Local Government Energy Audit Report

Lake Hiawatha Library

July 17, 2020

Prepared for:

Parsippany Troy Hills Township
68 Nokomis Avenue
Lake Hiawatha, New Jersey 07034

Prepared by:

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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 have received preliminary analysis of feasibility that identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to establish a basis for further discussion and to help prioritize energy measures.

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

TRC bases estimated 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 energy conservation measures in complete conformance with all applicable local, state and federal requirements.

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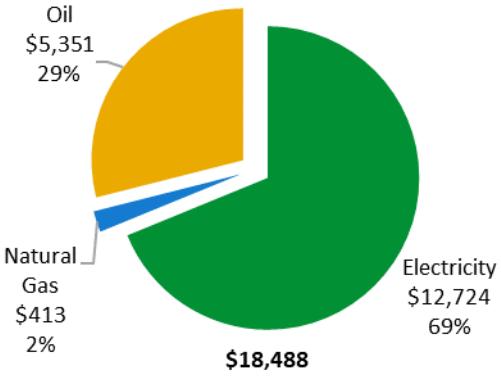
1 EXECUTIVE SUMMARY

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Lake Hiawatha 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 your facility. TRC conducted this study as part of a comprehensive effort to assist New Jersey school districts and local governments in controlling their energy costs and to help protect our environment by reducing statewide energy consumption.

BUILDING PERFORMANCE REPORT

Annual Utilities	Costs: $18,488 Electricity: 94,799 kWh Natural Gas: 103 Therms No. 2 Fuel Oil: 1,889 Gallons	
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.

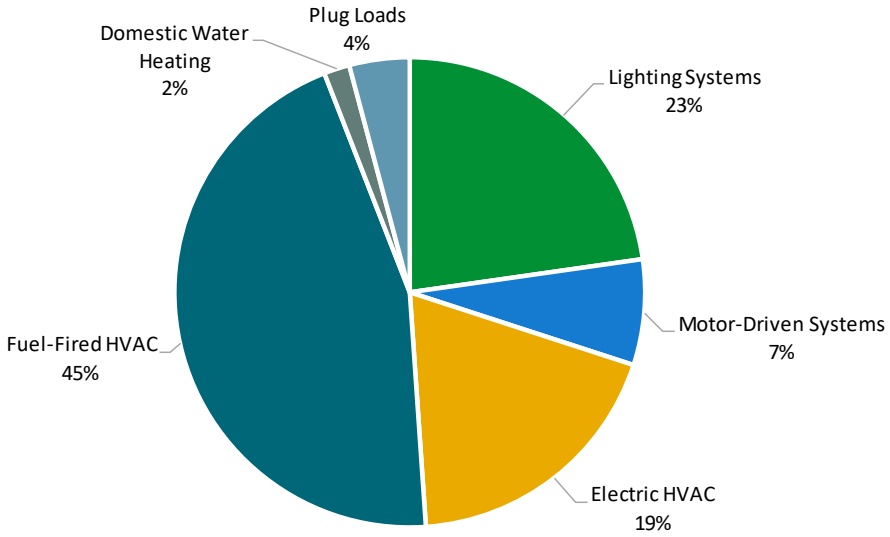


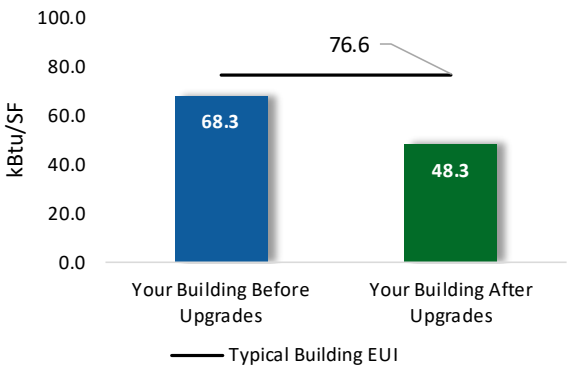
Figure 1 - Energy Use by System

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.

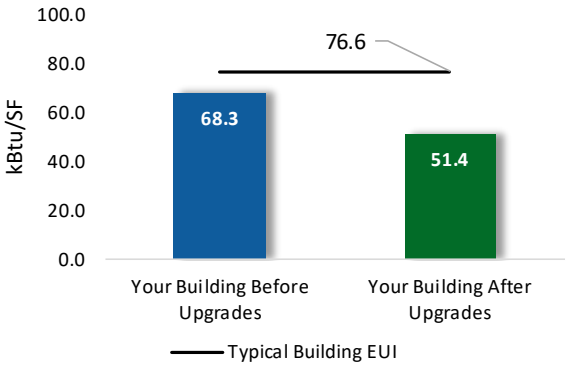
Scenario 1: Full Package (all evaluated measures)

Installation Cost	$42,749
Potential Rebates & Incentives[1]	$11,660
Annual Cost Savings	$6,537
Annual Energy Savings	Electricity: 43,830 kWh Natural Gas: 72 Therms No. 2 Fuel Oil: 129 Gallons
Greenhouse Gas Emission Savings	24 Tons
Simple Payback	4.8 Years
Site Energy Savings (all utilities)	29%



Scenario 2: Cost-Effective Package[2]

Installation Cost	$25,198
Potential Rebates & Incentives	$9,346
Annual Cost Savings	$5,868
Annual Energy Savings	Electricity: 42,125 kWh Natural Gas: 72 Therms
Greenhouse Gas Emission Savings	21 Tons
Simple Payback	2.7 Years
Site Energy Savings (all utilities)	25%



On-site Generation Potential

Photovoltaic	None
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			**23,954**	**6.9**	**-10**	**$3,016**	**$10,561**	**$4,674**	**$5,887**	**2.0**	**22,525**
ECM 1	Install LED Fixtures	Yes	1,041	0.0	0	$140	$1,366	$800	$566	4.1	1,048
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	7,046	2.4	-3	$884	$3,743	$940	$2,803	3.2	6,604
ECM 3	Retrofit Fixtures with LED Lamps	Yes	15,868	4.5	-7	$1,992	$5,452	$2,934	$2,518	1.3	14,873
Lighting Control Measures			**4,965**	**1.4**	**-2**	**$623**	**$6,840**	**$2,370**	**$4,470**	**7.2**	**4,654**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	4,343	1.3	-2	$545	$5,940	$1,470	$4,470	8.2	4,071
ECM 5	Install High/Low Lighting Controls	Yes	622	0.2	0	$78	$900	$900	$0	0.0	583
Variable Frequency Drive (VFD) Measures			**4,565**	**1.5**	**0**	**$613**	**$4,197**	**$1,800**	**$2,397**	**3.9**	**4,596**
ECM 6	Install VFDs on Constant Volume (CV) Fans	Yes	4,565	1.5	0	$613	$4,197	$1,800	$2,397	3.9	4,596
Electric Unitary HVAC Measures			**10,347**	**4.5**	**0**	**$1,389**	**$6,104**	**$368**	**$5,736**	**4.1**	**10,419**
ECM 7	Install High Efficiency Air Conditioning Units	No	1,706	0.9	0	$229	$2,722	$0	$2,722	11.9	1,718
ECM 8	Install High Efficiency Heat Pumps	Yes	8,641	3.6	0	$1,160	$3,382	$368	$3,014	2.6	8,702
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**22**	**$440**	**$14,830**	**$2,314**	**$12,516**	**28.5**	**3,520**
ECM 9	Install High Efficiency Hot Water Boilers	No	0	0.0	22	$440	$14,830	$2,314	$12,516	28.5	3,520
HVAC System Improvements			**0**	**0.0**	**15**	**$443**	**$203**	**$120**	**$83**	**0.2**	**2,142**
ECM 10	Install Pipe Insulation	Yes	0	0.0	15	$443	$203	$120	$83	0.2	2,142
Domestic Water Heating Upgrade			**0**	**0.0**	**0**	**$13**	**$14**	**$14**	**$0**	**0.0**	**39**
ECM 11	Install Low-Flow DHW Devices	Yes	0	0.0	0	$13	$14	$14	$0	0.0	39
TOTALS (COST EFFECTIVE MEASURES)			**42,125**	**13.4**	**4**	**$5,868**	**$25,198**	**$9,346**	**$15,851**	**2.7**	**42,658**
TOTALS (ALL MEASURES)			**43,830**	**14.3**	**25**	**$6,537**	**$42,749**	**$11,660**	**$31,089**	**4.8**	**47,896**

* - 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 Fluorescent Fixtures with LED Lamps and Drivers	X	X	
ECM 3	Retrofit Fixtures with LED Lamps	X	X	
ECM 4	Install Occupancy Sensor Lighting Controls	X	X	
ECM 5	Install High/Low Lighting Controls	X	X	
ECM 6	Install VFDs on Constant Volume (CV) Fans	X		
ECM 7	Install High Efficiency Air Conditioning Units		X	
ECM 8	Install High Efficiency Heat Pumps	X	X	
ECM 9	Install High Efficiency Hot Water Boilers	X	X	
ECM 10	Install Pipe Insulation	X	X	
ECM 11	Install Low-Flow DHW Devices	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 Lake Hiawatha Library. This report provides information on how the Library uses energy, identifies energy conservation measures (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 Lake Hiawatha Library located in Lake Hiawatha, New Jersey. TRC met with John Pirny to review the Library operations and help focus our investigation on specific energy-using systems.

Lake Hiawatha Library at Parsippany Troy Hills is a 2-story, 8,724 square foot building built in 1969 and last renovated in 1994. It consists of a partially below-grade basement with a ground floor directly above. Spaces include offices, conference room, children and non-fiction sections, main area, meeting room, lobby, hallway, restrooms, and mechanical room.

The building is heated using an oil-fired hot water boiler and electric heat pumps. Cooling is provided by a 15-ton outdoor condensing unit and Mitsubishi heat pumps. Domestic water is heated by natural gas.

For a detailed list of the locations and recommended energy conservation measures 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 on Sundays during the summer months. Typical weekday occupancy is 15 staff members and a varying number of visitors.

Building Name	Weekday/Weekend	Operating Schedule
Lake Hiawatha Library	Monday to Thursday	9:00 AM-9:00 PM
	Friday & Saturday	9:00 AM-5:00 PM
	Sunday	1:00 PM-5:00 PM

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 constructed of brick veneer and concrete masonry units over structural steel. The interior primarily consists of painted gypsum wallboard. Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall fair condition with signs of cracks at some portions of the walls.

Wood trusses support a pitched roof with a wood deck covered with asphalt shingles. The roof flashing, gutters, and downspouts were inspected during the field audit. The roof appears to be in acceptable condition.

Most windows are vinyl with vinyl frames and single pane glazing. The glass-to-frame seals are in poor condition and most windows installation have cracks in around the frames. Windows are in poor condition, showing evidence of wear. The exterior doors are wood framed with a small section of single pane glass panels. Exterior doors are in poor condition with damaged doors seals. Degraded window and door seals increase drafts and outside air infiltration.

Overall, the building envelope appears to be in fair condition.

Building Walls

Exterior Doors and Windows

2.4 Lighting Systems

The primary interior lighting system consists of a mixture of 32- and 40-Watt linear fluorescent T8 and T12 lamps. There are also some incandescent lamps. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts. Fixture types include 2-, 3-, or 4-lamp, 2- or 4-foot long troffer, recessed, surface-mounted and pendant fixtures. Spaces such as the basement hallway, children's section, meeting room, main area, and meeting room are lit with linear T8 fixtures. The remaining spaces are mainly illuminated with linear T12 fixtures. Most fixtures are in good condition, although there some fixtures that are in fair condition. All exit signs are LED units. Interior lighting levels were generally sufficient. Light fixtures are controlled by wall switches.

Exterior lighting consists of halogen incandescent lamps at front entrance for the sign and wall-mounted metal halide fixtures. Fixtures are controlled by a timeclock.

Linear T12 and T8 Fixtures

Recessed Incandescent Lamp, Wall Switches, and Timeclock

2-Foot T12 and Pendant T8 Fixtures

Metal Halide and Halogen Incandescent Fixtures

2.5 Air Handling Systems

Packaged Units

The ground floor of the building is served with one air handing unit (AHU) that is equipped with hot water coils for heating. They provide cooling using a 15-ton outdoor condenser unit. Supply fans provide air distribution to supply air registers by ducts concealed above the ceilings. The AHU was not fully accessible during the site visit, although it appeared to be old and in poor condition.

Air Conditioners

The basement area is conditioned by four Mitsubishi heat pumps. Each unit has a 2-ton cooling and 33 MBh heating capacity. They are nearing their normal useful life and appear to be in fair condition. The units have been evaluated for replacement.

Two offices and the lounge room are each served with a Carrier window air conditioner (AC). The window ACs are in poor condition.

The 15-ton Carrier outdoor condensing unit that serves the AHU cooling coils was manufactured in 2008 and is in good working condition.

Both the Mitsubishi and the Carrier units use R-22 as a refrigerant. Heating and cooling systems are controlled by programmable thermostats.

15-Tons Carrier and Mitsubishi Units

Carrier Window AC and Mitsubishi Unit Air Register

2.6 Heating Hot Water Systems

One HB Smith 661 MBh oil-fired hot water boiler serves part of the building heating load. The burner is non-modulating with a nominal efficiency of 81%. Hot water is distributed to the AHU heating coils and to other end uses using two 1/6 hp constant flow pumps. Installed in 1990, the oil-fired boiler is in fair condition and has been evaluated for replacement with a gas-fired hot water boiler. Heating hot water pipes are not insulated. We recommend engaging the services of a local heating system engineer to establish a basis of design for your optimal heating system. The heating system is controlled with programmable thermostats.

In addition to the hot water system and heat pumps, three 4-foot electric resistance heaters are used to provide heating in spaces such as the restrooms.

Oil-Fired Hot Water Boiler and Pumps

Electric Resistance Heater and Programmable Thermostats

2.7 Domestic Hot Water

Hot water is produced with an 80% efficient, 50-gallon 40 MBh gas-fired storage water heater. The hot water is in good condition; however, the hot water pipes are not insulated.

Storage Tank Water Heater and Pipes

2.8 Plug Load & Vending Machines

You may wish to consider paying particular attention to minimizing your plug load usage. This report makes suggestions for ECMs in this area as well as Energy Efficient Best Practices.

There are approximately 23 computer workstations throughout the Library. Plug loads throughout the building include general café and office equipment.

Copier and Desktop Computers

2.9 Water-Using Systems

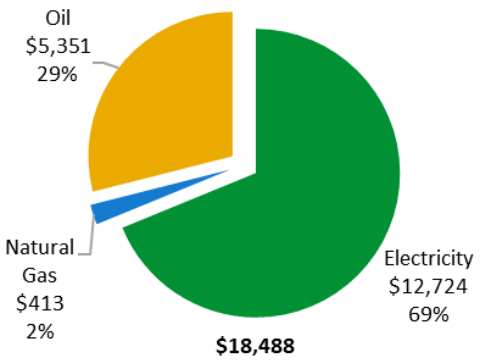
There are four restrooms with toilets, urinals, and sinks. Faucet flow rates are at 2.2 gallons per minute (gpm) or higher. Toilets are rated at 2.5 gallons per flush (gpf) and urinals are rated at 2.5 gpf.

Typical Sink

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	94,799 kWh	$12,724
Natural Gas	103 Therms	$413
No. 2 Fuel Oil	1,889 Gallons	$5,351
Total		**$18,488**



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.

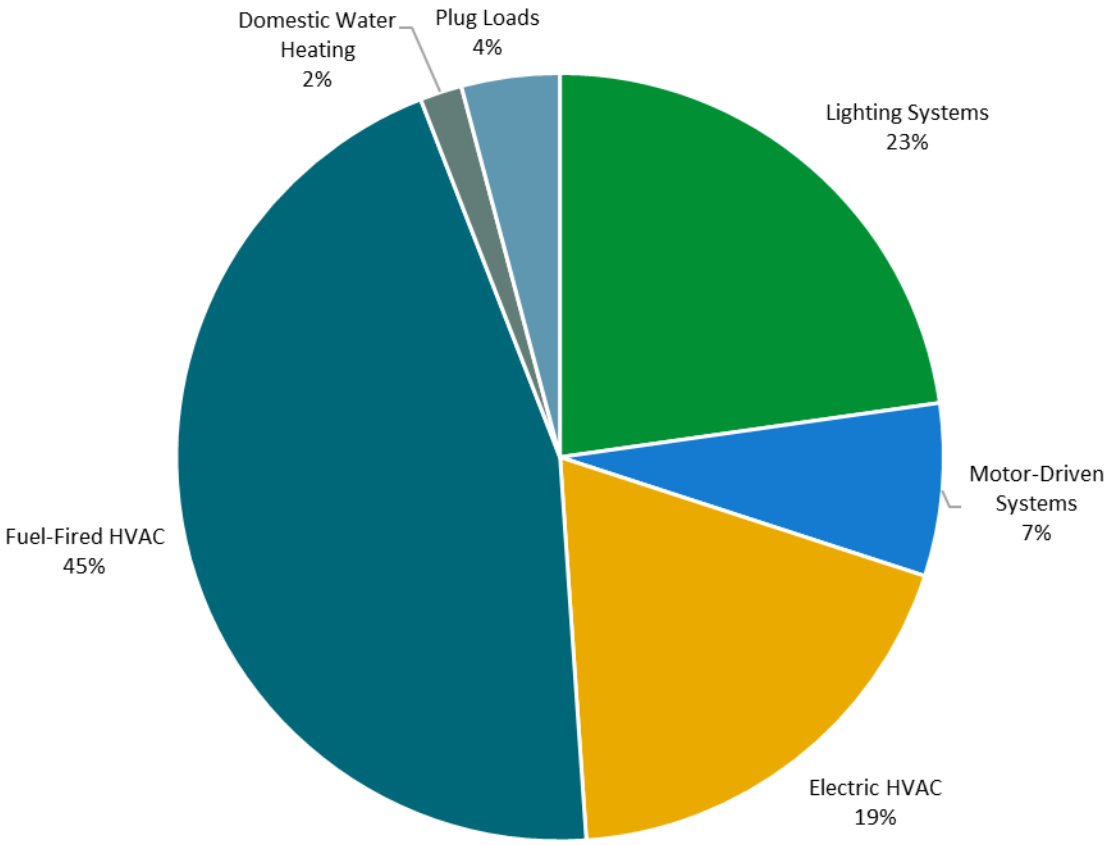
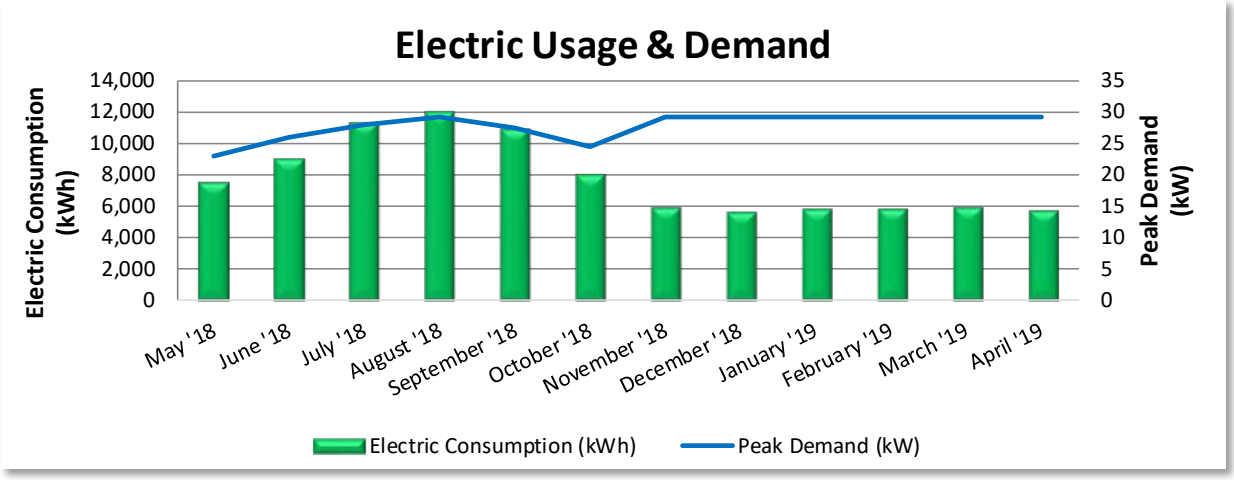


Figure 5 - Energy Balance

3.1 Electricity

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



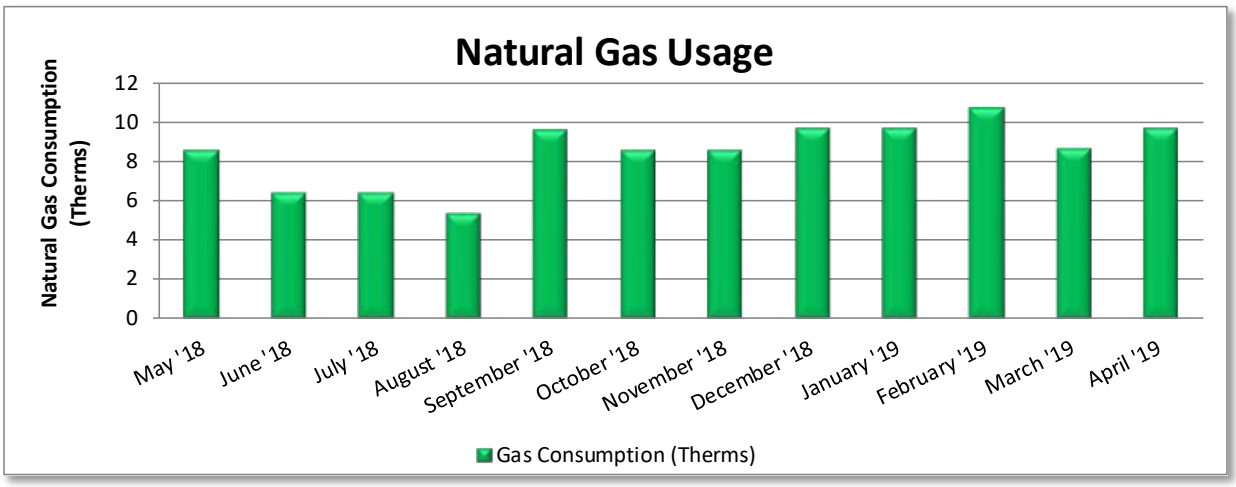
Electric Billing Data					
Period Ending	**Days in Period**	**Electric Usage (kWh)**	**Demand (kW)**	**Demand Cost**	**Total Electric Cost**
5/21/18	30	7,560	23	$144	$1,071
6/19/18	29	9,000	26	$175	$1,190
7/20/18	31	11,320	28	$188	$1,394
8/18/18	29	12,040	29	$196	$1,474
9/19/18	32	10,920	27	$184	$1,441
10/19/18	30	8,000	24	$153	$1,138
11/19/18	31	5,960	29	$89	$834
12/18/18	29	5,640	29	$89	$786
1/21/19	34	5,840	29	$89	$801
2/19/19	29	5,840	29	$89	$799
3/20/19	29	5,920	29	$89	$835
4/17/19	28	5,720	29	$89	$823
Totals	**361**	**93,760**	**29**	**$1,573**	**$12,585**
Annual	**365**	**94,799**	**29**	**$1,591**	**$12,724**

Notes:

- Peak demand of 29 kW occurred repeatedly in many months.
- Average demand over the past 12 months was 28 kW.
- The average electric cost over the past 12 months was $0.134/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 006.



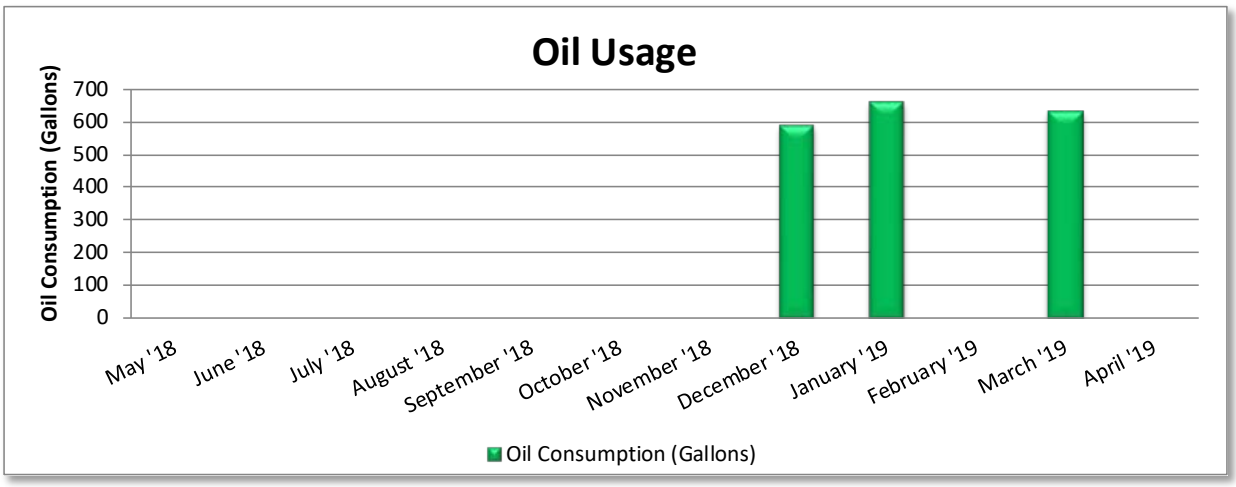
Gas Billing Data			
Period Ending	**Days in Period**	**Natural Gas Usage (Therms)**	**Natural Gas Cost**
5/21/18	30	9	$34
6/19/18	29	6	$32
7/20/18	31	6	$32
8/18/18	29	5	$31
9/19/18	32	10	$34
10/19/18	30	9	$34
11/19/18	31	9	$39
12/18/18	29	10	$34
1/21/19	34	10	$29
2/19/19	29	11	$41
3/20/19	29	9	$34
4/17/19	28	10	$35
Totals	**361**	**101**	**$408**
Annual	**365**	**103**	**$413**

Notes:

- The average gas cost for the past 12 months is $4.023/therm, which is the blended rate used throughout the analysis. Domestic hot water is the only gas load in a building, the rate is artificially high since the customer charge constitutes most of the cost.

3.3 No. 2 Fuel Oil

Allied Oil LLC delivers No. 2 Fuel Oil to the project site.



No. 2 Fuel Oil Billing Data			
Period Ending	**Days in Period**	**Oil Usage (Gallons)**	**Fuel Cost**
5/21/18	30	0	$0
6/19/18	31	0	$0
7/20/18	30	0	$0
8/18/18	31	0	$0
9/19/18	31	0	$0
10/19/18	30	0	$0
11/19/18	31	0	$0
12/18/18	30	593	$1,696
1/21/19	31	664	$1,872
2/19/19	31	0	$0
3/20/19	28	632	$1,783
4/17/19	31	0	$0
Totals	**365**	**1,889**	**$5,351**
Annual	**365**	**1,889**	**$5,351**

Notes:

- The average No. 2 Fuel Oil cost for the past 12 months is $2.833/Gallon, which is the blended rate used throughout the analysis.

3.4 Benchmarking

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

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

Benchmarking Score	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.

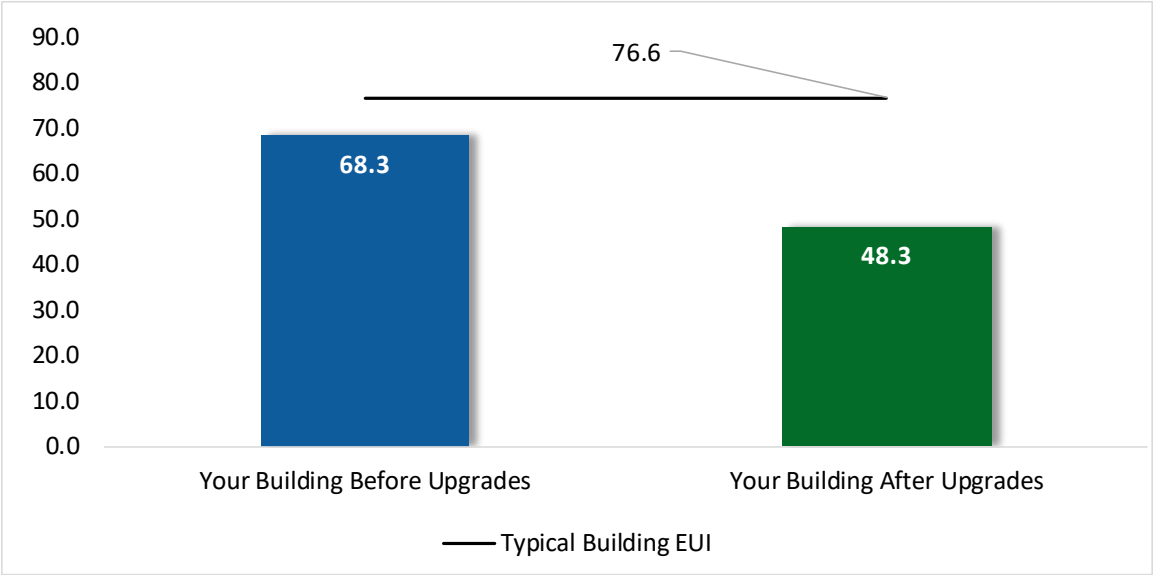


Figure 6 - Energy Use Intensity Comparison[3]

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

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[4].

[4] 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 energy conservation measures 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			**23,954**	**6.9**	**-10**	**$3,016**	**$10,561**	**$4,674**	**$5,887**	**2.0**	**22,525**
ECM 1	Install LED Fixtures	Yes	1,041	0.0	0	$140	$1,366	$800	$566	4.1	1,048
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	7,046	2.4	-3	$884	$3,743	$940	$2,803	3.2	6,604
ECM 3	Retrofit Fixtures with LED Lamps	Yes	15,868	4.5	-7	$1,992	$5,452	$2,934	$2,518	1.3	14,873
Lighting Control Measures			**4,965**	**1.4**	**-2**	**$623**	**$6,840**	**$2,370**	**$4,470**	**7.2**	**4,654**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	4,343	1.3	-2	$545	$5,940	$1,470	$4,470	8.2	4,071
ECM 5	Install High/Low Lighting Controls	Yes	622	0.2	0	$78	$900	$900	$0	0.0	583
Variable Frequency Drive (VFD) Measures			**4,565**	**1.5**	**0**	**$613**	**$4,197**	**$1,800**	**$2,397**	**3.9**	**4,596**
ECM 6	Install VFDs on Constant Volume (CV) Fans	Yes	4,565	1.5	0	$613	$4,197	$1,800	$2,397	3.9	4,596
Electric Unitary HVAC Measures			**10,347**	**4.5**	**0**	**$1,389**	**$6,104**	**$368**	**$5,736**	**4.1**	**10,419**
ECM 7	Install High Efficiency Air Conditioning Units	No	1,706	0.9	0	$229	$2,722	$0	$2,722	11.9	1,718
ECM 8	Install High Efficiency Heat Pumps	Yes	8,641	3.6	0	$1,160	$3,382	$368	$3,014	2.6	8,702
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**22**	**$440**	**$14,830**	**$2,314**	**$12,516**	**28.5**	**3,520**
ECM 9	Install High Efficiency Hot Water Boilers	No	0	0.0	22	$440	$14,830	$2,314	$12,516	28.5	3,520
HVAC System Improvements			**0**	**0.0**	**15**	**$443**	**$203**	**$120**	**$83**	**0.2**	**2,142**
ECM 10	Install Pipe Insulation	Yes	0	0.0	15	$443	$203	$120	$83	0.2	2,142
Domestic Water Heating Upgrade			**0**	**0.0**	**0**	**$13**	**$14**	**$14**	**$0**	**0.0**	**39**
ECM 11	Install Low-Flow DHW Devices	Yes	0	0.0	0	$13	$14	$14	$0	0.0	39
TOTALS			**43,830**	**14.3**	**25**	**$6,537**	**$42,749**	**$11,660**	**$31,089**	**4.8**	**47,896**

* - 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		**23,954**	**6.9**	**-10**	**$3,016**	**$10,561**	**$4,674**	**$5,887**	**2.0**	**22,525**
ECM 1	Install LED Fixtures	1,041	0.0	0	$140	$1,366	$800	$566	4.1	1,048
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	7,046	2.4	-3	$884	$3,743	$940	$2,803	3.2	6,604
ECM 3	Retrofit Fixtures with LED Lamps	15,868	4.5	-7	$1,992	$5,452	$2,934	$2,518	1.3	14,873
Lighting Control Measures		**4,965**	**1.4**	**-2**	**$623**	**$6,840**	**$2,370**	**$4,470**	**7.2**	**4,654**
ECM 4	Install Occupancy Sensor Lighting Controls	4,343	1.3	-2	$545	$5,940	$1,470	$4,470	8.2	4,071
ECM 5	Install High/Low Lighting Controls	622	0.2	0	$78	$900	$900	$0	0.0	583
Variable Frequency Drive (VFD) Measures		**4,565**	**1.5**	**0**	**$613**	**$4,197**	**$1,800**	**$2,397**	**3.9**	**4,596**
ECM 6	Install VFDs on Constant Volume (CV) Fans	4,565	1.5	0	$613	$4,197	$1,800	$2,397	3.9	4,596
Electric Unitary HVAC Measures		**8,641**	**3.6**	**0**	**$1,160**	**$3,382**	**$368**	**$3,014**	**2.6**	**8,702**
ECM 8	Install High Efficiency Heat Pumps	8,641	3.6	0	$1,160	$3,382	$368	$3,014	2.6	8,702
HVAC System Improvements		**0**	**0.0**	**15**	**$443**	**$203**	**$120**	**$83**	**0.2**	**2,142**
ECM 10	Install Pipe Insulation	0	0.0	15	$443	$203	$120	$83	0.2	2,142
Domestic Water Heating Upgrade		**0**	**0.0**	**0**	**$13**	**$14**	**$14**	**$0**	**0.0**	**39**
ECM 11	Install Low-Flow DHW Devices	0	0.0	0	$13	$14	$14	$0	0.0	39
TOTALS		**42,125**	**13.4**	**4**	**$5,868**	**$25,198**	**$9,346**	**$15,851**	**2.7**	**42,658**

* - 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		**23,954**	**6.9**	**-10**	**$3,016**	**$10,561**	**$4,674**	**$5,887**	**2.0**	**22,525**
ECM 1	Install LED Fixtures	1,041	0.0	0	$140	$1,366	$800	$566	4.1	1,048
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	7,046	2.4	-3	$884	$3,743	$940	$2,803	3.2	6,604
ECM 3	Retrofit Fixtures with LED Lamps	15,868	4.5	-7	$1,992	$5,452	$2,934	$2,518	1.3	14,873

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 Fluorescent Fixtures with LED Lamps and Drivers

Retrofit fluorescent T12 fixtures by removing the fluorescent tubes and ballasts and replacing them with LED tubes and LED drivers (if necessary), which are designed to be used in retrofitted fluorescent fixtures.

The measure uses the existing fixture housing but replaces the electric components with more efficient lighting technology, which uses less power than other lighting technologies while providing equivalent lighting output. Maintenance savings may also be achieved since LED tubes last longer than fluorescent tubes and therefore do not need to be replaced as often.

Affected building areas: all areas with fluorescent fixtures with T12 tubes.

ECM 3: Retrofit Fixtures with LED Lamps

Replace fluorescent T8, 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		**4,965**	**1.4**	**-2**	**$623**	**$6,840**	**$2,370**	**$4,470**	**7.2**	**4,654**
ECM 4	Install Occupancy Sensor Lighting Controls	4,343	1.3	-2	$545	$5,940	$1,470	$4,470	8.2	4,071
ECM 5	Install High/Low Lighting Controls	622	0.2	0	$78	$900	$900	$0	0.0	583

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

ECM 4: Install Occupancy Sensor Lighting Controls

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

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

Occupancy sensors can be mounted on the wall at existing switch locations, 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 room, meeting room, restrooms, non-fiction and children sections, and main area.

ECM 5: Install High/Low Lighting Controls

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

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

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

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

Affected building areas: hallways and 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		**4,565**	**1.5**	**0**	**$613**	**$4,197**	**$1,800**	**$2,397**	**3.9**	**4,596**
ECM 6	Install VFDs on Constant Volume (CV) Fans	4,565	1.5	0	$613	$4,197	$1,800	$2,397	3.9	4,596

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 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 air handler: AHU serving the ground floor.

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		**10,347**	**4.5**	**0**	**$1,389**	**$6,104**	**$368**	**$5,736**	**4.1**	**10,419**
ECM 7	Install High Efficiency Air Conditioning Units	1,706	0.9	0	$229	$2,722	$0	$2,722	11.9	1,718
ECM 8	Install High Efficiency Heat Pumps	8,641	3.6	0	$1,160	$3,382	$368	$3,014	2.6	8,702

Replacing the window units has a long payback period and may not be justifiable based simply on energy considerations. However, the units at the Library have reached the end of their normal useful life and are in poor condition. Typically, the marginal cost of purchasing a high-efficiency unit can be justified by the marginal savings from the improved efficiency. When the window units are eventually replaced, consider purchasing equipment that exceeds the minimum efficiency required by building codes.

ECM 7: Install High-Efficiency Air Conditioning Units

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

Affected units: all three window units.

ECM 8: Install High-Efficiency Heat Pumps

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

Affected units: all four heat pumps.

4.5 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**	**22**	**$440**	**$14,830**	**$2,314**	**$12,516**	**28.5**	**3,520**
ECM 9	Install High Efficiency Hot Water Boilers	0	0.0	22	$440	$14,830	$2,314	$12,516	28.5	3,520

ECM 9: Install High-Efficiency Hot Water Boilers

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

For the purposes of this analysis, we evaluated the replacement of boiler on a one-for-one basis with equipment of the same capacity. We recommend that you work with your mechanical design team to select boiler that is sized appropriately for the heating load at the Library.

Replacing the boiler has a long payback and may not be justifiable based simply on energy considerations. However, the boiler is nearing 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 boilers that exceed the minimum efficiency required by building codes. We also recommend working with your mechanical design team to determine whether the heating system can operate with return water temperatures below 130°F, which would allow the use of condensing boilers.

4.6 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		**0**	**0.0**	**15**	**$443**	**$203**	**$120**	**$83**	**0.2**	**2,142**
ECM 10	Install Pipe Insulation	0	0.0	15	$443	$203	$120	$83	0.2	2,142

ECM 10: 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 reduced 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.

4.7 Domestic Water Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**0**	**$13**	**$14**	**$14**	**$0**	**0.0**	**39**
ECM 11	Install Low-Flow DHW Devices	0	0.0	0	$13	$14	$14	$0	0.0	39

ECM 11: Install Low-Flow DHW Devices

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

Device	Flow Rate
Faucet aerators (lavatory)	0.5 gpm

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

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[5] . 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.

[5] 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.

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 facility's occupied setpoint temperature. In general, during the cooling season, thermostats should be set as high as possible without sacrificing occupant comfort.

HVAC Filter Cleaning and Replacement

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

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.

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.

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[6] or download a copy of EPA's "WaterSense® at Work: Best Management Practices for Commercial and Institutional Facilities"[7] 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 facility 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.

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

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

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 no potential for installing a PV array.

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

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

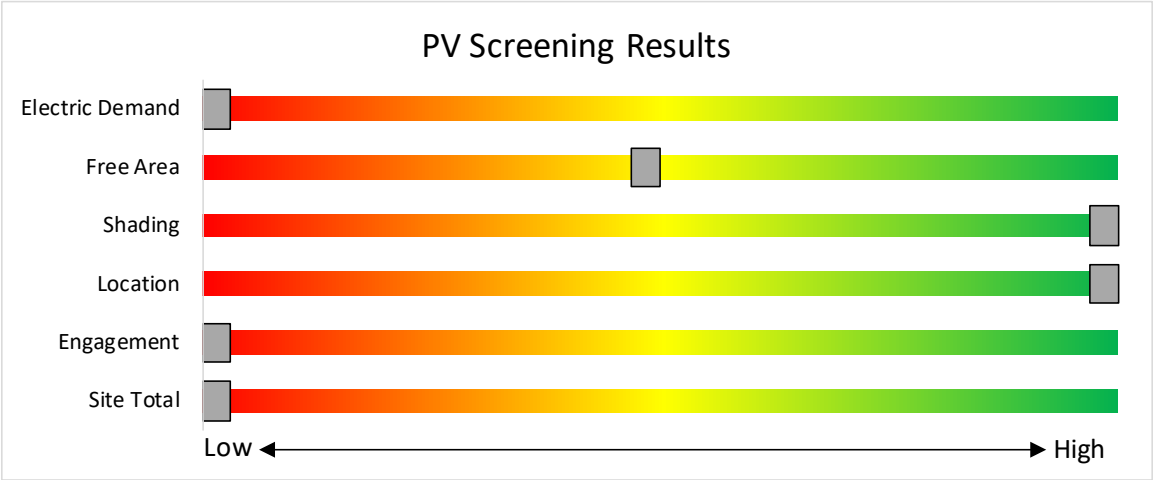


Figure 9 - Photovoltaic Screening

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.

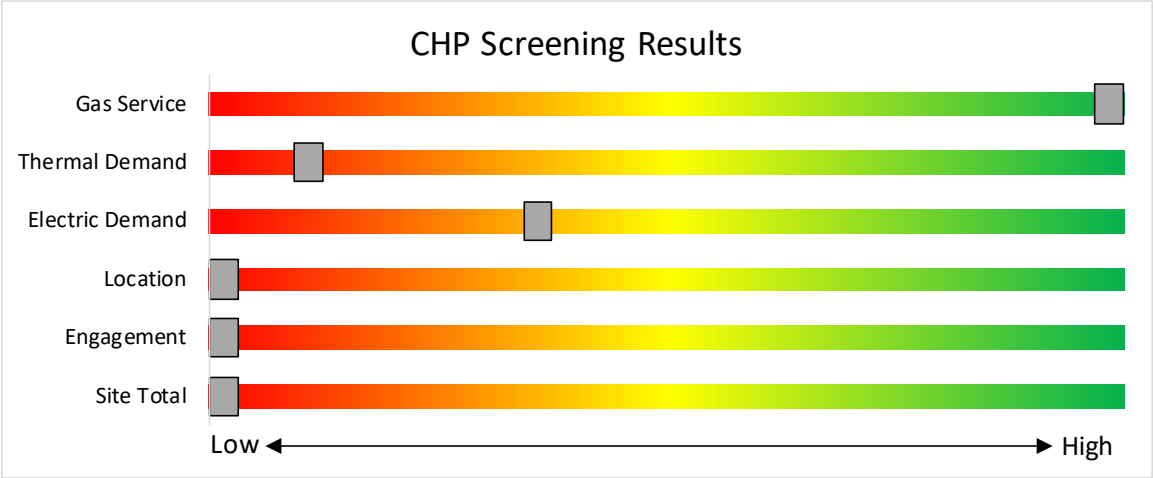


Figure 10 - Combined Heat and Power Screening

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 this facility 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 your facility 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 facility 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] Gas Internal Combustion Engine	≤500 kW	$2,000	30-40%[2]	$2 million
	>500 kW - 1 MW	$1,000		
Gas Combustion Turbine Microturbine Fuel Cells with Heat Recovery	> 1 MW - 3 MW	$550	30%	$3 million
	>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 your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility already buys electricity from a third-party supplier, review and compare prices at the end of each contract year.

A list of licensed third-party electric suppliers is available at the NJBPU website[8].

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 your facility already purchases natural gas from a third-party supplier, review and compare prices at the end of each contract year.

A list of licensed third-party natural gas suppliers is available at the NJBPU website[9].

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

[9] 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	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	1,820	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,820	0.1	116	0	$15	$69	$20	3.4
Elevator Room	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	1,092	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,092	0.1	70	0	$9	$69	$20	5.6
Custodial	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	1,456	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,456	0.1	93	0	$12	$69	$20	4.2
Men Restroom	1	Linear Fluorescent - T12: 2' T12 (20W) - 4L	Wall Switch	S	100	1,820	2	Relamp & Reballast	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	1,820	0.1	130	0	$16	$110	$24	5.3
Women Restroom	1	Linear Fluorescent - T12: 2' T12 (20W) - 4L	Wall Switch	S	100	1,820	2	Relamp & Reballast	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	1,820	0.1	130	0	$16	$110	$24	5.3
Basement Hallway	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,912	3, 5	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,009	0.4	1,585	-1	$199	$888	$690	1.0
Basement Hallway	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
Children Section	27	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,912	3, 4	Relamp	Yes	27	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,009	1.0	3,566	-2	$448	$1,796	$750	2.3
Children Section	2	Linear Fluorescent - T12: 2' T12 (20W) - 2L	Wall Switch	S	50	3,276	2, 4	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	2,260	0.1	271	0	$34	$130	$24	3.1
Children Section	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
Children Section	1	Compact Fluorescent: Screw in Lamp	Wall Switch	S	23	2,912	3, 4	Relamp	Yes	1	LED Lamps: LED Screw in Lamp	Occupancy Sensor	16	2,009	0.0	37	0	$5	$17	$2	3.2
Children Section	3	Halogen Incandescent: Screw in Lamp	Wall Switch	S	75	2,912	3, 4	Relamp	Yes	3	LED Lamps: Screw in LED Lamp	Occupancy Sensor	11	2,009	0.2	634	0	$80	$322	$76	3.1
Office	3	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	2,184	2, 4	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,507	0.2	481	0	$60	$476	$130	5.7
Meeting Room	12	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,496	3, 4	Relamp	Yes	12	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,722	0.4	1,358	-1	$170	$978	$380	3.5
Meeting 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
Lounge Room	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	2,496	2, 4	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,722	0.1	367	0	$46	$408	$40	8.0
Stairwell	1	Compact Fluorescent: Screw in Lamp	Wall Switch	S	23	2,912	3	Relamp	No	1	LED Lamps: LED Screw in Lamp	Wall Switch	16	2,912	0.0	22	0	$3	$17	$2	5.6
Main Area	32	Linear Fluorescent - T8: 4' T8 (32W) - 3L	Wall Switch	S	93	2,912	3, 4	Relamp	Yes	32	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	2,009	1.8	6,339	-3	$796	$2,833	$1,240	2.0
Upper Level	37	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,912	3, 4	Relamp	Yes	37	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,009	1.4	4,886	-2	$613	$2,431	$1,020	2.3
Upper Level	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
Main Area	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
Conference Room	6	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	1,872	2, 4	Relamp & Reballast	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,292	0.4	825	0	$104	$683	$190	4.8
Mechanical Room	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	1,560	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,560	0.1	99	0	$12	$69	$20	3.9
Non-Fiction Section	14	Linear Fluorescent - T12: 2' T12 (20W) - 2L	Wall Switch	S	50	2,912	2, 4	Relamp & Reballast	Yes	14	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	2,009	0.5	1,685	-1	$212	$1,447	$308	5.4
Non-Fiction Section	7	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	2,912	2, 4	Relamp & Reballast	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,009	0.4	1,497	-1	$188	$751	$210	2.9

	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
Front Desk	1	Linear Fluorescent - T12: 2' T12 (20W) - 4L	Wall Switch	S	100	2,912	2	Relamp & Reballast	No	1	LED - Linear Tubes: (4) 2' Lamps	Wall Switch	34	2,912	0.1	208	0	$26	$110	$24	3.3
Front Desk	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	2,912	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,912	0.1	186	0	$23	$69	$20	2.1
Office	4	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	2,184	2, 4	Relamp & Reballast	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,507	0.2	641	0	$81	$545	$150	4.9
Office	3	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	2,184	2, 4	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,507	0.2	481	0	$60	$476	$130	5.7
Lobby	10	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	62	2,912	3, 5	Relamp	Yes	10	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,009	0.4	1,321	-1	$166	$815	$650	1.0
Lobby	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
Men Restroom	1	Linear Fluorescent - T12: 2' T12 (20W) - 2L	Wall Switch	S	50	1,820	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,820	0.0	65	0	$8	$65	$12	6.5
Women Restroom	1	Linear Fluorescent - T12: 2' T12 (20W) - 2L	Wall Switch	S	50	1,820	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,820	0.0	65	0	$8	$65	$12	6.5
Closet	1	Incandescent: Screw in Lamp	Wall Switch	S	65	1,248	3	Relamp	No	1	LED Lamps: Screw in LED Lamp	Wall Switch	10	1,248	0.0	74	0	$9	$17	$2	1.6
Exit Door	1	Incandescent: Screw in Lamp	Wall Switch	S	65	2,912	3	Relamp	No	1	LED Lamps: Screw in LED Lamp	Wall Switch	10	2,912	0.0	174	0	$22	$17	$2	0.7
Elevator Lobby	1	Linear Fluorescent - T12: 2' T12 (20W) - 2L	Wall Switch	S	50	2,912	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,912	0.0	104	0	$13	$65	$12	4.1
Main Entrance	1	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	S	176	2,912	2	Relamp & Reballast	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,912	0.1	371	0	$47	$118	$40	1.7
Front Entrance	2	Halogen Incandescent: Flood Light	Timeclock		90	2,920	1	Fixture Replacement	No	2	LED - Fixtures: Architectural Flood/Spot Luminaire	Timeclock	14	2,920	0.0	447	0	$60	$466	$300	2.8
Flag Light	2	Halogen Incandescent: Flood Light	Timeclock		90	2,920	1	Fixture Replacement	No	2	LED - Fixtures: Architectural Flood/Spot Luminaire	Timeclock	14	2,920	0.0	447	0	$60	$466	$300	2.8
Wall Pack	1	Metal Halide: (1) 50W Lamp	Timeclock		72	2,920	1	Fixture Replacement	No	1	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Timeclock	22	2,920	0.0	147	0	$20	$435	$200	11.9

Motor Inventory & Recommendations

		Existing Conditions							Proposed Conditions					Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	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 System	2	Heating Hot Water Pump	0.2	65.0%	No	W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Elevator Room	Elevator	1	Other	20.0	80.0%	No	W	73		No	80.0%	No		0.0	0	0	$0	$0	$0	0.0
Library	Restroom	3	Exhaust Fan	0.2	65.0%	No	W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Library	AHU	1	Supply Fan	5.0	87.5%	No	W	2,745	6	No	89.5%	Yes	1	1.5	4,565	0	$613	$4,197	$1,800	3.9
Boiler Room	Boiler	1	Combustion Air Fan	0.3	65.0%	No	W	2,000		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0

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
Lounge Room	Lounge Room	1	Window AC	1.50		B	7	Yes	1	Window AC	1.50		12.00		0.2	332	0	$45	$1,633	$0	36.7
Offices	Offices	2	Window AC	1.00		B	7	Yes	1	Window AC	1.00		12.00		0.7	1,374	0	$184	$1,089	$0	5.9
Ground Floor	AHU	1	Split-System AC	15.00		W		No							0.0	0	0	$0	$0	$0	0.0
Ground Floor	Library	4	Split-System Air-Source HP	2.00	33.00	B	8	Yes	1	Split-System Air-Source HP	2.00	33.00	14.00	3.80	3.6	8,641	0	$1,160	$3,382	$368	2.6
Library	Library	3	Electric Resistance Heat		5.12	W		No							0.0	0	0	$0	$0	$0	0.0

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 System	1	Non-Condensing Hot Water Boiler	661	B	9	Yes	1	Non-Condensing Hot Water Boiler	661	85.00%	Et	0.0	0	22	$440	$16,830	$2,314	28.5

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
Boiler Room	Domestic Hot Water System	10	20	0.75	0.0	0	7	$276	$115	$80	0.1
Boiler Room	Heating Hot Water System	10	10	2.00	0.0	0	8	$167	$88	$40	0.3

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
Boiler Room	Domestic Hot Water System	1	Storage Tank Water Heater (≤ 50 Gal)	W		No						0.0	0	0	$0	$0	$0	0.0

Low-Flow Device Recommendations

	Recommedation Inputs					Energy Impact & Financial Analysis						
Location	ECM #	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Restrooms	11	2	Faucet Aerator (Lavatory)	1.50	0.50	0.0	0	0	$13	$14	$14	0.0

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Library	23	Desktop Computer	120	Yes
Library	2	Copy machine	600	Yes
Library	4	Desktop Printer	135	Yes
Library	1	Microwave	800	No
Library	1	Coffee Machine	600	No
Library	1	Refrigerator	244	Yes

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]

Lake Hiawatha Library

Primary Property Type: Library
Gross Floor Area (ft²): 8,724
Built: 1969

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
Lake Hiawatha Library 68 Nokomis Avenue Lake Hiawatha, New Jersey 07034	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: 9002229

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
76 kBtu/ft²

Source EUI
142.6 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	10,525 (2%)
Electric - Grid (kBtu)	320,489 (48%)
Fuel Oil (No. 2) (kBtu)	332,332 (50%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	76.6
National Median Source EUI (kBtu/ft²)	143.6
% Diff from National Median Source EUI	-1%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	58

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.