CFL, and 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 direct replacements for most other lighting technologies.

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, CFL, and incandescent lamps.

4.2 Lighting Controls

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**21,970**	**5.6**	**-5**	**$2,846**	**$17,152**	**$6,565**	**$10,587**	**3.7**	**21,576**
ECM 3	Install Occupancy Sensor Lighting Controls	19,227	4.9	-4	$2,491	$14,002	$3,430	$10,572	4.2	18,882
ECM 4	Install High/Low Lighting Controls	2,742	0.6	-1	$355	$3,150	$3,135	$15	0.4	2,693

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

ECM 3: Install Occupancy Sensor Lighting Controls

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

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

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

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

Affected building areas: offices, conference rooms, restrooms, lounge room, tech lab, record room, children library, adult library, and storage rooms.

ECM 4: Install High/Low Lighting Controls

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

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

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

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

Affected building areas: hallways, stairwells, main entrance, and main lobby.

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 an occupant approaches.

4.3 Variable Frequency Drives (VFD)

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**36,390**	**14.6**	**0**	**$4,806**	**$59,967**	**$12,350**	**$47,617**	**9.9**	**36,645**
ECM 5	Install VFD on Variable Air Volume (VAV) Fans	4,438	1.9	0	$586	$7,577	$1,950	$5,627	9.6	4,469
ECM 6	Install VFDs on Constant Volume (CV) Fans	25,524	11.2	0	$3,371	$32,581	$9,000	$23,581	7.0	25,703
ECM 7	Install VFDs on Chilled Water Pumps	3,774	1.1	0	$498	$7,768	$800	$6,968	14.0	3,800
ECM 8	Install VFDs on Heating Water Pumps	2,654	0.4	0	$351	$12,041	$600	$11,441	32.6	2,673

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

ECM 5: Install VFD on Variable Air Volume (VAV) Fans

Replace existing air volume control devices on variable volume fans, such as inlet vanes and variable pitch fan blades, with VFDs. Inlet guide vanes and variable pitch fan blades 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 using a more efficient control device to regulate the air flow provided by the fan. Additional maintenance savings may result from this measure. VFDs are solid state electronic devices, which generally requires less maintenance than mechanical air volume control devices.

Affected air handlers: AHU 2 and 3.

ECM 6: Install VFDs on Constant Volume (CV) Fans

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

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

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: RTU 1-8.

ECM 7: Install VFDs on Chilled Water Pumps

We evaluated installing VFDs to control chilled water pumps. Two-way valves must serve the chilled water coils being served and the chilled water loop must have a differential pressure sensor installed. If a bypass leg or three-way valves are used in the chilled water distribution, they will need to be modified when this measure is implemented. As the chilled water valves close, the differential pressure increases, and the VFD modulates the pump speed to maintain a differential pressure setpoint.

For systems with variable chilled water flow through the chiller, the minimum flow to prevent the chiller from tripping off will need to be determined during the final project design. The control system should be programmed to maintain the minimum flow through the chiller and to prevent pump cavitation.

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

Affected pumps: chilled water pumps 1 and 2.

ECM 8: Install VFDs on Heating Water Pumps

We evaluated installing VFDs 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 a bypass leg or three-way valves 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: hot water pumps 3, 4, 5, and 6.

4.4 Electric Unitary HVAC

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Electric Unitary HVAC Measures		**11,679**	**11.2**	**0**	**$1,543**	**$185,711**	**$17,681**	**$168,030**	**108.9**	**11,760**
ECM 9	Install High Efficiency Air Conditioning Units	11,679	11.2	0	$1,543	$185,711	$17,681	$168,030	108.9	11,760

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

ECM 9: Install High-Efficiency AC Units

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

This measure is part of a measure to replace package units at this site and as such must be considered in combination with ECM 12.

Affected units: Trane packaged and split system ac.

4.5 Electric Chiller

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Electric Chiller Replacement		**8,497**	**11.0**	**0**	**$1,122**	**$42,659**	**$9,000**	**$33,659**	**30.0**	**8,557**
ECM 10	Install High Efficiency Chillers	8,497	11.0	0	$1,122	$42,659	$9,000	$33,659	30.0	8,557

ECM 10: Install High-Efficiency Chiller

We evaluated replacing older inefficient electric chillers with new high-efficiency chillers. The type of chiller to be installed depends on the magnitude of the cooling load and variability of the cooling load profile, for example:

- Positive displacement chillers are usually under 600 tons of cooling capacity and centrifugal chillers generally start at 150 tons of cooling capacity.
- Constant speed chillers should be used to meet cooling loads with little or no variation while variable speed chillers are more efficient for variable cooling load profiles.
- Water cooled chillers are more efficient than air cooled chillers but require cooling towers and additional pumps to circulate the cooling water.
- In any given size range, variable speed chillers tend to have better partial load efficiency, but worse full load efficiency, than constant speed chillers.

Energy savings result from the improvement in chiller efficiency and matching the right type of chiller to the cooling load. The energy savings are calculated based on the cooling capacity of the new chiller, the improvement in efficiency compared with the base case equipment, the cooling load profile, and the estimated annual operating hours of the chiller before and after the upgrade.

For the purposes of this analysis, we evaluated the replacement of chillers on a one-for-one basis with equipment of the same capacity. We recommend that you work with your design team to select chillers that are sized appropriately for the cooling load at the Library. In some cases, the plant energy use can be reduced by selecting multiple chillers that match the Library load profile rather than one or two large chillers. This can also improve the chiller plant reliability through increased redundancy. Energy savings are maximized by proper selection of new equipment based on the cooling load profile.

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

4.6 Gas-Fired Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**76**	**$902**	**$69,431**	**$13,506**	**$55,925**	**62.0**	**8,906**
ECM 11	Install High Efficiency Hot Water Boilers	0	0.0	29	$342	$30,845	$7,106	$23,739	69.3	3,381
ECM 12	Install High Efficiency Furnaces	0	0.0	47	$560	$38,585	$6,400	$32,185	57.5	5,525

ECM 11: Install High-Efficiency Hot Water Boiler

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

The most notable efficiency improvement is condensing hydronic boilers which 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 at the Library. 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 boiler has a long payback and may not be justifiable based simply on energy considerations. However, the boiler has reached the end of its normal useful life. Typically, the marginal cost of purchasing high-efficiency boiler can be justified by the marginal savings from the improved efficiency. When the boiler is eventually replaced, consider purchasing boiler 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.

ECM 12: Install High-Efficiency Furnaces

We evaluated replacing standard efficiency furnaces with condensing furnaces. Improved combustion technology and heat exchanger design optimize heat recovery from the combustion gases, which can significantly improve furnace efficiency. Savings result from improved system efficiency.

Note: these units produce acidic condensate that requires proper drainage.

This measure is part of a measure to replace package units at this site and as such must be considered in combination with ECM 9.

Affected units: Trane packaged units.

4.7 HVAC Improvements

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
HVAC System Improvements		**2,283**	**0.0**	**16**	**$489**	**$423**	**$208**	**$215**	**0.4**	**4,151**
ECM 13	Install Pipe Insulation	2,283	0.0	16	$489	$423	$208	$215	0.4	4,151

ECM 13: Install Pipe Insulation

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

Affected systems: domestic and heating hot water.

4.8 Food Service & Refrigeration Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Food Service & Refrigeration Measures		**3,566**	**0.4**	**0**	**$471**	**$690**	**$200**	**$490**	**1.0**	**3,591**
ECM 14	Vending Machine Control	3,566	0.4	0	$471	$690	$200	$490	1.0	3,591

ECM 14: 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.

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. 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 can't manage what you don't 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[7] . 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 and thus 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 (ACH) 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.

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.

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

Lighting Controls

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

Motor Maintenance

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

Fans to Reduce Cooling Load

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

Thermostat Schedules and Temperature Resets

Use thermostat setback temperatures and schedules to reduce heating and cooling energy use during periods of low or no occupancy. Thermostats should be programmed for a setback of 5-10°F during low occupancy hours (reduce heating setpoints and increase cooling setpoints). Cooling load can be reduced by increasing the Library' 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.

Chiller Maintenance

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

AC System Evaporator/Condenser Coil Cleaning

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

HVAC Filter Cleaning and Replacement

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

Boiler Maintenance

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

Furnace Maintenance

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

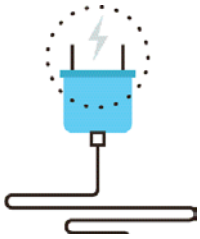
Water Heater Maintenance

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.

Plug Load Controls



Reducing plug loads is a common way to decrease your electrical use. Limiting the energy use of plug loads can include increasing occupant awareness, removing under-used equipment, installing hardware controls, and using software controls. Consider enabling the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips[8]. Your local utility may offer incentives or rebates for this equipment.

Computer Power Management Software

Many computers consume power during nights, weekends, and holidays. Screen savers are commonly confused as a power management strategy. This contributes to avoidable, excessive electrical energy consumption. There are innovative power management software packages available that are designed to deliver significant energy saving and provide ongoing tracking measurements. A central power management platform helps enforce energy savings policies as well as identify and eliminate underutilized devices.

Water Conservation

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

For more information regarding water conservation go to the EPA's WaterSense® website[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.

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

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

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

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

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

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

Procurement Strategies

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

6 On-site Generation

You don't have to look far in New Jersey to see one of the thousands of solar electric systems providing clean power to homes, businesses, schools, and government buildings. On-site generation includes both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) technologies that generate power to meet all or a portion of the Library'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 the Library. Before deciding to install an on-site generation system, we recommend conducting a feasibility study to analyze existing energy profiles, siting, interconnection, and the costs associated with the generation project including interconnection costs, departing load charges, and any additional special facilities charges.

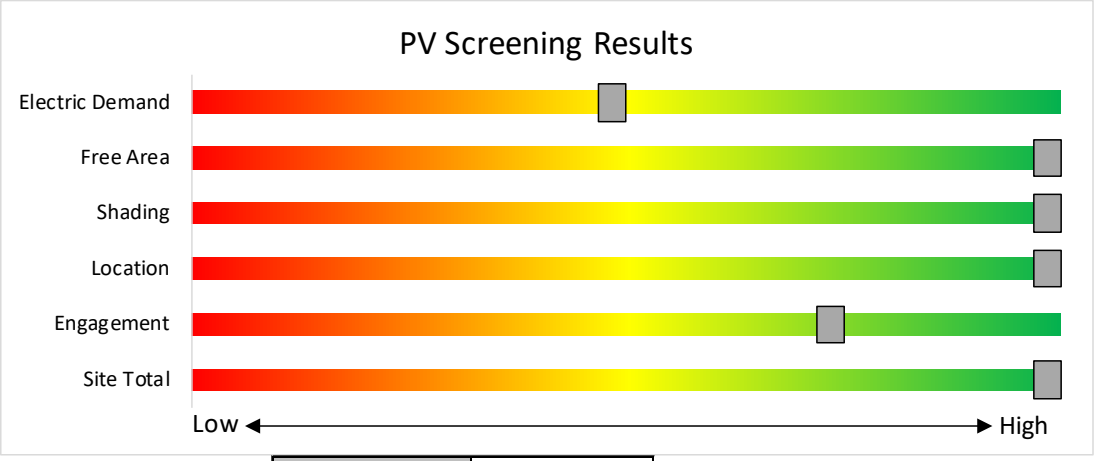
6.1 Solar Photovoltaic

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

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

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

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



Potential	High	
System Potential	107	kW DC STC
Electric Generation	127,477	kWh/yr
Displaced Cost	$16,840	/yr
Installed Cost	$278,200	

Figure 9 - Photovoltaic Screening

Solar Renewable Energy Certificate (SREC) Registration Program (SRP)

Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SREC Registration Program before starting construction. Once your PV system is up and running, you periodically earn credits, which can then be sold on the open market for up to 15 years.

If you are considering installing solar photovoltaics on your building, visit www.njcleanenergy.com/srec for more information about the SREC Registration Program.

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:

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

6.2 Combined Heat and Power

Combined heat and power (CHP) generate electricity at the Library 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 Library 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. Low or infrequent thermal load, and lack of space for siting the equipment are the most significant factors contributing to the lack of CHP potential.

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

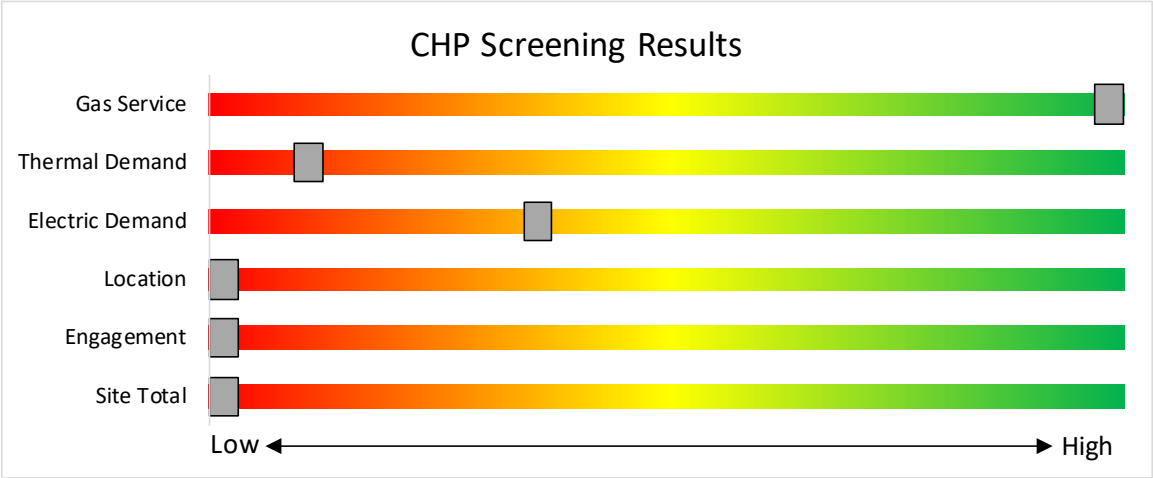


Figure 10 - Combined Heat and Power Screening

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/

7 Project Funding and Incentives

Ready to improve your building's performance? New Jersey's Clean Energy Programs can help. Pick the program that works best for you. Incentive programs that may apply to the Library are identified in the Executive Summary. This section provides an overview of currently available New Jersey's Clean Energy Programs.

	SmartStart *Flexibility to install at your own pace*	**Direct Install** *Turnkey installation*	**Pay for Performance** *Whole building upgrades*
Who should use it?	Buildings installing individual measures or small group of measures.	Small to mid-size facilities that can bundle multiple measures together. Average peak demand should be below 200 kW. Not suitable for significant building shell issues.	Mid to large size facilities looking to implement as many measures as possible at one time. Peak demand should be over 200 kW.
How does it work?	Use in-house staff or your preferred contractor.	Pre-approved contractors pass savings along to you via reduced material and labor costs.	Whole-building approach to energy upgrades designed to reduce energy use by at least 15%. The more you save, the higher the incentives.
What are the Incentives?	Fixed incentives for specific energy efficiency measures.	Incentives pay up to 70% of eligible costs, up to $125,000 per project. You pay the remaining 30% directly to the contractor.	Up to 25% of installation cost, calculated based on level of energy savings per square foot.
How do I participate?	Submit an application for the specific equipment to be installed.	Contact a participating contractor in your region.	Contact a pre-qualified Partner to develop your Energy Reduction Plan and set your energy savings targets.
Take the next step by visiting **www.njcleanenergy.com** for program details, applications, and to contact a qualified contractor.			

7.1 SmartStart

SmartStart offers incentives for installing prescriptive and custom energy efficiency measures at the Library. 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.

SmartStart routinely adds, removes, or modifies incentives from year-to-year for various energy efficient equipment based on market trends and new technologies.

Equipment with Prescriptive Incentives Currently Available:

Electric Chillers
Electric Unitary HVAC
Gas Cooling
Gas Heating
Gas Water Heating
Ground Source Heat Pumps
Lighting
Lighting Controls
Refrigeration Doors
Refrigeration Controls
Refrigerator/Freezer Motors
Food Service Equipment
Variable Frequency Drives

Incentives

The SmartStart Prescriptive program provides fixed incentives for specific energy efficiency measures. Prescriptive incentives vary by equipment type.

SmartStart Custom provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentives. Custom incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings. Incentives are capped at 50% of the total installed incremental project cost, or a project cost buy down to a one-year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

Submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. You can work with your preferred contractor or use internal staff to install measures.

Visit www.njcleanenergy.com/SSB for a detailed program description, instructions for applying, and applications.

7.2 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 over the recent 12-month period. You work directly with a pre-approved contractor who will perform a free energy assessment at the Library, 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, up to $125,000 per project. Each entity is limited to incentives up to $250,000 per fiscal year.

How to Participate

To participate in Direct Install, you will need to contact the participating contractor assigned to the region of the state where the Library is located. A complete list of Direct Install program partners is provided on the Direct Install website linked below. 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 program, subject to program caps and eligibility, while the remaining 30% of the cost is paid to the contractor by the customer.

Detailed program descriptions and applications can be found at: www.njcleanenergy.com/DI.

7.3 Pay for Performance - Existing Buildings

Pay for Performance works for larger customers with a peak demand over 200 kW. The minimum installed scope of work must include at least two unique measures that results in at least 15% source energy savings, and lighting cannot make up the majority of the savings. P4P is a generally a good option for medium-to-large sized facilities looking to implement as many measures as possible under a single project to achieve deep energy savings. This program 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.

Based on the site building and utility data provided, the Library does not meet the requirements of the current P4P program.

Incentives

Incentives are based on estimated and achieved energy savings ranging from $0.18-$0.22/kWh and $1.80-$2.50/therm, capped at the lesser of 50% total project cost, or $1 million per electric account and $1 million per natural gas account, per fiscal year, not to exceed $2 million per project. An incentive of $0.15/square foot is also available to offset the cost of developing the Energy Reduction Plan (see below) contingent on the project moving forward with measure installation.

How to Participate

Contact one of the pre-approved consultants and contractors ("Partners"). Under direct contract to you, they will help further evaluate the measures identified in this report through development of the energy reduction plan), assist you in implementing selected measures, and verify actual savings one year after the installation. Your Partner will also help you apply for incentives.

Approval of the final scope of work is required by the program prior to installation. Installation can be done by the contractor of your choice (some P4P Partners are also contractors) or by internal staff, but the Partner remains involved throughout construction to ensure compliance with the program requirements.

Detailed program descriptions, instructions for applying, applications and list of Partners can be found at: www.njcleanenergy.com/P4P.

7.4 Combined Heat and Power

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

Incentives

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

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

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

How to Participate

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

7.5 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 in to contracts to help finance building energy upgrades. Annual payments are lower than the savings projected from the 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 (ESP) 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.

7.6 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install 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 SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

After the registration is accepted, construction is complete, and final paperwork has been submitted and is deemed complete, the project is issued a New Jersey certification number, which enables it to generate New Jersey SRECs. SREC's are generated once the solar project has been authorized to be energized by the Electric Distribution Company (EDC).

Each time a solar installation generates 1,000 kilowatt-hours (kWh) of electricity, an SREC is earned. Solar project owners report the energy production to the SREC Tracking System. This reporting allows SREC's to be placed in the customer's electronic account. SRECs can then be sold on the SREC Tracking System, providing revenue for the first 15 years of the project's life.

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar Renewable Portfolio Standard. Purchasing SRECs can help them meet those requirements. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period fluctuates depending on supply and demand.

Information about the SRP can be found at: www.njcleanenergy.com/srec.

8 Energy Purchasing and Procurement Strategies

8.1 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. So, though you may choose a different company from which to buy your electric power, responsibility for the Library's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If the Library is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If the Library 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[11].

8.2 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 that fluctuate monthly. The utility provides basic gas supply service (BGSS) 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 the Library does not already purchase natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If the Library 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[12].

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

[12] 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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,808	2	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,808	0.1	300	0	$39	$110	$60	1.3
Mechanical Room	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,496	2	Relamp	No	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,496	0.3	890	0	$115	$365	$200	1.4
Mechanical Room	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
Tech Service	8	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,496	2, 3	Relamp	Yes	8	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,722	0.4	1,358	0	$176	$708	$310	2.3
Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,496	2, 3	Relamp	Yes	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,722	0.1	340	0	$44	$380	$130	5.7
Tech Service	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
Supply Room	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,496	2, 3	Relamp	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,722	0.2	679	0	$88	$489	$190	3.4
Supply Room	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Lounge Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,808	2, 3	Relamp	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,938	0.2	764	0	$99	$489	$190	3.0
Basement Hallway	19	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,536	2, 4	Relamp	Yes	19	LED - Linear Tubes: (2) U-Lamp	High/Low Control	33	2,440	0.7	2,846	-1	$369	$2,277	$1,280	2.7
Basement Hallway	1	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	3,536	2, 4	Relamp	Yes	1	LED - Linear Tubes: (3) 4' Lamps	High/Low Control	44	2,440	0.1	241	0	$31	$55	$30	0.8
Basement Hallway	4	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	4	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Custodial Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,248	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,248	0.0	44	0	$6	$37	$20	2.9
Tech Lab	16	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,496	2, 3	Relamp	Yes	16	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,722	0.6	1,784	0	$231	$702	$134	2.5
Tech Lab	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Storage Room	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,248	2, 3	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	861	0.4	566	0	$73	$905	$200	9.6
Storage Room	2	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Server Room	2	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,496	2, 3	Relamp	Yes	2	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,722	0.1	223	0	$29	$170	$8	5.6
Electrical Room	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,496	2	Relamp	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,496	0.1	267	0	$35	$110	$60	1.4
Record's Room	2	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,496	2, 3	Relamp	Yes	2	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,722	0.1	223	0	$29	$324	$78	8.5
Friend's Room	4	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	3,120	2, 3	Relamp	Yes	4	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	2,153	0.1	557	0	$72	$378	$86	4.0
Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,248	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,248	0.0	44	0	$6	$37	$20	2.9
Men's Rest Room	4	Compact Fluorescent: (2) 26W Plug-In Lamps	Occupancy Sensor	S	52	2,440	2	Relamp	No	4	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	2,440	0.1	158	0	$20	$100	$16	4.1
Men's Rest Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	S	114	2,440	2	Relamp	No	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,440	0.2	590	0	$76	$292	$160	1.7
Women's Rest Room	4	Compact Fluorescent: (2) 26W Plug-In Lamps	Occupancy Sensor	S	52	2,440	2	Relamp	No	4	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	2,440	0.1	158	0	$20	$100	$16	4.1

	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Women's Rest Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Occupancy Sensor	S	114	2,440	2	Relamp	No	4	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,440	0.2	590	0	$76	$292	$160	1.7
Galla Area	6	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	2,808	2, 3	Relamp	Yes	6	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	1,938	0.1	482	0	$62	$150	$24	2.0
Galla Area	17	Compact Fluorescent: (1) 42W Plug-In Lamp	Wall Switch	S	42	2,808	2, 3	Relamp	Yes	17	LED Lamps: (1) 29W Plug-In Lamp	Occupancy Sensor	29	1,938	0.3	1,134	0	$147	$753	$174	3.9
Galla Area	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
Galla Area	8	LED Lamps: (1) 19W Flood Lamp	Wall Switch	S	19	2,808	3	None	Yes	8	LED Lamps: (1) 19W Flood Lamp	Occupancy Sensor	19	1,938	0.0	143	0	$19	$0	$0	0.0
Tutorial Room	2	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,808	2, 3	Relamp	Yes	2	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,938	0.1	251	0	$32	$324	$78	7.6
Tutorial Room 2	2	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,808	2, 3	Relamp	Yes	2	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,938	0.1	251	0	$32	$324	$78	7.6
Elevator Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,248	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,248	0.0	44	0	$6	$37	$20	2.9
Meeting Room B	18	Compact Fluorescent: (2) 40W Biax Lamps	Occupancy Sensor	S	80	2,440	2	Relamp	No	18	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	2,440	0.4	1,138	0	$147	$486	$72	2.8
Meeting Room B	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
Closet	1	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	1,248	2	Relamp	No	1	LED Lamps: (2) 18.5W Plug-In Lamps	Wall Switch	37	1,248	0.0	20	0	$3	$25	$4	8.0
Printing Room	2	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,808	2, 3	Relamp	Yes	2	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,938	0.1	251	0	$32	$170	$8	5.0
Meeting Room A	24	Compact Fluorescent: (2) 40W Biax Lamps	Occupancy Sensor	S	80	2,440	2	Relamp	No	24	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	2,440	0.5	1,518	0	$197	$648	$96	2.8
Meeting Room A	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
Meeting Room A	2	LED Lamps: (1) 10W Screw-In Lamp	Wall Switch	S	10	2,808		None	No	2	LED Lamps: (1) 10W Screw-In Lamp	Wall Switch	10	2,808	0.0	0	0	$0	$0	$0	0.0
Sprinkler Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,560	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,560	0.0	56	0	$7	$37	$20	2.3
Children Library	74	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	3,536	2, 3	Relamp	Yes	74	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	2,440	2.7	11,688	-2	$1,514	$4,158	$856	2.2
Children Library	5	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	5	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Children Library	9	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	3,536	2, 3	Relamp	Yes	9	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	2,440	0.2	910	0	$118	$495	$106	3.3
Rest Room	1	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	2,808	2, 3	Relamp	Yes	1	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	1,938	0.0	80	0	$10	$25	$4	2.0
Rest Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,808	2, 3	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,938	0.1	449	0	$58	$416	$150	4.6
Children Activities Room	4	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	2,808	2, 3	Relamp	Yes	4	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	1,938	0.1	321	0	$42	$100	$16	2.0
Children Activities Room	7	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,808	2, 3	Relamp	Yes	7	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,938	0.4	1,337	0	$173	$653	$280	2.2
Children Activities Room	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
Youth Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,440	2	Relamp	No	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,440	0.2	522	0	$68	$219	$120	1.5

	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Youth Office	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
Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,440	2	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,440	0.1	261	0	$34	$110	$60	1.5
Children Library	6	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	3,536	2, 3	Relamp	Yes	6	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	2,440	0.1	607	0	$79	$420	$94	4.1
Stairwell	3	Compact Fluorescent: (1) 42W Plug-In Lamp	Wall Switch	S	42	3,536	2, 4	Relamp	Yes	3	LED Lamps: (1) 29W Plug-In Lamp	High/Low Control	29	2,440	0.1	252	0	$33	$263	$216	1.4
Stairwell	1	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	3,536	2, 4	Relamp	Yes	1	LED Lamps: (2) 18.5W Plug-In Lamps	High/Low Control	37	2,440	0.0	101	0	$13	$25	$4	1.6
Main Entrance	8	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	3,536	2, 4	Relamp	Yes	8	LED Lamps: (2) 18.5W Plug-In Lamps	High/Low Control	37	2,440	0.2	809	0	$105	$650	$482	1.6
Main 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
Main Lobby	28	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	3,536	2, 4	Relamp	Yes	28	LED Lamps: (2) 18.5W Plug-In Lamps	High/Low Control	37	2,440	0.7	2,830	-1	$367	$2,275	$1,687	1.6
Main Lobby	8	LED Lamps: (1) 10W Screw-In Lamp	Wall Switch	S	10	3,536	4	None	Yes	8	LED Lamps: (1) 10W Screw-In Lamp	High/Low Control	10	2,440	0.0	95	0	$12	$0	$0	0.0
Main Lobby	1	Compact Fluorescent: (6) 26W Plug-In Lamps	Wall Switch	S	156	3,536	2, 4	Relamp	Yes	1	LED Lamps: (6) 18.5W Plug-In Lamps	High/Low Control	110	2,440	0.1	306	0	$40	$75	$12	1.6
Main Area	64	Compact Fluorescent: (2) 40W Biax Lamps	Occupancy Sensor	S	80	2,440	2	Relamp	No	64	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	2,440	1.4	4,047	-1	$524	$1,728	$256	2.8
Main Area	18	Compact Fluorescent: (2) 26W Plug-In Lamps	Occupancy Sensor	S	52	2,440	2	Relamp	No	18	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	2,440	0.2	711	0	$92	$450	$72	4.1
Main Area	3	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Non-Fiction Stack	117	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,536	2, 3	Relamp	Yes	117	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,440	4.3	18,762	-4	$2,431	$6,972	$3,040	1.6
Non-Fiction Stack	3	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Fiction Stack	18	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,536	2, 3	Relamp	Yes	18	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,440	0.7	2,886	-1	$374	$1,197	$500	1.9
Study Room 1	4	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,808	2, 3	Relamp	Yes	4	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,938	0.1	502	0	$65	$378	$86	4.5
Study Room 2	4	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,808	2, 3	Relamp	Yes	4	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,938	0.1	502	0	$65	$378	$86	4.5
Robotics Club	14	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,808	2, 3	Relamp	Yes	14	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,938	0.5	1,756	0	$227	$918	$196	3.2
Robotics Club	9	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	62	2,440	2	Relamp	No	9	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,440	0.3	783	0	$101	$329	$180	1.5
Robotics Club	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
Copy Area	2	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,808	2, 3	Relamp	Yes	2	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,938	0.1	251	0	$32	$324	$78	7.6
Media Section	38	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	3,536	2, 3	Relamp	Yes	38	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	2,440	1.4	6,002	-1	$778	$1,836	$362	1.9
Media Section	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	3,536	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,440	0.1	641	0	$83	$146	$80	0.8
Media Section	3	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	3	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0

	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Men's Rest Room	1	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	2,808	2, 3	Relamp	Yes	1	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	1,938	0.0	80	0	$10	$25	$4	2.0
Men's Rest Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,808	2, 3	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,938	0.1	449	0	$58	$416	$150	4.6
Women's Rest Room	1	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	2,808	2, 3	Relamp	Yes	1	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	1,938	0.0	80	0	$10	$25	$4	2.0
Women's Rest Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,808	2, 3	Relamp	Yes	1	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,938	0.1	224	0	$29	$343	$110	8.0
Customer Service	17	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,808	2, 3	Relamp	Yes	17	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	1,938	0.6	2,132	0	$276	$999	$208	2.9
Customer Service	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
Office	4	Compact Fluorescent: (2) 40W Biax Lamps	Occupancy Sensor	S	80	2,440	2	Relamp	No	4	LED Lamps: (2) 28W Biax Lamps	Occupancy Sensor	56	2,440	0.1	253	0	$33	$108	$16	2.8
Reference Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,440	2	Relamp	No	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,440	0.2	522	0	$68	$219	$120	1.5
Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,440	2	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,440	0.1	261	0	$34	$110	$60	1.5
Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,440	2	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,440	0.1	261	0	$34	$110	$60	1.5
Admin Services	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,440	2	Relamp	No	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,440	0.2	522	0	$68	$219	$120	1.5
Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,440	2	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,440	0.1	261	0	$34	$110	$60	1.5
Copy Room	1	Compact Fluorescent: (2) 40W Biax Lamps	Wall Switch	S	80	2,496	2	Relamp	No	1	LED Lamps: (2) 28W Biax Lamps	Wall Switch	56	2,496	0.0	65	0	$8	$27	$4	2.7
HR Office	2	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,440	2	Relamp	No	2	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,440	0.1	261	0	$34	$110	$60	1.5
Director Office	4	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Occupancy Sensor	S	93	2,440	2	Relamp	No	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,440	0.2	522	0	$68	$219	$120	1.5
Director Office	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
Rest Room	1	Compact Fluorescent: (2) 26W Plug-In Lamps	Occupancy Sensor	S	52	2,440	2	Relamp	No	1	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	2,440	0.0	40	0	$5	$25	$4	4.1
Rest Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	2,808	2, 3	Relamp	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,938	0.1	449	0	$58	$416	$150	4.6
Conference Room	6	Compact Fluorescent: (2) 26W Plug-In Lamps	Wall Switch	S	52	2,808	2, 3	Relamp	Yes	6	LED Lamps: (2) 18.5W Plug-In Lamps	Occupancy Sensor	37	1,938	0.1	482	0	$62	$420	$94	5.2
Conference Room	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
Closet	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,248	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,248	0.0	44	0	$6	$37	$20	2.9
Roof Access	1	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	1,560	2	Relamp	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,560	0.0	56	0	$7	$37	$20	2.3
Roof	12	Halogen Incandescent: (1) 90W Flood Light	Photocell		90	4,380	2	Relamp	No	12	LED Lamps: (1) 13.5W Flood Lamp	Photocell	14	4,380	0.0	4,021	0	$531	$207	$24	0.3
Exterior	11	Compact Fluorescent: (1) 32W Plug-In Lamp	Timeclock		32	4,380	2	Relamp	No	11	LED Lamps: (1) 22W Plug-In Lamp	Timeclock	22	4,380	0.0	482	0	$64	$138	$22	1.8
Parking Lot	6	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock		135	4,380		None	No	6	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock	135	4,380	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Parking Lot	3	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock		120	4,380		None	No	3	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Timeclock	120	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior	6	Metal Halide: (1) 150W Lamp	Timeclock		190	4,380	1	Fixture Replacement	No	6	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock	45	4,380	0.0	3,811	0	$503	$3,477	$1,200	4.5
Exterior	4	Compact Fluorescent: (1) 42W Plug-In Lamp	Timeclock		42	4,380	2	Relamp	No	4	LED Lamps: (1) 29W Plug-In Lamp	Timeclock	29	4,380	0.0	228	0	$30	$50	$8	1.4
Sign Light	2	LED - Fixtures: Architectural Flood/Spot Luminaire	Photocell		45	4,380		None	No	2	LED - Fixtures: Architectural Flood/Spot Luminaire	Photocell	45	4,380	0.0	0	0	$0	$0	$0	0.0
Flag Light	1	LED - Fixtures: Architectural Flood/Spot Luminaire	Photocell		37	4,380		None	No	1	LED - Fixtures: Architectural Flood/Spot Luminaire	Photocell	37	4,380	0.0	0	0	$0	$0	$0	0.0

Motor Inventory & Recommendations

		Existing Conditions							Proposed Conditions					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Heating Hot Water System	1	Heating Hot Water Pump	0.8	70.0%	No	W	2,028		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Sewer System	2	Other	1.0	77.0%	No	W	1,373		No	77.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	AHU/AC1	1	Supply Fan	20.0	91.0%	Yes	W	2,028		No	91.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Hot Water Unit Heaters	2	Supply Fan	0.3	65.0%	No	W	2,028		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Room	Heating Hot Water System	2	Heating Hot Water Pump	1.0	85.5%	No	W	2,028	8	No	85.5%	Yes	2	0.2	1,327	0	$175	$6,020	$300	32.6
Mechanical Room	Heating Hot Water System	2	Heating Hot Water Pump	1.0	85.5%	No	W	2,028	8	No	85.5%	Yes	2	0.2	1,327	0	$175	$6,020	$300	32.6
Mechanical Room	Cooling System	2	Chilled Water Pump	3.0	90.2%	No	W	2,028	7	No	90.2%	Yes	2	1.1	3,774	0	$498	$7,768	$800	14.0
Mechanical Room	AHU2/AC2	1	Supply Fan	5.0	87.5%	No	W	2,028	5	No	89.5%	Yes	1	1.5	3,372	0	$445	$4,197	$1,800	5.4
Mechanical Room	AHU3/AC3	1	Supply Fan	1.5	84.0%	No	W	2,028	5	No	86.5%	Yes	1	0.4	1,066	0	$141	$3,380	$150	22.9
Elevator Room	Elevator	1	Other	75.0	93.0%	No	W	780		No	93.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	Rest Room	3	Exhaust Fan	0.3	65.0%	No	W	2,028		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Roof	EF-7/AHU1	1	Exhaust Fan	5.0	87.5%	Yes	W	2,028		No	87.5%	No		0.0	0	0	$0	$0	$0	0.0
Roof	RTU-6	1	Supply Fan	7.5	88.5%	No	B	2,028	6	No	91.0%	Yes	1	2.2	5,046	0	$666	$4,738	$2,000	4.1
Roof	RTU-5	1	Supply Fan	3.0	86.5%	No	B	2,028	6	No	89.5%	Yes	1	0.9	2,086	0	$276	$3,884	$400	12.6
Roof	RTU-4	1	Supply Fan	2.0	84.0%	No	B	2,028	6	No	86.5%	Yes	1	0.6	1,421	0	$188	$3,261	$200	16.3
Roof	RTU-3	1	Supply Fan	2.0	84.0%	No	B	2,028	6	No	86.5%	Yes	1	0.6	1,421	0	$188	$3,261	$200	16.3
Roof	RTU-2	1	Supply Fan	7.5	88.5%	No	B	2,028	6	No	91.0%	Yes	1	2.2	5,046	0	$666	$4,738	$2,000	4.1
Roof	RTU-1	1	Supply Fan	5.0	87.5%	No	B	2,028	6	No	89.5%	Yes	1	1.5	3,372	0	$445	$4,076	$1,800	5.1
Ground Floor	RTU-8	1	Supply Fan	3.0	86.5%	No	B	2,028	6	No	89.5%	Yes	1	0.9	2,086	0	$276	$3,884	$400	12.6
Ground Floor	RTU-7	1	Supply Fan	7.5	88.5%	No	B	2,028	6	No	91.0%	Yes	1	2.2	5,046	0	$666	$4,738	$2,000	4.1

Electric 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)	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/EER)	Heating Mode Efficiency (COP)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Mechanical Room	Server Room	1	Ductless Mini-Split AC	1.03		W		No							0.0	0	0	$0	$0	$0	0.0
Roof	RTU-6	1	Packaged AC	20.00		B	9	Yes	1	Packaged AC	20.00		10.50		1.9	1,984	0	$262	$33,748	$3,160	116.7
Roof	RTU-5	1	Packaged AC	7.50		B	9	Yes	1	Packaged AC	7.50		11.50		0.4	435	0	$57	$13,366	$1,095	213.5
Roof	RTU-4	1	Packaged AC	5.00		B	9	Yes	1	Packaged AC	5.00		14.00		0.8	829	0	$109	$11,345	$920	95.2
Roof	RTU-3	1	Packaged AC	5.00		B	9	Yes	1	Packaged AC	5.00		14.00		0.7	696	0	$92	$11,345	$920	113.4
Roof	RTU-2	1	Packaged AC	20.00		B	9	Yes	1	Packaged AC	20.00		10.50		1.9	1,984	0	$262	$33,748	$3,160	116.7
Roof	RTU-1	1	Packaged AC	12.50		B	9	Yes	1	Packaged AC	12.50		11.50		1.5	1,542	0	$204	$17,423	$1,975	75.8
Ground Floor	RTU-8	1	Packaged AC	7.50		B	9	Yes	1	Packaged AC	7.50		11.50		0.4	435	0	$57	$13,366	$1,095	213.5
Ground Floor	Library	1	Split-System AC	10.00		B	9	Yes	1	Split-System AC	10.00		11.50		1.1	1,105	0	$146	$11,638	$1,460	69.8
Ground Floor	Library	1	Split-System AC	4.00		B	9	Yes	1	Split-System AC	4.00		14.00		0.7	685	0	$91	$5,985	$736	58.0
Ground Floor	RTU-7	1	Packaged AC	20.00		B	9	Yes	1	Packaged AC	20.00		10.50		1.9	1,984	0	$262	$33,748	$3,160	116.7

Electric Chiller Inventory & Recommendations

		Existing Conditions				Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Chiller Quantity	System Type	Cooling Capacity per Unit (Tons)	Remaining Useful Life	ECM #	Install High Efficiency Chillers?	Chiller Quantity	System Type	Constant/ Variable Speed	Cooling Capacity (Tons)	Full Load Efficiency (kW/Ton)	IPLV Efficiency (kW/Ton)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Ground Floor	Cold Water System	1	Air-Cooled Scroll Chiller	50.00	B	10	Yes	1	Air-Cooled Centrifugal Chiller	Variable	50.00	1.24	0.74	11.0	8,497	0	$1,122	$42,659	$9,000	30.0

Fuel Heating 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)	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Heating Hold Water System	1	Non-Condensing Hot Water Boiler	1,615	B	11	Yes	1	Condensing Hot Water Boiler	1,615	89.00%	Et	0.0	0	29	$342	$30,845	$7,106	69.3
Roof	RTU-6	1	Furnace	324	B	12	Yes	1	Furnace	324	83.00%	AFUE	0.0	0	8	$100	$7,341	$800	65.4
Roof	RTU-5	1	Furnace	160	B	12	Yes	1	Furnace	160	83.00%	AFUE	0.0	0	5	$60	$3,625	$800	47.3
Roof	RTU-4	1	Furnace	104	B	12	Yes	1	Furnace	104	83.00%	AFUE	0.0	0	3	$39	$2,356	$800	40.1
Roof	RTU-3	1	Furnace	104	B	12	Yes	1	Furnace	104	83.00%	AFUE	0.0	0	3	$39	$2,356	$800	40.1
Roof	RTU-2	1	Furnace	324	B	12	Yes	1	Furnace	324	83.00%	AFUE	0.0	0	8	$100	$7,341	$800	65.4
Roof	RTU-1	1	Furnace	203	B	12	Yes	1	Furnace	203	83.00%	AFUE	0.0	0	5	$63	$4,599	$800	60.6
Ground Floor	RTU-8	1	Furnace	160	B	12	Yes	1	Furnace	160	83.00%	AFUE	0.0	0	5	$60	$3,625	$800	47.3
Ground Floor	RTU-7	1	Furnace	324	B	12	Yes	1	Furnace	324	83.00%	AFUE	0.0	0	8	$100	$7,341	$800	65.4

Pipe Insulation Recommendations

		Recommendation Inputs			Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Affected	ECM #	Length of Uninsulated Pipe (ft)	Pipe Diameter (in)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Janitorial Closet	Domestic Hot Water System	13	30	0.75	0.0	2,283	0	$301	$173	$120	0.2
Boiler Room	Heating Hot Water System	13	12	2.00	0.0	0	10	$117	$105	$48	0.5
Boiler Room	Heating Hot Water System	13	20	0.50	0.0	0	6	$71	$144	$40	1.5

DHW Inventory & Recommendations

		Existing Conditions			Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Custodial Closet	Domestic Hot Water System	1	Storage Tank Water Heater (≤ 50 Gal)	N		No						0.0	0	0	$0	$0	$0	0.0

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Building	72	Computer	125	
Building	13	Printer	300	
Building	3	Refrigerator	244	
Building	4	Microwave	800	
Building	1	Water Cooler	92	
Building	3	Copy Machine	600	
Building	2	TV	240	
Building	2	Coffee Machine	600	

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	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Galla Area	2	Refrigerated	14	Yes	0.4	3,224	0	$426	$460	$200	0.6
Galla Area	1	Non-Refrigerated	14	Yes	0.0	343	0	$45	$230	$0	5.1

APPENDIX B: ENERGY STAR® STATEMENT OF ENERGY PERFORMANCE

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

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ENERGY STAR® Statement of Energy Performance

N/A

ENERGY STAR® Score[1]

Parsippany-Troy Hills Public Library (Main Library)

Primary Property Type: Library
Gross Floor Area (ft²): 38,872
Built: 1980

For Year Ending: March 31, 2019
Date Generated: March 31, 2020

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
Parsippany-Troy Hills Public Library (Main Library) 449 Halsey Road Parsippany, New Jersey 07054	Township of Parsippany-Troy Hills 1001 Parsippany Boulevard Parsippany, NJ 07054 973-263-4391	Keith Kazmark 1001 Parsippany Boulevard Parsippany, NJ 07054 973-263-4391 kkazmark@parsippany.net

Property ID: 9002219

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
73.3 kBtu/ft²

Source EUI
142.6 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	1,391,291 (49%)
Electric - Grid (kBtu)	1,457,307 (51%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	73.8
National Median Source EUI (kBtu/ft²)	143.6
% Diff from National Median Source EUI	-1%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	222

Signature & Stamp of Verifying Professional

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

LP Signature: _____Date: _____

Licensed Professional

____ _____
.
(____)____-_____
_____

Professional Engineer or Registered Architect Stamp (if applicable)

APPENDIX C: GLOSSARY

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

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

SEER	*Seasonal energy efficiency ratio:* a measure of efficiency in terms of annual cooling energy provided divided by total electric input.
SEP	*Statement of energy performance:* a summary document from the ENERGY STAR® Portfolio Manager®.
Simple Payback	The amount of time needed to recoup the funds expended in an investment or to reach the break-even point between investment and savings.
SREC	*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.