# Local Government Energy Audit Report

Reading Senior Center

November 17, 2021

*Prepared for:*
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# Disclaimer

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

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

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

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

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

# Table of Contents

# ENERGY EFFICIENCY INCENTIVE & REBATE TRANSITION

For the purposes of your LGEA, estimated incentives and rebates are included as placeholders for planning purposes. New Jersey utilities are rolling out their own energy efficiency programs, which your project may be eligible for depending on individual measures, quantities, and size of the building.

In 2018, Governor Murphy signed into law the landmark legislation known as the Clean Energy Act. The law called for a significant overhaul of New Jersey's clean energy systems by building sustainable infrastructure in order to fight climate change and reduce carbon emissions, which will in turn create well-paying local jobs, grow the state's economy, and improve public health while ensuring a cleaner environment for current and future residents.

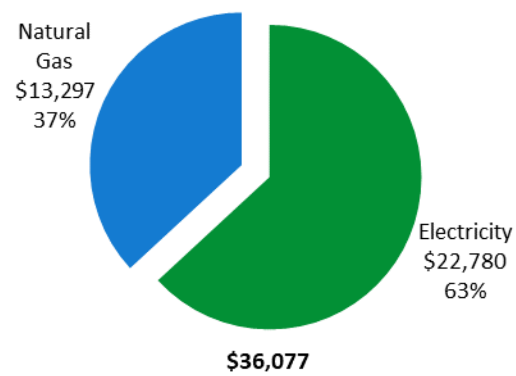
These "next generation" energy efficiency programs feature new ways of managing and delivering programs historically administered by New Jersey's Clean Energy Program™ (NJCEP). All of the investor-owned gas and electric utility companies will now also offer complementary energy efficiency programs and incentives directly to customers like you. NJCEP will still offer programs for new construction, renewable energy, the Energy Savings Improvement Program (ESIP), and large energy users.

New utility programs are expected to start rolling out in the spring and summer of 2021. Keep up to date with developments by visiting the NJCEP website.

# 1 EXECUTIVE SUMMARY

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

## BUILDING PERFORMANCE REPORT

| | | |
|---|---|---|
| Annual Utilities | Costs: $36,077<br>Electricity: 134,760 kWh<br>Natural Gas: 16,025 Therms |   |
| ENERGY STAR® Benchmarking Score | N/A *(1-100 scale)* | A standard energy use benchmark is not available for this facility type. This report contains suggestions about how to improve building performance and reduce energy costs. |

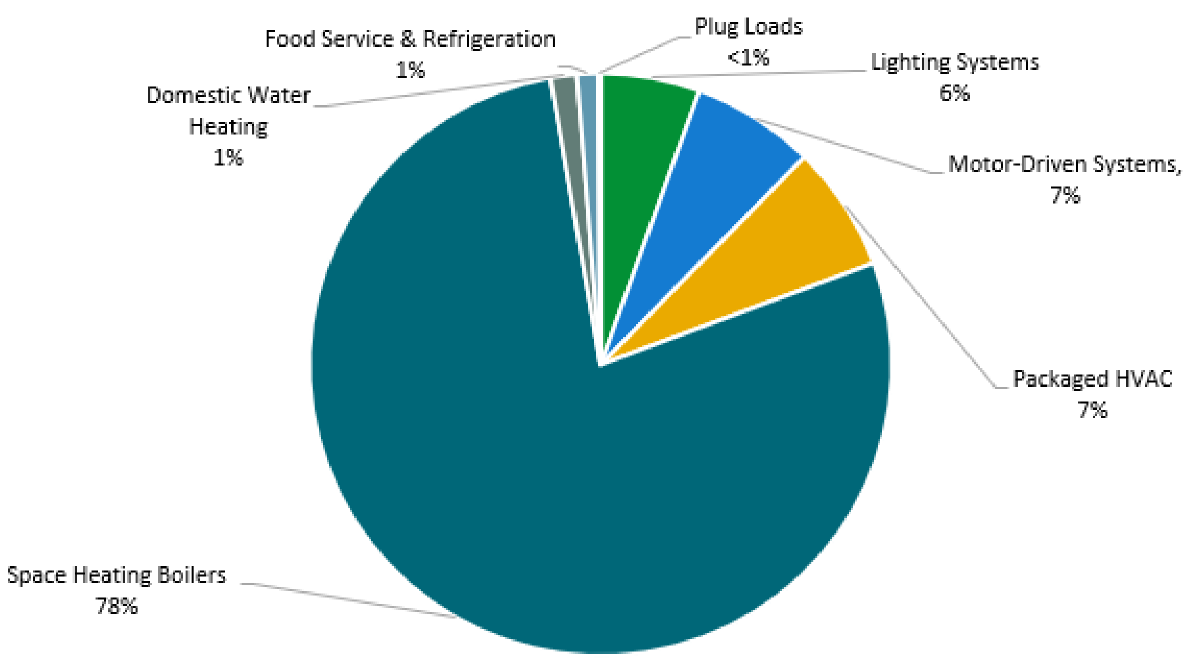


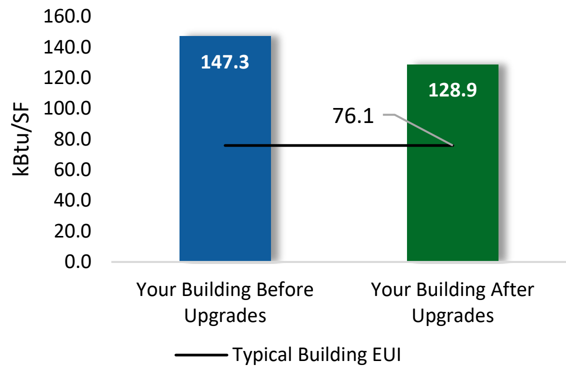

*Figure 1 - Energy Use by System*

## POTENTIAL IMPROVEMENTS

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

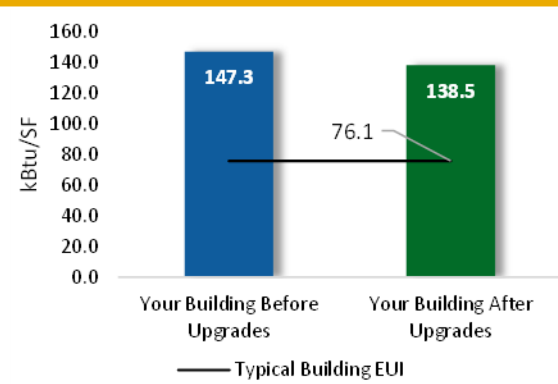
### Scenario 1: Full Package (all evaluated measures)

| | |
|---|---|
| Installation Cost | $59,180 |
| Potential Rebates & Incentives[1] | $8,275 |
| Annual Cost Savings | $7,341 |
| Annual Energy Savings | Electricity: 36,929 kWh<br>Natural Gas: 1,324 Therms |
| Greenhouse Gas Emission Savings | 26 Tons |
| Simple Payback | 6.9 Years |
| Site Energy Savings (all utilities) | 13% |




### Scenario 2: Cost Effective Package[2]

| | |
|---|---|
| Installation Cost | $22,125 |
| Potential Rebates & Incentives | $2,462 |
| Annual Cost Savings | $5,995 |
| Annual Energy Savings | Electricity: 35,354 kWh<br>Natural Gas: 23 Therms |
| Greenhouse Gas Emission Savings | 18 Tons |
| Simple Payback | 3.3 Years |
| Site Energy Savings (all utilities) | 6% |




### On-site Generation Potential

| | |
|---|---|
| Photovoltaic | None |
| Combined Heat and Power | None |

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

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

| # | Energy Conservation Measure | Cost Effective? | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Upgrades** | | | **22,764** | **8.9** | **-5** | **$3,808** | **$12,140** | **$2,240** | **$9,900** | **2.6** | **22,356** |
| ECM 1 | Retrofit Fluorescent Fixtures with LED Lamps and Drivers | Yes | 4,780 | 1.9 | -1 | $800 | $2,508 | $360 | $2,148 | 2.7 | 4,695 |
| ECM 2 | Retrofit Fixtures with LED Lamps | Yes | 17,643 | 6.9 | -4 | $2,951 | $9,488 | $1,880 | $7,608 | 2.6 | 17,327 |
| ECM 3 | Install LED Exit Signs | Yes | 341 | 0.0 | 0 | $57 | $145 | $0 | $145 | 2.5 | 334 |
| **Lighting Control Measures** | | | **2,688** | **1.1** | **-1** | **$450** | **$1,852** | **$160** | **$1,692** | **3.8** | **2,640** |
| ECM 4 | Install Occupancy Sensor Lighting Controls | Yes | 2,688 | 1.1 | -1 | $450 | $1,852 | $160 | $1,692 | 3.8 | 2,640 |
| **Motor Upgrades** | | | **4,949** | **1.2** | **0** | **$837** | **$5,574** | **$0** | **$5,574** | **6.7** | **4,983** |
| ECM 5 | Premium Efficiency Motors | Yes | 4,949 | 1.2 | 0 | $837 | $5,574 | $0 | $5,574 | 6.7 | 4,983 |
| **Unitary HVAC Measures** | | | **1,575** | **1.1** | **0** | **$266** | **$6,521** | **$1,050** | **$5,471** | **20.5** | **1,586** |
| ECM 6 | Install High Efficiency Air Conditioning Units | No | 1,575 | 1.1 | 0 | $266 | $6,521 | $1,050 | $5,471 | 20.5 | 1,586 |
| **Gas Heating (HVAC/Process) Replacement** | | | **0** | **0.0** | **130** | **$1,080** | **$30,534** | **$4,764** | **$25,771** | **23.9** | **15,237** |
| ECM 7 | Install High Efficiency Hot Water Boilers | No | 0 | 0.0 | 130 | $1,080 | $30,534 | $4,764 | $25,771 | 23.9 | 15,237 |
| **HVAC System Improvements** | | | **0** | **0.0** | **6** | **$50** | **$79** | **$36** | **$43** | **0.9** | **705** |
| ECM 8 | Install Pipe Insulation | Yes | 0 | 0.0 | 6 | $50 | $79 | $36 | $43 | 0.9 | 705 |
| **Domestic Water Heating Upgrade** | | | **0** | **0.0** | **2** | **$14** | **$29** | **$26** | **$3** | **0.2** | **199** |
| ECM 9 | Install Low-Flow DHW Devices | Yes | 0 | 0.0 | 2 | $14 | $29 | $26 | $3 | 0.2 | 199 |
| **Food Service & Refrigeration Measures** | | | **4,953** | **0.6** | **0** | **$837** | **$2,450** | **$0** | **$2,450** | **2.9** | **4,988** |
| ECM 10 | Replace Refrigeration Equipment | Yes | 4,953 | 0.6 | 0 | $837 | $2,450 | $0 | $2,450 | 2.9 | 4,988 |
| **TOTALS (COST EFFECTIVE MEASURES)** | | | **35,354** | **11.7** | **2** | **$5,995** | **$22,125** | **$2,462** | **$19,663** | **3.3** | **35,871** |
| **TOTALS (ALL MEASURES)** | | | **36,929** | **12.8** | **132** | **$7,341** | **$59,180** | **$8,275** | **$50,905** | **6.9** | **52,694** |

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

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

*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

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

For details on these programs please visit New Jersey's Clean Energy Program website or contact your utility provider.

## 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 Reading Senior Center. This report provides information on how your facility uses energy, identifies energy conservation measures (ECMs) that can reduce your energy use, and provides information and assistance to help you implement the ECMs.

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

## 2.1 Site Overview

On March 23, 2021, TRC performed an energy audit at Reading Senior Center located in Trenton, New Jersey. TRC met with Akil Muse to review the facility operations and help focus our investigation on specific energy-using systems.

The Reading Senior Center is a four-story, 14,000 square foot building built in 1898. The facility was originally a train station that had been converted to a senior center. Spaces include offices, corridors, stairwells, senior center dining room, kitchen, and basement mechanical space. The facility was under major renovation at the time of the audit. Some mechanical equipment had been removed during the renovation including the AHU-1, located in the basement mechanical space. Information was taken in part from previous studies as well as from current construction documents. Upgrades to the facility are part of the City of Trenton Department and Economic Development program.

## 2.2 Building Occupancy

The facility is occupied year-round. Typical weekday occupancy is five to ten staff and unknown number of visitors.

| Building Name | Weekday/Weekend | Operating Schedule |
|---|---|---|
| Reading Senior Center | Weekday | 8:30 AM - 4:30 PM |
| | Weekend | closed |

*Figure 3 - Building Occupancy Schedule*

## 2.3 Building Envelope

The facility was originally constructed as a train station. There is a large single open floor section and a smaller footprint with four floors. The large single floor section has walls constructed of brick with a wood truss system. It has a pitched roof. This area was the station portion.

The second section of the facility is made of brick with wood framed roof and floors. This space originally had offices and mechanical spaces. The roof covering this section has insulation which may have been added as part of the renovation. Interior walls are covered with gypsum board, or painted brick. The roof is pitched, with gables, and covered with asphalt shingles. The original foundation is made of stone. Block supports have been installed, most likely part of this or previous renovations.


*Exterior Brick Façade*


*Four Floor Section*


*Lower Station Section*


*Interior Floor Frame*


*Roof Frame*


*Truss*

Most of the windows are single glazed and have wood frames. The glass-to-frame seals are in fair condition. The operable window weather seals are in fair condition. Exterior doors have aluminum frames and are in good condition with undamaged door seals. Degraded window and door seals increase drafts and outside air infiltration. The new door is double glazed.


*Window*


*New Door*


*Window*

## 2.4 Lighting Systems

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps. There are also several 40-Watt T12 fixtures. Additionally, there are some LED general purpose lamps. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts.

Fixture types include 1-lamp or 2-lamp, 4-foot-long surface mounted fixtures. Most fixtures are in fair condition. Multipurpose fixtures have manually controlled high bay high intensity discharge (HID) lamps that are in the process of being of being upgraded to LED sources. All exit signs are LED units. Interior lighting levels were generally sufficient lit. Most lighting fixtures are controlled manually. Exterior fixtures include canopy lights with LED lamps. Exterior light fixtures are controlled by a time clock.

*Exterior*

*Fluorescent Mechanical Area Lighting*

*HID High Bay Lighting,*

*Fluorescent Vanity Lighting*

## 2.5 Air Handling Systems

**<u>Unitary Electric HVAC Equipment</u>**

The facility is cooled by several split system A/C units which are connected to air handlers conditioning most of the facility.  The unit's range in size from 5 to 25 tons. Most of the units are in good condition.

*Split system condensing units*

*Split system condensing units*

**<u>Air Handling Units (AHUs)</u>**

The building is conditioned by air handling units. Each unit is equipped with a hot water heating coil and a refrigerant coil for cooling. Cooling is provided by the split systems previously described. The heating source is the boiler, described below.

Air Handling Units Located in Mechanical Rooms

Air Handling Units Located in Mechanical Rooms

Air Handling Units Located in Mechanical Rooms

## 2.6 Heating Hot Water Systems

One H.B. Smith 1,361.7 MBh hot water boiler serves the building heating load.

Hot water is distributed by two, 3 hp constant speed hot water pumps. The boilers provide hot water to AHUs located throughout the building. The boilers serve a primary-only distribution system. There are nine feet of 1.5-inch pipe with no insulation that should be repaired.

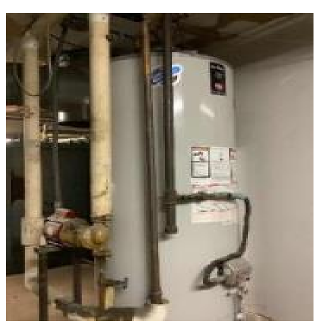

Hot Water Boiler

Hot Water Circulation Pumps

## 2.7 Domestic Hot Water

Hot water is produced by a 75 gallon, 76 MBh gas-fired storage water heater with a rated efficiency of 78%.

Domestic Hot Water Circulation Pump



Hot Water Heater


Label

## 2.8 Plug Load & Vending Machines

The location is doing a great job managing their electrical plug loads. This report makes additional suggestions for ECMs in this area as well as Energy Efficient Best Practices.

Plug loads throughout the building include general café and office equipment. There are residential-style refrigerators, microwaves, and televisions in the facility.


*Microwave*


*Printer*


*Television*

## 2.9 Water-Using Systems

There are two restrooms with sinks. Faucet flow rates are at 2.2 gallons per minute (gpm) or higher.

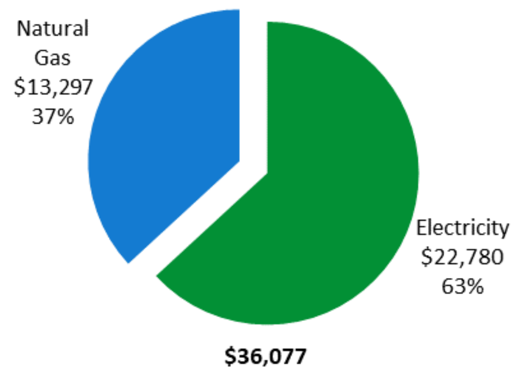

*Restroom sink*


*Restroom 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 | 134,760 kWh | $22,780 |
| Natural Gas | 16,025 Therms | $13,297 |
| **Total** | | **$36,077** |




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.

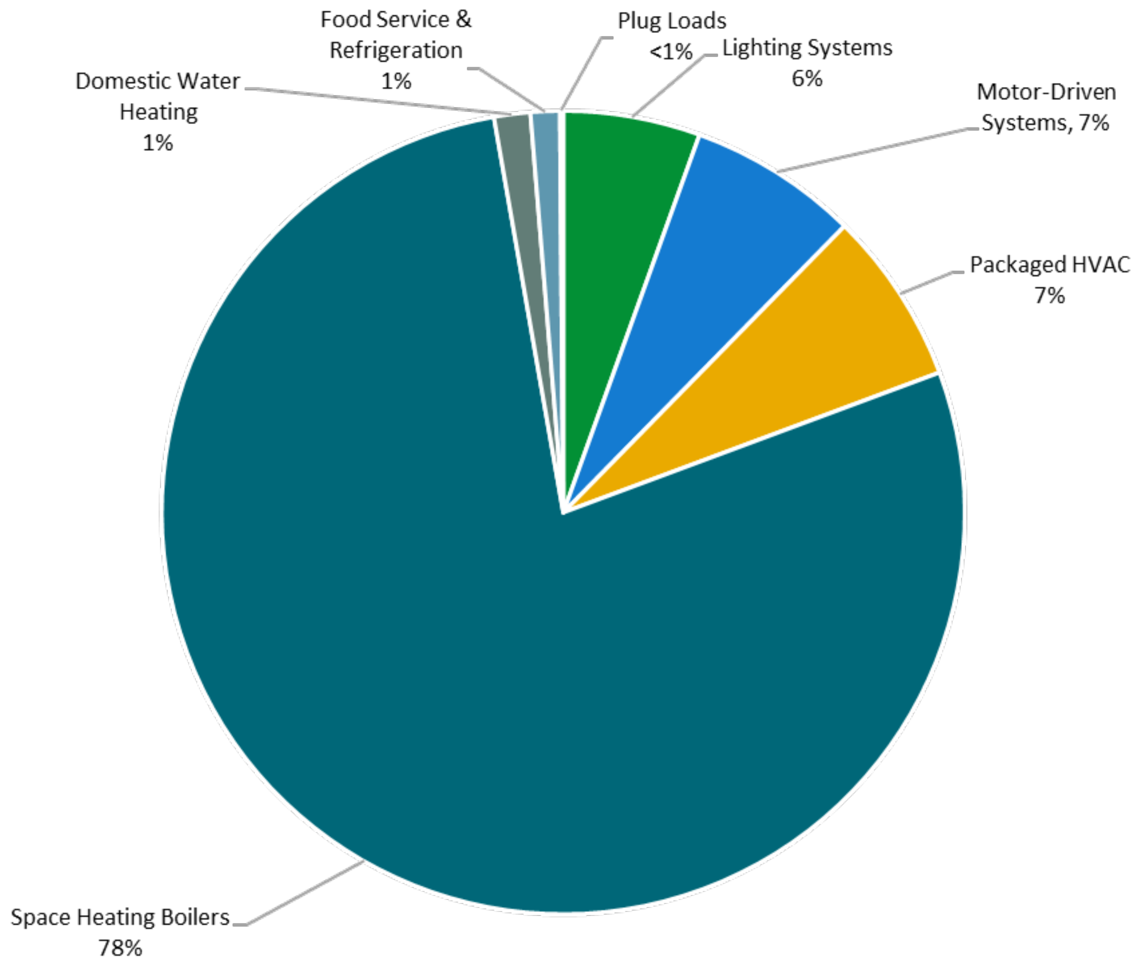
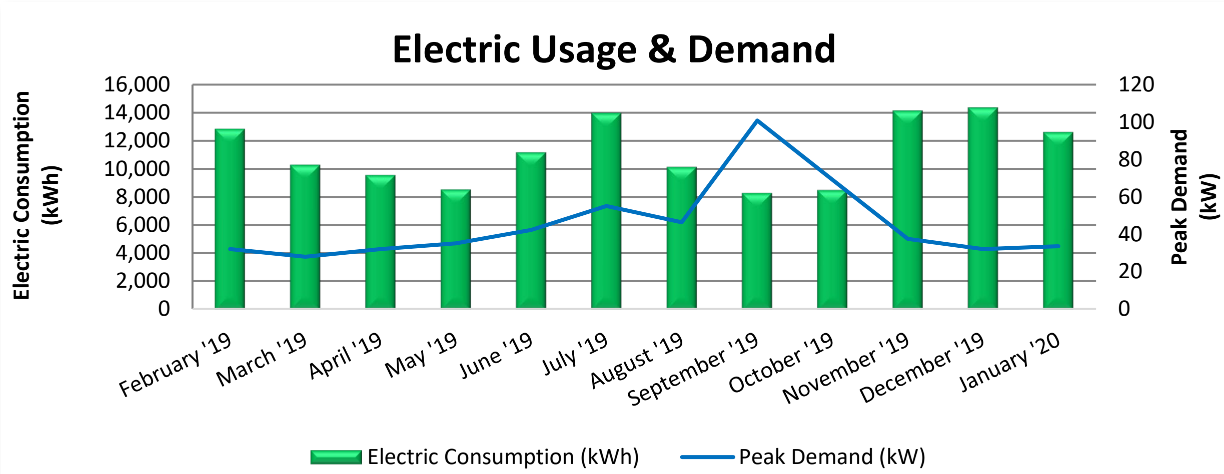



*Figure 4 - Energy Balance*

## 3.1 Electricity

PSE&G delivers electricity under rate class General Lighting & Power (GLP).



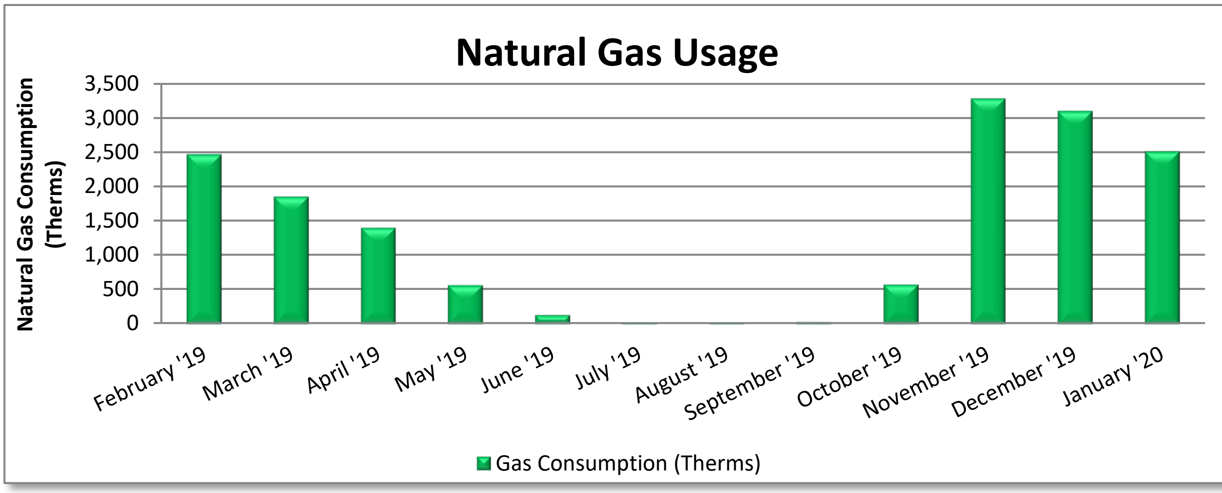

| Electric Billing Data | | | | | |
|---|---|---|---|---|---|
| **Period Ending** | **Days in Period** | **Electric Usage (kWh)** | **Demand (kW)** | **Demand Cost** | **Total Electric Cost** |
| 3/4/19 | 28 | 12,880 | 32 | $126 | $1,924 |
| 4/4/19 | 31 | 10,320 | 28 | $110 | $1,860 |
| 5/6/19 | 32 | 9,600 | 32 | $126 | $1,835 |
| 6/5/19 | 30 | 8,560 | 35 | $485 | $2,077 |
| 7/5/19 | 30 | 11,200 | 42 | $584 | $2,231 |
| 8/5/19 | 31 | 14,000 | 55 | $760 | $2,537 |
| 9/4/19 | 30 | 10,160 | 46 | $639 | $2,082 |
| 10/3/19 | 29 | 8,320 | 101 | $198 | $1,542 |
| 11/4/19 | 32 | 8,520 | 69 | $173 | $1,108 |
| 12/4/19 | 30 | 14,160 | 38 | $148 | $1,874 |
| 1/6/20 | 33 | 14,400 | 32 | $126 | $1,927 |
| 2/4/20 | 29 | 12,640 | 34 | $132 | $1,784 |
| **Totals** | **365** | **134,760** | **101** | **$3,608** | **$22,780** |
| **Annual** | **365** | **134,760** | **101** | **$3,608** | **$22,780** |

Notes:

- Peak demand of 101 kW occurred in September 2019.
- Average demand over the past 12 months was 45 kW.
- The average electric cost over the past 12 months was $0.169/kWh, which is the blended rate that includes energy supply, distribution, demand, and other charges. This report uses this blended rate to estimate energy cost savings.

## 3.2 Natural Gas

PSE&G delivers natural gas under rate class Large Volume Gas (LVG).




| Gas Billing Data | | | |
|---|---|---|---|
| **Period Ending** | **Days in Period** | **Natural Gas Usage (Therms)** | **Natural Gas Cost** |
| 3/4/19 | 28 | 2,478 | $2,030 |
| 4/4/19 | 31 | 1,860 | $1,200 |
| 5/6/19 | 32 | 1,409 | $941 |
| 6/5/19 | 30 | 571 | $463 |
| 7/5/19 | 30 | 136 | $215 |
| 8/5/19 | 31 | 15 | $146 |
| 9/4/19 | 30 | 18 | $147 |
| 10/3/19 | 29 | 37 | $158 |
| 11/4/19 | 32 | 581 | $488 |
| 12/4/19 | 30 | 3,293 | $2,765 |
| 1/6/20 | 33 | 3,110 | $2,604 |
| 2/4/20 | 29 | 2,519 | $2,139 |
| **Totals** | **365** | **16,025** | **$13,297** |
| **Annual** | **365** | **16,025** | **$13,297** |

Notes:

- The average gas cost for the past 12 months is $0.830/therm, which is the blended rate used throughout the analysis.

## 3.3 Benchmarking

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

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

| Benchmarking Score | [N/A] |
|---|---|

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

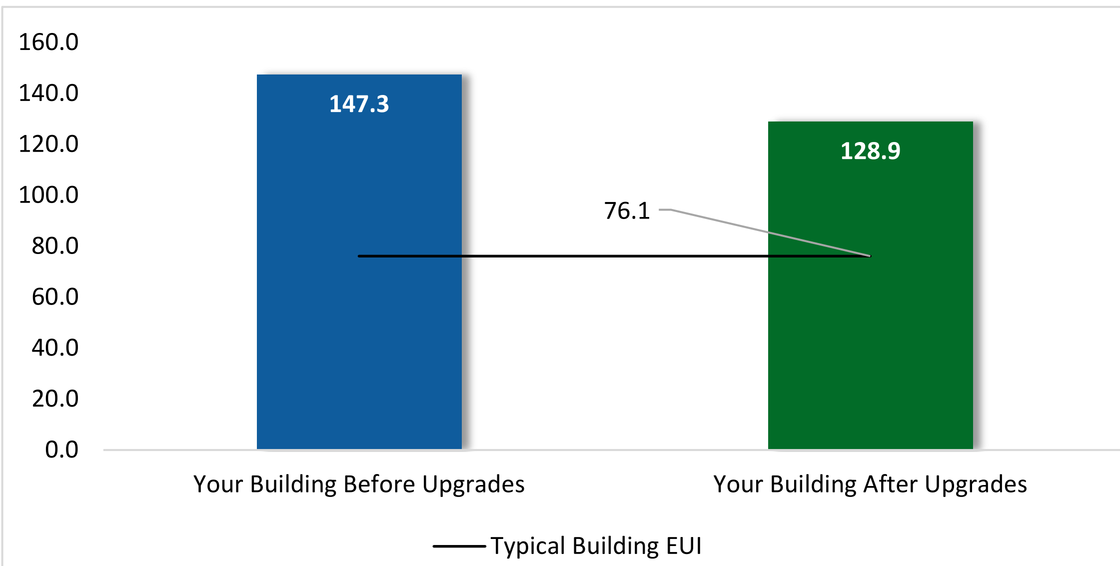



***Figure 5 - Energy Use Intensity Comparison[3]***

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

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

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

Financial incentives are based on previously run state rebate programs. New utility programs are expected to start rolling out in the spring and summer of 2021. Keep up to date with developments by visiting the NJCEP website. Some measures and proposed upgrades may be eligible for higher incentives than those shown below.

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

| # | Energy Conservation Measure | Cost Effective? | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Upgrades** | | | **22,764** | **8.9** | **-5** | **$3,808** | **$12,140** | **$2,240** | **$9,900** | **2.6** | **22,356** |
| ECM 1 | Retrofit Fluorescent Fixtures with LED Lamps and Drivers | Yes | 4,780 | 1.9 | -1 | $800 | $2,508 | $360 | $2,148 | 2.7 | 4,695 |
| ECM 2 | Retrofit Fixtures with LED Lamps | Yes | 17,643 | 6.9 | -4 | $2,951 | $9,488 | $1,880 | $7,608 | 2.6 | 17,327 |
| ECM 3 | Install LED Exit Signs | Yes | 341 | 0.0 | 0 | $57 | $145 | $0 | $145 | 2.5 | 334 |
| **Lighting Control Measures** | | | **2,688** | **1.1** | **-1** | **$450** | **$1,852** | **$160** | **$1,692** | **3.8** | **2,640** |
| ECM 4 | Install Occupancy Sensor Lighting Controls | Yes | 2,688 | 1.1 | -1 | $450 | $1,852 | $160 | $1,692 | 3.8 | 2,640 |
| **Motor Upgrades** | | | **4,949** | **1.2** | **0** | **$837** | **$5,574** | **$0** | **$5,574** | **6.7** | **4,983** |
| ECM 5 | Premium Efficiency Motors | Yes | 4,949 | 1.2 | 0 | $837 | $5,574 | $0 | $5,574 | 6.7 | 4,983 |
| **Unitary HVAC Measures** | | | **1,575** | **1.1** | **0** | **$266** | **$6,521** | **$1,050** | **$5,471** | **20.5** | **1,586** |
| ECM 6 | Install High Efficiency Air Conditioning Units | No | 1,575 | 1.1 | 0 | $266 | $6,521 | $1,050 | $5,471 | 20.5 | 1,586 |
| **Gas Heating (HVAC/Process) Replacement** | | | **0** | **0.0** | **130** | **$1,080** | **$30,534** | **$4,764** | **$25,771** | **23.9** | **15,237** |
| ECM 7 | Install High Efficiency Hot Water Boilers | No | 0 | 0.0 | 130 | $1,080 | $30,534 | $4,764 | $25,771 | 23.9 | 15,237 |
| **HVAC System Improvements** | | | **0** | **0.0** | **6** | **$50** | **$79** | **$36** | **$43** | **0.9** | **705** |
| ECM 8 | Install Pipe Insulation | Yes | 0 | 0.0 | 6 | $50 | $79 | $36 | $43 | 0.9 | 705 |
| **Domestic Water Heating Upgrade** | | | **0** | **0.0** | **2** | **$14** | **$29** | **$26** | **$3** | **0.2** | **199** |
| ECM 9 | Install Low-Flow DHW Devices | Yes | 0 | 0.0 | 2 | $14 | $29 | $26 | $3 | 0.2 | 199 |
| **Food Service & Refrigeration Measures** | | | **4,953** | **0.6** | **0** | **$837** | **$2,450** | **$0** | **$2,450** | **2.9** | **4,988** |
| ECM 10 | Replace Refrigeration Equipment | Yes | 4,953 | 0.6 | 0 | $837 | $2,450 | $0 | $2,450 | 2.9 | 4,988 |
| **TOTALS** | | | **36,929** | **12.8** | **132** | **$7,341** | **$59,180** | **$8,275** | **$50,905** | **6.9** | **52,694** |

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

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

*Figure 6 – All Evaluated ECMs*

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Upgrades** | | **22,764** | **8.9** | **-5** | **$3,808** | **$12,140** | **$2,240** | **$9,900** | **2.6** | **22,356** |
| ECM 1 | Retrofit Fluorescent Fixtures with LED Lamps and Drivers | 4,780 | 1.9 | -1 | $800 | $2,508 | $360 | $2,148 | 2.7 | 4,695 |
| ECM 2 | Retrofit Fixtures with LED Lamps | 17,643 | 6.9 | -4 | $2,951 | $9,488 | $1,880 | $7,608 | 2.6 | 17,327 |
| ECM 3 | Install LED Exit Signs | 341 | 0.0 | 0 | $57 | $145 | $0 | $145 | 2.5 | 334 |
| **Lighting Control Measures** | | **2,688** | **1.1** | **-1** | **$450** | **$1,852** | **$160** | **$1,692** | **3.8** | **2,640** |
| ECM 4 | Install Occupancy Sensor Lighting Controls | 2,688 | 1.1 | -1 | $450 | $1,852 | $160 | $1,692 | 3.8 | 2,640 |
| **Motor Upgrades** | | **4,949** | **1.2** | **0** | **$837** | **$5,574** | **$0** | **$5,574** | **6.7** | **4,983** |
| ECM 5 | Premium Efficiency Motors | 4,949 | 1.2 | 0 | $837 | $5,574 | $0 | $5,574 | 6.7 | 4,983 |
| **HVAC System Improvements** | | **0** | **0.0** | **6** | **$50** | **$79** | **$36** | **$43** | **0.9** | **705** |
| ECM 8 | Install Pipe Insulation | 0 | 0.0 | 6 | $50 | $79 | $36 | $43 | 0.9 | 705 |
| **Domestic Water Heating Upgrade** | | **0** | **0.0** | **2** | **$14** | **$29** | **$26** | **$3** | **0.2** | **199** |
| ECM 9 | Install Low-Flow DHW Devices | 0 | 0.0 | 2 | $14 | $29 | $26 | $3 | 0.2 | 199 |
| **Food Service & Refrigeration Measures** | | **4,953** | **0.6** | **0** | **$837** | **$2,450** | **$0** | **$2,450** | **2.9** | **4,988** |
| ECM 10 | Replace Refrigeration Equipment | 4,953 | 0.6 | 0 | $837 | $2,450 | $0 | $2,450 | 2.9 | 4,988 |
| **TOTALS** | | **35,354** | **11.7** | **2** | **$5,995** | **$22,125** | **$2,462** | **$19,663** | **3.3** | **35,871** |

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

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

*Figure 7 – Cost Effective ECMs*

## 4.1 Lighting

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Upgrades** | | **22,764** | **8.9** | **-5** | **$3,808** | **$12,140** | **$2,240** | **$9,900** | **2.6** | **22,356** |
| ECM 1 | Retrofit Fluorescent Fixtures with LED Lamps and Drivers | 4,780 | 1.9 | -1 | $800 | $2,508 | $360 | $2,148 | 2.7 | 4,695 |
| ECM 2 | Retrofit Fixtures with LED Lamps | 17,643 | 6.9 | -4 | $2,951 | $9,488 | $1,880 | $7,608 | 2.6 | 17,327 |
| ECM 3 | Install LED Exit Signs | 341 | 0.0 | 0 | $57 | $145 | $0 | $145 | 2.5 | 334 |

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 facility, which should help reduce future maintenance costs.

### ECM 1: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Retrofit fluorescent 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 use less power than other lighting technologies but provides 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 2: Retrofit Fixtures with LED Lamps

Replace fluorescent or HID lamps with LED lamps. Many LED tubes are direct replacements for existing fluorescent tubes and can be installed while leaving the fluorescent fixture ballast in place. LED lamps can be used in existing fixtures as a direct replacement for most other lighting technologies.

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

**Affected building areas:** all areas with fluorescent fixtures with T8 tubes and HID fixtures in the Multiuse room.

### ECM 3: Install LED Exit Signs

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

## 4.2 Lighting Controls

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Lighting Control Measures** | | **2,688** | **1.1** | **-1** | **$450** | **$1,852** | **$160** | **$1,692** | **3.8** | **2,640** |
| ECM 4 | Install Occupancy Sensor Lighting Controls | 2,688 | 1.1 | -1 | $450 | $1,852 | $160 | $1,692 | 3.8 | 2,640 |

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

### ECM 4: Install Occupancy Sensor Lighting Controls

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

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

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

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

**Affected building areas:** multipurpose, storage, and dining area.

## 4.3 Motors

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Motor Upgrades** | | **4,949** | **1.2** | **0** | **$837** | **$5,574** | **$0** | **$5,574** | **6.7** | **4,983** |
| ECM 5 | Premium Efficiency Motors | 4,949 | 1.2 | 0 | $837 | $5,574 | $0 | $5,574 | 6.7 | 4,983 |

### ECM 5: Premium Efficiency Motors

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

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

**Affected motors:**

| Location | Area(s)/System(s) Served | Motor Quantity | Motor Application | HP Per Motor | Additional Motor Description |
|---|---|---|---|---|---|
| Mechanical room 1 | Reading Senior Center | 1 | Combustion Air Fan | 1.0 | |
| Mechanical room 1 | Reading Senior Center | 2 | Heating Hot Water Pump | 3.0 | 89.5 |
| Mechanical room 2 | Reading Senior Center | 1 | Supply Fan | 5.0 | AHU-5 |
| Mechanical room 2 | Reading Senior Center | 1 | Supply Fan | 1.5 | AHU-3 |
| Mechanical room 2 | Reading Senior Center | 1 | Supply Fan | 1.5 | AHU-4 |
| Mechanical room 1 | Reading Senior Center | 1 | Supply Fan | 1.5 | AHU-1 |

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

## 4.4 Unitary HVAC

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Unitary HVAC Measures** | | **1,575** | **1.1** | **0** | **$266** | **$6,521** | **$1,050** | **$5,471** | **20.5** | **1,586** |
| ECM 6 | Install High Efficiency Air Conditioning Units | 1,575 | 1.1 | 0 | $266 | $6,521 | $1,050 | $5,471 | 20.5 | 1,586 |

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

### ECM 6: Evaluate High Efficiency Air Conditioning Units

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

**Affected units:** System 4B.

## 4.5 Gas-Fired Heating

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Gas Heating (HVAC/Process) Replacement** | | **0** | **0.0** | **130** | **$1,080** | **$30,534** | **$4,764** | **$25,771** | **23.9** | **15,237** |
| ECM 7 | Install High Efficiency Hot Water Boilers | 0 | 0.0 | 130 | $1,080 | $30,534 | $4,764 | $25,771 | 23.9 | 15,237 |

### ECM 7: Evaluate High Efficiency Hot Water Boilers

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

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

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

## 4.6 HVAC Improvements

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **HVAC System Improvements** | | **0** | **0.0** | **6** | **$50** | **$79** | **$36** | **$43** | **0.9** | **705** |
| ECM 8 | Install Pipe Insulation | 0 | 0.0 | 6 | $50 | $79 | $36 | $43 | 0.9 | 705 |

### ECM 8: Install Pipe Insulation

Install insulation on heating water system piping. Distribution system losses are dependent on system fluid temperature, the size of the distribution system, and the level of insulation of the piping. Significant energy savings can be achieved when insulation has not been well maintained. 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 system efficiency can be significantly reduced. This measure saves energy by reducing heat transfer in the distribution system.

**Affected Systems:** Approximately nine feet of 1.5-inch DHW pipe insulation should be repaired

## 4.7 Domestic Water Heating

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Domestic Water Heating Upgrade** | | **0** | **0.0** | **2** | **$14** | **$29** | **$26** | **$3** | **0.2** | **199** |
| ECM 9 | Install Low-Flow DHW Devices | 0 | 0.0 | 2 | $14 | $29 | $26 | $3 | 0.2 | 199 |

### ECM 9: Install Low-Flow DHW Devices

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

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

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

Additional cost savings may result from reduced water usage.

## 4.8 Food Service & Refrigeration Measures

| # | Energy Conservation Measure | Annual Electric Savings (kWh) | Peak Demand Savings (kW) | Annual Fuel Savings (MMBtu) | Annual Energy Cost Savings ($) | Estimated M&L Cost ($) | Estimated Incentive ($)* | Estimated Net M&L Cost ($) | Simple Payback Period (yrs)** | $CO_2e$ Emissions Reduction (lbs) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Food Service & Refrigeration Measures** | | **4,953** | **0.6** | **0** | **$837** | **$2,450** | **$0** | **$2,450** | **2.9** | **4,988** |
| ECM 10 | Replace Refrigeration Equipment | 4,953 | 0.6 | 0 | $837 | $2,450 | $0 | $2,450 | 2.9 | 4,988 |

### ECM 10: Replace Refrigeration Equipment

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

# 5 Energy Efficient Best Practices

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

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

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

### Energy Tracking with ENERGY STAR® Portfolio Manager®

You've heard it before - you 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.

### Lighting Maintenance

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

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

### Motor Maintenance

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

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

## Fans to Reduce Cooling Load

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

## AC System Evaporator/Condenser Coil Cleaning

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

## HVAC Filter Cleaning and Replacement

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

## Ductwork Maintenance

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

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

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

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

## Boiler Maintenance

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

## Label HVAC Equipment

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

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

## Optimize HVAC Equipment Schedules

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

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

## Water Heater Maintenance

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

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

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

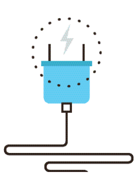
## Refrigeration Equipment Maintenance

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

Maintaining your commercial refrigeration equipment can save between 5 and 10 percent on energy costs. When condenser coils are dirty, your commercial refrigerators and freezers work harder to maintain the temperature inside. Worn gaskets, hinges, door handles or faulty seals cause cold air to leak from the unit, forcing the unit to run longer and use more electricity.

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

## Plug Load Controls



Reducing plug loads is a common way to decrease your electrical use. Limiting the energy use of plug loads can include increasing occupant awareness, removing under-used equipment, installing hardware controls, and using software controls. Consider enabling the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips[6]. Your local utility may offer incentives or rebates for this equipment.

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

## 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[7] or download a copy of EPA's "WaterSense® at Work: Best Management Practices for Commercial and Institutional Facilities"[8] 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.

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

[8] 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 facility's electric energy needs. Also referred to as distributed generation, these systems contribute to greenhouse gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, which results in improved electric grid reliability through better use of transmission and distribution systems.

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

## 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 facility'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.

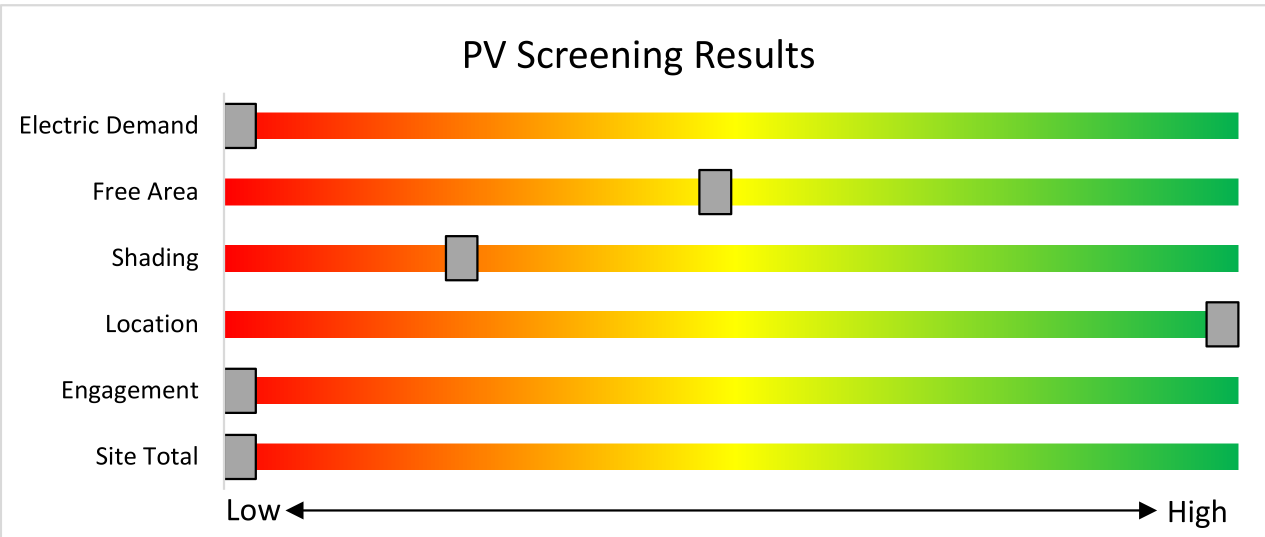



*Figure 8 - Photovoltaic Screening*

**Transition Incentive (TI) Program**

The TI program is a bridge between the Legacy SREC Program and a to-be determined Successor Incentive Program. The program 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 TRECs (Transition Incentive Renewable Energy Certificates). The Transition Incentive is structured as a factorized renewable energy certificate. The factors allow the TI Program to provide differentiated financial incentives for different types of solar installation.

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:

**Transition Incentive (TI) Program:** https://www.njcleanenergy.com/renewable-energy/programs/transition-incentive-program

- **Basic Info on Solar PV in NJ**: www.njcleanenergy.com/whysolar.
- **NJ Solar Market FAQs**: www.njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-transition/solar-market-faqs.
- **Approved Solar Installers in the NJ 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) generates electricity at the facility and puts waste heat energy to good use. Common types of CHP systems are reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines.

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

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

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

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

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

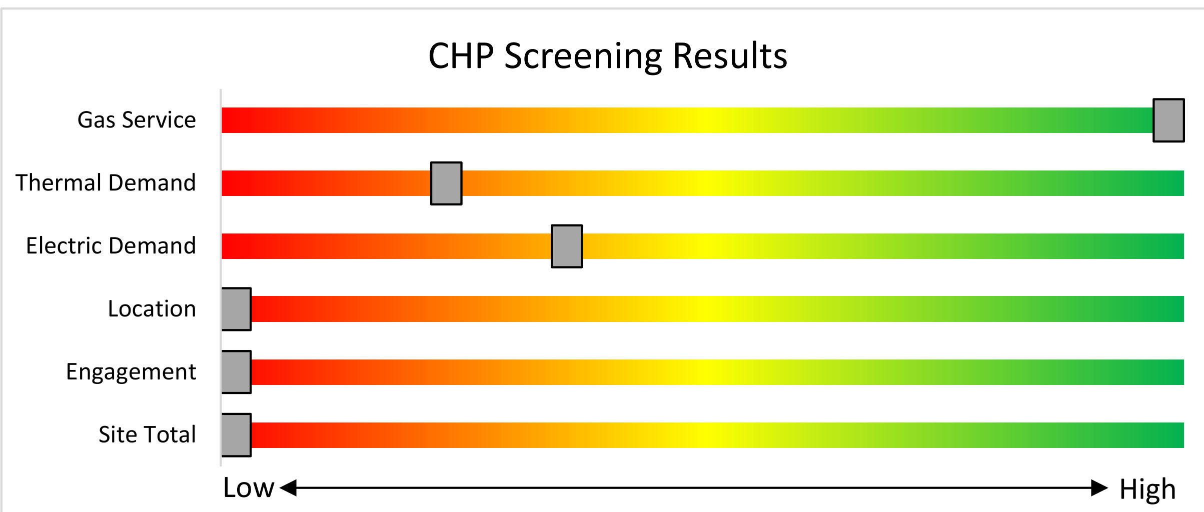



*Figure 93 - Combined Heat and Power Screening*

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/.](http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/)

# 7 Project Funding and Incentives

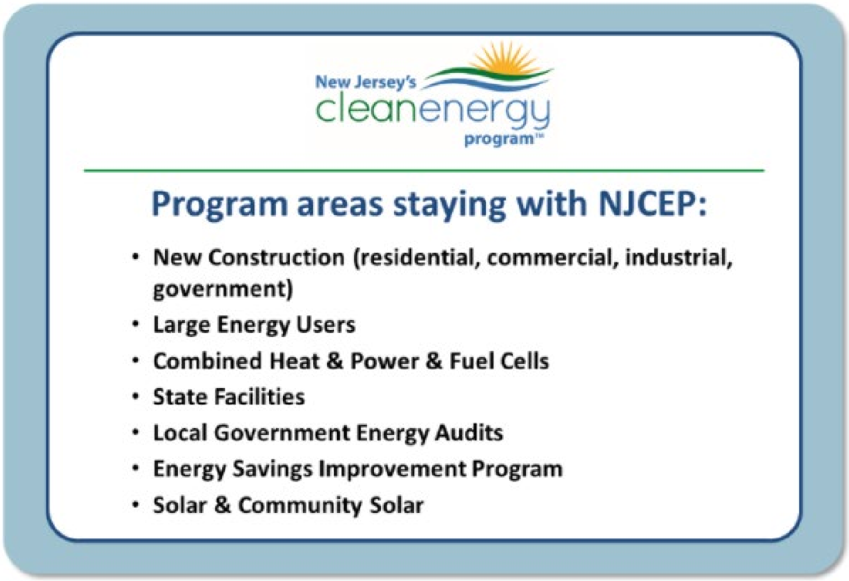
Ready to improve your building's performance? Your utility provider may be able to help.

## 7.1 Utility Energy Efficiency Programs


New utility programs are expected to start rolling out in the spring and summer of 2021. Keep up to date with developments by visiting the [NJCEP website](NJCEP website).

# 8 New Jersey's Clean Energy Programs

New Jersey's Clean Energy Program will continue to offer some energy efficiency programs.



## 8.1 Combined Heat and Power

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

**Incentives**

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

## 8.2 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 description 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.*

## 8.3 Transition Incentive (TI) Program

The TI program is a bridge between the Legacy SREC Program and a to-be determined Successor Incentive Program. The program 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 TRECs (Transition Incentive Renewable Energy Certificates). The Transition Incentive is structured as a factorized renewable energy certificate. The factors allow the TI Program to provide differentiated financial incentives for different types of solar installations. NJBPU calculates the value of a Transition Renewable Energy Certificate (TREC) by multiplying the base compensation rate ($152/MWh) by the project's assigned factor (i.e. $152 x 0.85 = $129.20/MWh). The TREC factors are defined based on the chart below:

| Project Type | Factor |
|---|---|
| Subsection (t): landfill, brownfield, areas of historic fill | 1.00 |
| Grid supply (Subsection (r)) rooftop | 1.00 |
| Net metered non-residential rooftop and carport | 1.00 |
| Community solar | 0.85 |
| Grid supply (Subsection (r)) ground mount | 0.60 |
| Net metered residential ground mount | 0.60 |
| Net metered residential rooftop and carport | 0.60 |
| Net metered non-residential ground mount | 0.60 |

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 TRECs.

Eligible projects may generate TRECs for 15 years following the commencement of commercial operations (also referred to as the "Transition Incentive Qualification Life"). After 15 years, projects may be eligible for a NJ Class I REC.

TRECs will be used by the identified compliance entities to satisfy a compliance obligation tied to a new Transition Incentive Renewable Portfolio Standard ("Tl-RPS"), which will exist in parallel with, and completely separate from, the existing Solar RPS for Legacy SRECs. The Tl-RPS is a carve-out of the current Class I RPS requirement. The creation of TRECs is based upon metered generation supplied to PJM-EIS General Attribute Tracking System ("GATS") by the owners of eligible facilities or their agents. GATS would create one TREC for each MWh of energy produced from a qualified facility.

TRECs will be purchased monthly by a TREC Administrator who will allocate the TRECs to the Load Serving Entities (BGS Providers and Third-Party Suppliers) annually based on their market share of retail electricity sold during the relevant Energy Year.

Solar projects help the State of New Jersey reach renewable energy goals outlined in the state's Energy Master Plan. The Transition Incentive Program online portal is now open to new applications effective May 1, 2020. There are instructions on "How and When to Transfer my SRP Registration to the Transition Incentive Program". If you are considering installing solar photovoltaics on your building, visit the following link for more information:

https://www.njcleanenergy.com/renewable-energy/programs/transition-incentive-program

# 9 Project Development

Energy conservation measures (ECMs) have been identified for your site and their energy and economic analyses are provided within this LGEA report. The next steps with project development are to set goals and create a comprehensive project plan. The graphic below provides an overview of the process flow for a typical energy efficiency or renewable energy project. We recommend implementing as many ECMs as possible prior to undertaking a feasibility study for a renewable project. The cyclical nature of this process flow demonstrates the ongoing work required to continually improve building energy efficiency over time. If your building(s) scope of work is relatively simple to implement or small in scope, the measurement and verification (M&V) step may not be required. It should be noted through a typical project cycle, there will be changes in costs based on specific scopes of work, contractor selections, design considerations, construction, etc. The estimated costs provided throughout this LGEA report demonstrate the unburdened turn-key material and labor cost only. There will be contingencies and additional costs at the time of implementation. We recommend comprehensive project planning includes the review of multiple bids for project work, incorporate potential operational & maintenance (O&M) cost savings and maximize your incentive potential.

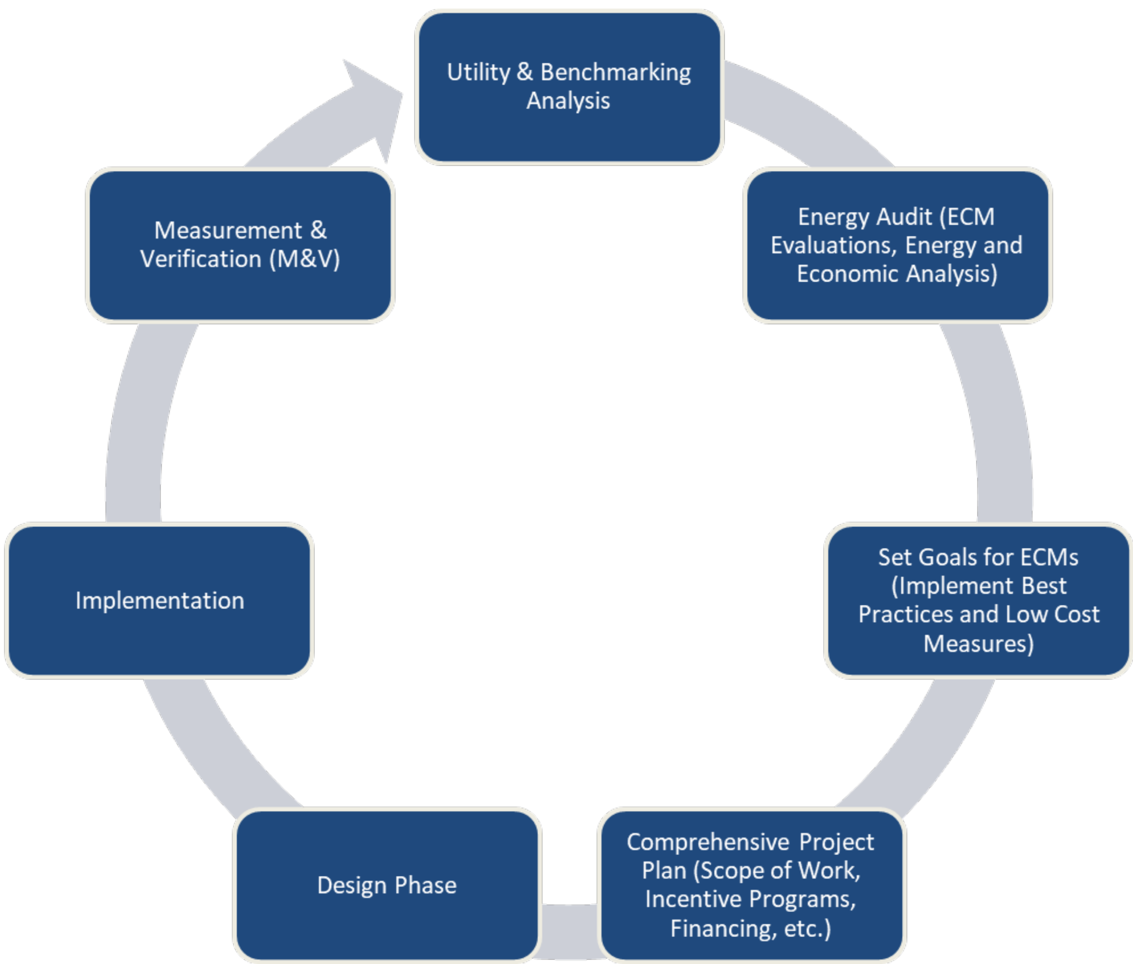



*Figure 4 – Project Development Cycle*

# 10 Energy Purchasing and Procurement Strategies

## 10.1 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 your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third-party electric suppliers. If your facility already buys electricity from a third-party supplier, review and compare prices at the end of each contract year.

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

## 10.2 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 your facility does not already purchase natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility already purchases natural gas from a third-party supplier, review and compare prices at the end of each contract year.

A list of licensed third-party natural gas suppliers is available at the NJBPU website[10].

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

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

# Appendix A: Equipment Inventory & Recommendations

**Lighting Inventory & Recommendations**

| | Existing Conditions | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Fixture Quantity | Fixture Description | Control System | Light Level | Watts per Fixture | Annual Operating Hours | ECM # | Fixture Recommendation | Add Controls? | Fixture Quantity | Fixture Description | Control System | Watts per Fixture | Annual Operating Hours | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Mechanical | 6 | Linear Fluorescent - T12: 4' T12 (40W) - 2L | Wall Switch | S | 88 | 2,080 | 1 | Relamp & Reballast | No | 6 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 2,080 | 0.3 | 795 | 0 | $133 | $413 | $60 | 2.7 |
| Dining Area 1 | 2 | Exit Signs: Fluorescent | None | | 24 | 8,760 | 3 | Fixture Replacement | No | 2 | LED Exit Signs: 2 W Lamp | None | 6 | 8,760 | 0.0 | 341 | 0 | $57 | $145 | $0 | 2.5 |
| Dining Area 1 | 15 | LED Lamps: 30W-Corn cob | Wall Switch | S | 30 | 2,080 | 4 | None | Yes | 15 | LED Lamps: 30W-Corn cob | Occupancy Sensor | 30 | 1,435 | 0.1 | 313 | 0 | $52 | $270 | $35 | 4.5 |
| Dining hallway | 5 | LED Lamps: 10W-A lamp | Wall Switch | S | 10 | 2,080 | | None | No | 5 | LED Lamps: 10W-A lamp | Wall Switch | 10 | 2,080 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Janitorial 1 | 4 | Linear Fluorescent - T12: 4' T12 (40W) - 2L | Wall Switch | S | 88 | 2,080 | 1, 4 | Relamp & Reballast | Yes | 4 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,435 | 0.2 | 611 | 0 | $102 | $391 | $60 | 3.2 |
| Kitchen 1 | 5 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,080 | 2, 4 | Relamp | Yes | 5 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,435 | 0.2 | 472 | 0 | $79 | $453 | $85 | 4.7 |
| Kitchen storage | 1 | Linear Fluorescent - T12: 4' T12 (40W) - 2L | Wall Switch | S | 88 | 2,080 | 1 | Relamp & Reballast | No | 1 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 2,080 | 0.1 | 133 | 0 | $22 | $69 | $10 | 2.7 |
| Multipurpose 1 | 3 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 3 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Multipurpose 1 | 30 | Metal Halide: (1) 250W Lamp | Wall Switch | S | 295 | 2,080 | 2, 4 | Relamp & Reballast | Yes | 30 | LED Lamps - E39: ≤125 W Lamp | Occupancy Sensor | 75 | 1,435 | 6.5 | 16,393 | -3 | $2,742 | $8,640 | $1,570 | 2.6 |
| Restroom - Female 1 | 1 | Linear Fluorescent - T12: 4' T12 (40W) - 1L | Wall Switch | S | 46 | 2,080 | 1 | Relamp & Reballast | No | 1 | LED - Linear Tubes: (1) 4' Lamp | Wall Switch | 15 | 2,080 | 0.0 | 71 | 0 | $12 | $51 | $5 | 3.8 |
| Restroom - Female 1 | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,080 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 2,080 | 0.0 | 74 | 0 | $12 | $37 | $10 | 2.1 |
| Restroom - Male 1 | 1 | Linear Fluorescent - T12: 4' T12 (40W) - 1L | Wall Switch | S | 46 | 2,080 | 1 | Relamp & Reballast | No | 1 | LED - Linear Tubes: (1) 4' Lamp | Wall Switch | 15 | 2,080 | 0.0 | 71 | 0 | $12 | $51 | $5 | 3.8 |
| Restroom - Male 1 | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,080 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 2,080 | 0.0 | 74 | 0 | $12 | $37 | $10 | 2.1 |
| Storage 1 | 4 | Linear Fluorescent - T12: 4' T12 (40W) - 2L | Wall Switch | S | 88 | 2,080 | 1, 4 | Relamp & Reballast | Yes | 4 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,435 | 0.2 | 611 | 0 | $102 | $391 | $40 | 3.4 |
| Storage 2 | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,080 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 2,080 | 0.0 | 74 | 0 | $12 | $37 | $10 | 2.1 |
| Storage 2 (under construction) | 1 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 1 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Storage 2 (under construction) | 1 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,080 | 2 | Relamp | No | 1 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 2,080 | 0.0 | 74 | 0 | $12 | $37 | $10 | 2.1 |
| Stairs 1 | 2 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,080 | 2 | Relamp | No | 2 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 2,080 | 0.1 | 148 | 0 | $25 | $73 | $20 | 2.1 |
| Mechanical 2 | 8 | Linear Fluorescent - T12: 4' T12 (40W) - 2L | Wall Switch | S | 88 | 2,080 | 1 | Relamp & Reballast | No | 8 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 2,080 | 0.4 | 1,060 | 0 | $177 | $550 | $80 | 2.7 |
| Storage 1 | 1 | Exit Signs: LED - 2 W Lamp | None | | 6 | 8,760 | | None | No | 1 | Exit Signs: LED - 2 W Lamp | None | 6 | 8,760 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Storage 1 | 27 | Linear Fluorescent - T8: 4' T8 (32W) - 2L | Wall Switch | S | 62 | 2,080 | 2, 4 | Relamp | Yes | 27 | LED - Linear Tubes: (2) 4' Lamps | Occupancy Sensor | 29 | 1,435 | 1.0 | 2,547 | -1 | $426 | $1,526 | $270 | 2.9 |
| Attic | 12 | Linear Fluorescent - T12: 4' T12 (40W) - 2L | Wall Switch | S | 88 | 2,080 | 1 | Relamp & Reballast | No | 12 | LED - Linear Tubes: (2) 4' Lamps | Wall Switch | 29 | 2,080 | 0.6 | 1,590 | 0 | $266 | $825 | $120 | 2.7 |
| Exterior 1 | 22 | LED Lamps: 10W-A lamp | Timeclock | S | 10 | 4,380 | | None | No | 22 | LED Lamps: 10W-A lamp | Timeclock | 10 | 4,380 | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

## Motor Inventory & Recommendations

| | | Existing Conditions | | | | | | | | | Proposed Conditions | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Area(s)/System(s) Served | Motor Quantity | Motor Application | HP Per Motor | Full Load Efficiency | VFD Control? | Manufacturer | Model | Remaining Useful Life | Annual Operating Hours | ECM # | Install High Efficiency Motors? | Full Load Efficiency | Install VFDs? | Number of VFDs | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Mechanical room 1 | Reading Senior Center | 1 | Combustion Air Fan | 1.0 | 70.0% | No | Power Flame | C2 G 15HBS | B | 2,745 | 5 | Yes | 85.5% | No | | 0.1 | 398 | 0 | $67 | $747 | $0 | 11.1 |
| Mechanical room 2 | Kitchen | 1 | Exhaust Fan | 0.3 | 65.0% | No | Centri Vent | CB1613V | B | 2,745 | | No | 65.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical room 2 | Kitchen | 1 | Fan Coil Unit | 0.3 | 65.0% | No | unkown | unkown | W | 2,745 | | No | 65.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical room 1 | Reading Senior Center | 2 | Heating Hot Water Pump | 3.0 | 81.5% | No | US Electric Motors | 6156A | W | 2,555 | 5 | Yes | 89.5% | No | | 0.3 | 941 | 0 | $159 | $1,753 | $0 | 11.0 |
| Mechanical room 1 | Reading Senior Center | 1 | DHW Circulation Pump | 0.1 | 65.0% | No | Bell & Gossett | 1E+91 | W | 8,760 | | No | 65.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical room 1 | Reading Senior Center | 1 | Other | 0.5 | 65.0% | No | unkown | unkown | B | 1,095 | | No | 65.0% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Mechanical room 2 | Reading Senior Center | 1 | Supply Fan | 5.0 | 70.0% | No | York | NC300C00N6AAA1 | W | 3,120 | 5 | Yes | 89.5% | No | | 0.6 | 2,717 | 0 | $459 | $800 | $0 | 1.7 |
| | | | | | | | | | | | | | | | | | | | | | | |
| Mechanical room 2 | Reading Senior Center | 1 | Supply Fan | 1.5 | 84.0% | No | unkown | unkown | B | 3,120 | 5 | Yes | 86.5% | No | | 0.0 | 90 | 0 | $15 | $758 | $0 | 49.8 |
| | | | | | | | | | | | | | | | | | | | | | | |
| Mechanical room 2 | Reading Senior Center | 1 | Supply Fan | 1.5 | 84.0% | No | unkown | unkown | B | 3,120 | 5 | Yes | 86.5% | No | | 0.0 | 90 | 0 | $15 | $758 | $0 | 49.8 |
| | | | | | | | | | | | | | | | | | | | | | | |
| Attic | Reading Senior Center | 1 | Supply Fan | 1.5 | 86.5% | No | unkown | unkown | B | 3,120 | | No | 86.5% | No | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| | | | | | | | | | | | | | | | | | | | | | | |
| Mechanical room 1 | Reading Senior Center | 1 | Supply Fan | 1.5 | 70.0% | No | unkown | unkown | B | 3,120 | 5 | Yes | 86.5% | No | | 0.2 | 714 | 0 | $121 | $758 | $0 | 6.3 |

## Packaged HVAC Inventory & Recommendations

| | | Existing Conditions | | | | | | | | | Proposed Conditions | | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Area(s)/System(s) Served | System Quantity | System Type | Cooling Capacity per Unit (Tons) | Heating Capacity per Unit (MBh) | Cooling Mode Efficiency (SEER/IEER/EER) | Heating Mode Efficiency | Manufacturer | Model | Remaining Useful Life | ECM # | Install High Efficiency System? | System Quantity | System Type | Cooling Capacity per Unit (Tons) | Heating Capacity per Unit (MBh) | Cooling Mode Efficiency (SEER/IEER/EER) | Heating Mode Efficiency | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Ground | 3A | 1 | Split-System | 5.00 | | 12.00 | | York | H40B060S25A | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Ground | 3B | 1 | Split-System | 5.00 | | 13.00 | | Trane | 2TTA3060A3000AA | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Ground | 4A | 1 | Split-System | 5.00 | | 13.00 | | Trane | 2TTA3060A3000AA | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Ground | 4B | 1 | Split-System | 5.00 | | 10.00 | | Trane | 2TTA0060A3000AA | B | 6 | Yes | 1 | Split-System | 5.00 | | 16.00 | | 1.1 | 1,575 | 0 | $266 | $6,521 | $1,050 | 20.5 |
| Ground | Reading Senior Center | 1 | Split-System | 25.00 | | 10.20 | | York | YC300C00A4AAA4A | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Ground | Reading Senior Center | 1 | Split-System | 5.00 | | 13.00 | | York | YCJD60S43S4A | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |
| Ground | Reading Senior Center | 1 | Split-System | 5.00 | | 13.00 | | York | TCD60B31SA | W | | No | | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

## Space Heating Boiler Inventory & Recommendations

| | | Existing Conditions | | | | | | Proposed Conditions | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Area(s)/System(s) Served | System Quantity | System Type | Output Capacity per Unit (MBh) | Manufacturer | Model | Remaining Useful Life | ECM # | Install High Efficiency System? | System Quantity | System Type | Output Capacity per Unit (MBh) | Heating Efficiency | Heating Efficiency Units | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Mechanical room 1 | Reading Senior Center | 1 | Non-Condensing Hot Water Boiler | 1,362 | H.B. Smith | Series 28 | B | 7 | Yes | 1 | Non-Condensing Hot Water Boiler | 1,361 | 85.00% | Et | 0.0 | 0 | 130 | $1,080 | $30,534 | $4,764 | 23.9 |

## Pipe Insulation Recommendations

## DHW Inventory & Recommendations

| | | Existing Conditions | | | | | Proposed Conditions | | | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Area(s)/System(s) Served | System Quantity | System Type | Manufacturer | Model | Remaining Useful Life | ECM # | Replace? | System Quantity | System Type | Fuel Type | System Efficiency | Efficiency Units | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Mechanical room 1 | Reading Senior Center | 1 | Storage Tank Water Heater (> 50 Gal) | Bradford White | RG275H6N | W | | No | | | | | | 0.0 | 0 | 0 | $0 | $0 | $0 | 0.0 |

## Low-Flow Device Recommendations

| | Recommedation Inputs | | | | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | ECM # | Device Quantity | Device Type | Existing Flow Rate (gpm) | Proposed Flow Rate (gpm) | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Kitchen | 9 | 1 | Faucet Aerator (Kitchen) | 2.50 | 1.50 | 0.0 | 0 | 0 | $2 | $7 | $4 | 1.4 |
| Restrooms | 9 | 3 | Faucet Aerator (Lavatory) | 2.20 | 0.50 | 0.0 | 0 | 1 | $12 | $22 | $22 | 0.0 |

**Commercial Refrigerator/Freezer Inventory & Recommendations**

| | Existing Conditions | | | | | Proposed Conditions | | Energy Impact & Financial Analysis | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Quantity | Refrigerator/ Freezer Type | Manufacturer | Model | ENERGY STAR Qualified? | ECM # | Install ENERGY STAR Equipment? | Total Peak kW Savings | Total Annual kWh Savings | Total Annual MMBtu Savings | Total Annual Energy Cost Savings | Estimated M&L Cost ($) | Total Incentives | Simple Payback w/ Incentives in Years |
| Kitchen storage | 1 | Freezer Chest | unkown | unkown | No | 10 | Yes | 0.6 | 4,953 | 0 | $837 | $2,450 | $0 | 2.9 |

**Plug Load Inventory**

| | Existing Conditions | | | | | |
|---|---|---|---|---|---|---|
| Location | Quantity | Equipment Description | Energy Rate (W) | ENERGY STAR Qualified? | Manufacturer | Model |
| Dining area | 1 | Microwave | 1,000 | No | Panasonic | |
| Dining area | 1 | Refrigerator (Residential) | 126 | No | Frigidaire | |
| Dining area | 1 | Television | 133 | No | Philips | |
| Multipurpose room 1 | 1 | Printer | 600 | No | Xerox | |
| Multipurpose room 1 | 1 | Copier | 1,000 | No | HP | |
| Multipurpose room 1 | 1 | Television | 200 | No | Samsung | |

# 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.

## ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

**N/A**

ENERGY STAR® Score[1]

### Reading Senior Center

**Primary Property Type:** Social/Meeting Hall
**Gross Floor Area (ft²):** 14,000
**Built:** 1898

**For Year Ending:** February 29, 2020
**Date Generated:** May 18, 2021

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 |
|---|---|---|
| Reading Senior Center<br>15 Ringold Street<br>Trenton, New Jersey 08618 | City of Trenton<br>319 East State Street<br>Trenton, NJ 08618<br>(609) 989-3615 | Hoggarth Stephen<br>319 East State Street<br>Trenton, NJ 08618<br>(609) 989-3615<br>hstephen@trentonnj.org |

**Property ID:** 15281676

**Energy Consumption and Energy Use Intensity (EUI)**

**Site EUI**
146.8 kBtu/ft²

**Source EUI**
211.4 kBtu/ft²

| Annual Energy by Fuel | |
|---|---|
| Electric - Grid (kBtu) | 458,650 (22%) |
| Natural Gas (kBtu) | 1,598,057 (78%) |

| National Median Comparison | |
|---|---|
| National Median Site EUI (kBtu/ft²) | 76.1 |
| National Median Source EUI (kBtu/ft²) | 109.6 |
| % Diff from National Median Source EUI | 93% |
| **Annual Emissions** | |
| Greenhouse Gas Emissions (Metric Tons CO2e/year) | 129 |

### 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. |
| **TREC** | *Transition Incentive Renewable Energy Certificate:* a factorized renewable energy certificate 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 $1/8^{th}$ 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. |