Local Government Energy Audit Report

Clary Anderson Arena

March 10, 2025

Prepared for:
Township of Montclair
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Montclair, New Jersey 07042

Prepared by:
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Disclaimer

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

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

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

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

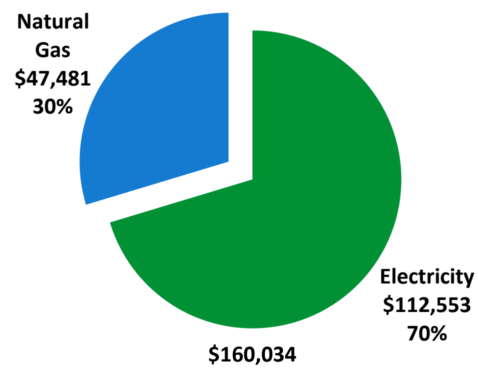
The customer and their respective contractor(s) are responsible to implement energy conservation measures in complete conformance with all applicable local, state, and federal requirements.

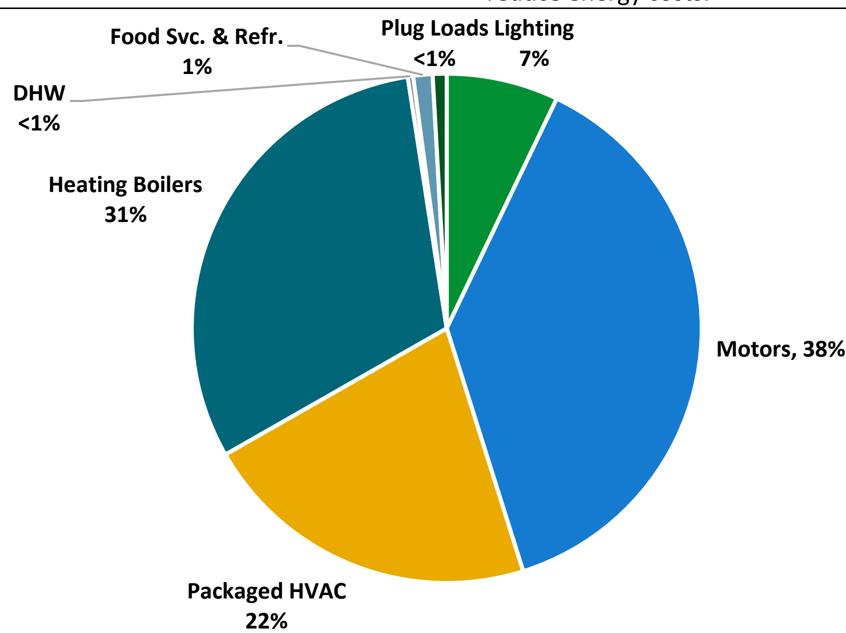
Table of Contents

1 Executive Summary

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

BUILDING PERFORMANCE REPORT

Annual Energy Utilities	Costs: $160,034 Electricity: 1,105,212 kWh Natural Gas: 43,064 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.



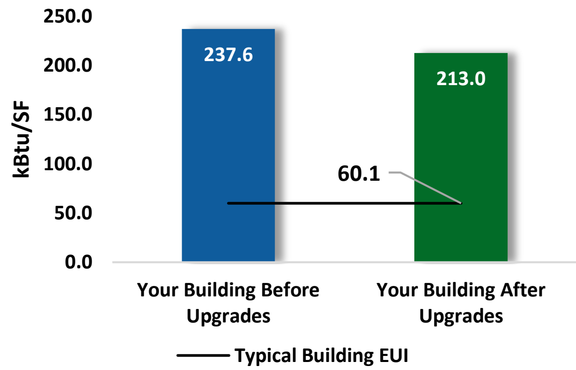
Energy Use by System

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.

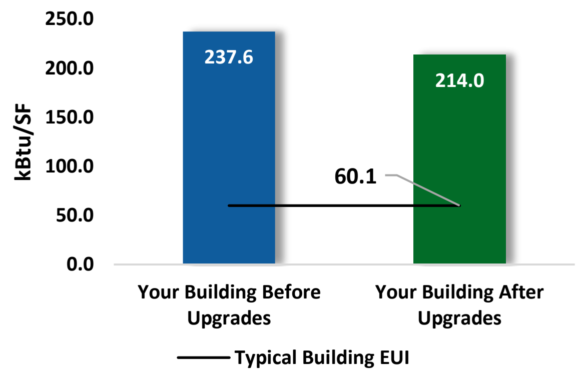
Scenario 1: Full Package (All Evaluated Measures)

Installation Cost	$141,230
Potential Rebates & Incentives[1]	$13,180
Annual Cost Savings	$24,135
Annual Energy Savings	Electricity: 232,649 kWh Natural Gas: 402 Therms
Greenhouse Gas Emission Savings	119 Tons
Simple Payback	5.3 Years
Site Energy Savings (All Utilities)	10%



Scenario 2: Cost Effective Package[2]

Installation Cost	$128,930
Potential Rebates & Incentives	$13,080
Annual Cost Savings	$23,554
Annual Energy Savings	Electricity: 228,942 kWh Natural Gas: 217 Therms
Greenhouse Gas Emission Savings	117 Tons
Simple Payback	4.9 Years
Site Energy Savings (all utilities)	10%



On-site Generation Potential

Photovoltaic	High
Combined Heat and Power	None

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

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

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**125,358**	**27.1**	**-25**	**$12,490**	**$51,330**	**$5,670**	**$45,660**	**3.7**	**123,296**
ECM 1	Install LED Fixtures	Yes	110,602	23.9	-22	$11,020	$45,120	$4,940	$40,180	3.6	108,786
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	13,079	2.9	-3	$1,303	$5,400	$610	$4,790	3.7	12,859
ECM 3	Retrofit Fixtures with LED Lamps	Yes	1,677	0.4	0	$167	$810	$120	$690	4.1	1,652
Lighting Control Measures			**3,111**	**0.7**	**-1**	**$310**	**$4,000**	**$670**	**$3,330**	**10.8**	**3,055**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	2,703	0.6	-1	$269	$3,720	$460	$3,260	12.1	2,655
ECM 5	Install High/Low Lighting Controls	Yes	408	0.1	0	$41	$280	$210	$70	1.7	400
Variable Frequency Drive (VFD) Measures			**102,028**	**20.9**	**4**	**$10,440**	**$64,100**	**$6,200**	**$57,900**	**5.5**	**103,265**
ECM 6	Install VFDs on Chilled Water Pumps	Yes	70,288	14.8	0	$7,158	$39,000	$3,900	$35,100	4.9	70,780
ECM 7	Install VFDs on Kitchen Hood Fan Motors	No	5,001	0.0	4	$559	$4,700	$100	$4,600	8.2	5,559
ECM 8	Install VFDs on Process/Pool Filtration Pumps	Yes	26,738	6.1	0	$2,723	$20,400	$2,200	$18,200	6.7	26,925
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**44**	**$486**	**$11,900**	**$400**	**$11,500**	**23.6**	**5,166**
ECM 9	Install High Efficiency Hot Water Boilers	Yes	0	0.0	44	$486	$11,900	$400	$11,500	23.6	5,166
Domestic Water Heating Upgrade			**0**	**0.0**	**3**	**$37**	**$950**	**$140**	**$810**	**22.1**	**389**
ECM 10	Install Low-Flow DHW Devices	Yes	0	0.0	3	$37	$950	$140	$810	22.1	389
Food Service & Refrigeration Measures			**3,445**	**0.4**	**0**	**$351**	**$1,350**	**$100**	**$1,250**	**3.6**	**3,469**
ECM 11	Vending Machine Control	Yes	3,445	0.4	0	$351	$1,350	$100	$1,250	3.6	3,469
Custom Measures			**-1,294**	**0.0**	**14**	**$22**	**$7,600**	**$0**	**$7,600**	**345.5**	**336**
ECM 12	Replace Gas Fired Water Heater with Heat Pump Water Heater	No	-1,294	0.0	14	$22	$7,600	$0	$7,600	345.5	336
TOTALS (COST EFFECTIVE MEASURES)			**228,942**	**49.1**	**22**	**$23,554**	**$128,930**	**$13,080**	**$115,850**	**4.9**	**233,081**
TOTALS (ALL MEASURES)			**232,649**	**49.1**	**40**	**$24,135**	**$141,230**	**$13,180**	**$128,050**	**5.3**	**238,977**

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

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

All Evaluated Energy Improvements[3]

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

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

1.1 Planning Your Project

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

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

Pick Your Installation Approach

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

Options from Your Utility Company

Prescriptive and Custom Rebates

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

Direct Install

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

Engineered Solutions

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

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

Options from New Jersey's Clean Energy Program

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

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

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

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

Successor Solar Incentive Program (SuSI)

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

Ongoing Electric Savings with Demand Response

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

Large Energy User Program (LEUP)

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

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

2 Existing Conditions

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) report for Clary Anderson Arena. 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 July 2, 2024, TRC performed an energy audit at Clary Anderson Arena located in Montclair, New Jersey. TRC met with Joe Gauweiler to review the facility operations and help focus our investigation on specific energy-using systems.

Clary Anderson Arena is a 2-story, 34,000 square foot building built in 1966. Spaces include offices, mechanical rooms, locker rooms, restrooms, conference rooms, and storage rooms.

Recent Improvements and Facility Concerns

There are no major recent improvements. Facility concerns include leaks from the roof.

2.2 Building Occupancy

The facility has two areas that operate on different schedules. Maintenance is operated mostly during these hours and sometimes outside of the operating schedule.

Building Name	Weekday/Weekend	Operating Schedule
Pool Hours (June - Aug)	Weekday	12:00 PM - 8:00 PM
	Weekend	11:00 AM - 8:00 PM
Clary Anderson Arena (Sep-June) - Regular Hours	Weekday	9:00 AM - 12:00 AM
	Weekend	5:00 AM - 12:00 AM

Building Occupancy Schedule

2.3 Building Envelope

The building masonry walls are partially clad with corrugated metal siding in fair condition. Some areas need residing. The windows are single pane ½ inch plexiglass with fixed metal frames in fair condition. Some windows need to be resealed. The roof has a pitched portion with corrugated metal and a flat portion with rubber in poor condition that is not insulated. The roof has some holes and needs to be refinished. The site expressed interest in installing insulation. The insulated metal doors in good condition. The frames are metal but some need to be weather stripped.

Exterior Wall

Typical Window

Front Door

Flat Roof

2.4 Lighting Systems

The primary interior lighting system uses metal halide lamps. Other areas of the building use LED lamps, linear fluorescent T12s, linear fluorescent T8s, incandescent, compact fluorescent, and LED linear tubes. The exit signs are LED and in good condition. The interior lighting systems are controlled by light switches. Most fixtures are in good condition. Interior lighting levels were generally sufficient.

Metal halide

CFL lamp

Exit sign

LED lamp

Exterior areas use a combination of LED fixtures, linear florescent T12s, high-pressure sodium lamps, incandescent, and metal halide lamps. These fixtures are controlled by wall switches or timeclocks.

Metal halide lamp

High-pressure sodium lamp

2.5 Air Handling Systems

Unitary Electric HVAC Equipment

The lobby, office – enclosed 1, and party room all use window or through-the wall air conditioning (AC) units. These vary in capacity from .67 to 1.00 tons. These units vary in condition from good to poor. They range in efficiency between 10 EER and 12 EER. They are not ENERGY STAR labeled.

Through-the wall AC

Window AC

Unitary Heating Equipment

The locker rooms, the ice rink, and the Zamboni room are all heated by a variety of electric resistance or gas-fired unit heaters and forced air furnaces. The electric resistance unit heaters have an output of 17.06 MBh and COPs of 1. The gas-powered units vary in capacity from 40 to 60 MBh and have an efficiency of 80 percent. These units are controlled by manual dial thermostats.

2.6 Heating Hot Water Systems

Two hot water boilers serve the building heating load and heat the snow pit. A Utica Boilers 205 MBh with a thermal efficiency of 82% is used to melt snow and a Caravan 200 MBh with a thermal efficiency of 80% is used to heat the lobby. There are three 1/6 hp, Bell & Gosset, hot water pumps servicing these boilers. Two are connected to the snow pit loop and one is connected to the lobby loop. Both boilers were installed in the 1990's and are in fair working condition. The Caravan boilers provide hot water to radiators that provide heat in the winter. They are manually controlled by a local thermostat. The piping for these systems is insulated and in good condition.

Electric resistance unit heater

Gas powered unit heater

Caravan hot water boiler

Utica Boilers hot water boiler

2.7 Chilled Water Systems

A glycol circulation system is used to keep the ice rink frozen. This system has two 150 hp compressors operating in a lead lag manner. In addition to these compressor motors, there are two 30 hp glycol circulation motors where one is backup for the other. Lastly, there is one 5 hp chilled water pump connected to the cooling tower portion of the chilled water system.

150 hp compressor motor

Cooling tower

2.8 Domestic Hot Water

Hot water is produced by 3 gas powered tankless water heaters and 2 gas powered storage tank water heaters. The tankless water heaters have an input capacity of 157.MBh and an efficiency of 92.99%. The storage tank water heats have a capacity of 75 gallons, an input capacity of 75 MBh, and a nominal efficiency of 80%.

Tankless water heater

Storage tank water heater

2.9 Food Service Equipment

The snack bar has a mix of gas and electric equipment that is used to prepare food for customers. The cooking is done using a gas fryer, an electric griddle, 2 food warmers, and a small electric oven. Equipment is not high efficiency and is in good or fair condition.

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

Griddle

Fryer

2.10 Refrigeration

The rink storage has a freezer chest. This freezer is in fair condition.

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

Freezer chest

2.11 Plug Load and Vending Machines

The location is doing a great job managing the electrical plug loads. This report makes additional suggestions for ECMs in this area as well as energy efficient best practices.

There are 7 computer workstations throughout the facility. Plug loads include general cafe and office equipment. There are several residential style refrigerators throughout the building. These vary in condition and efficiency. There are 3 non-refrigerated and 2 glass fronted refrigerated vending machines.

Kitchen refrigerator

Vending Machine

2.12 Water-Using Systems

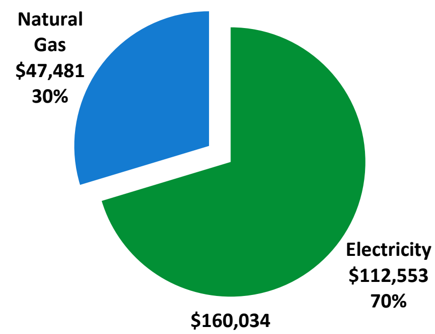
Potable water is used for drinking, cleaning, cooking, sanitary fixtures, landscaping, laundry, and vehicle washing. EPA WaterSense® has set maximum flow rates for sanitary fixtures. They are: 1.28 gallons per flush (gpf) for toilets, 0.5 gpf for urinals, 1.5 gallons per minute (gpm) for lavatory faucets, and 2.0 gpm for showerheads.

Typical restroom sink

3 Energy and Water Use and Costs

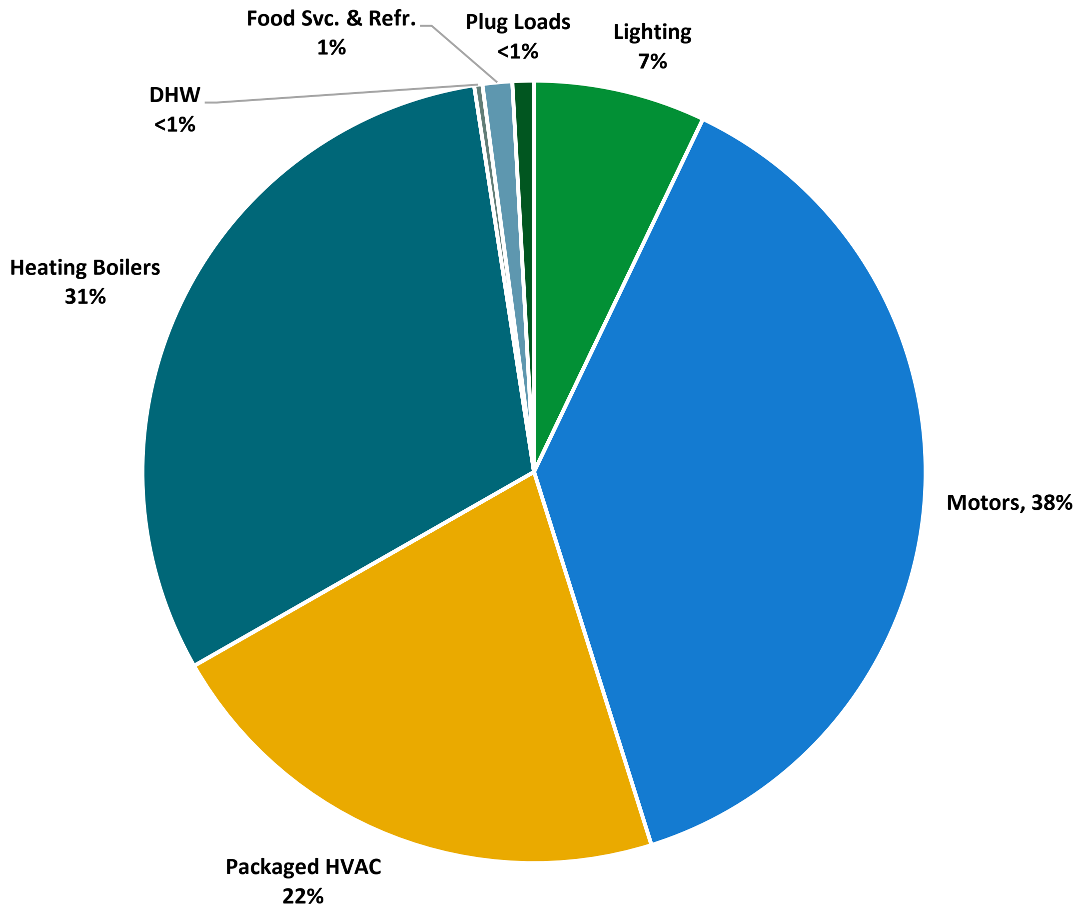
Twelve months of utility billing data are used to develop annual energy consumption and cost data. This information creates a profile of the annual energy consumption and energy costs.

Utility Summary		
Fuel	**Usage**	**Cost**
Electricity	1,105,212 kWh	$112,553
Natural Gas	43,064 Therms	$47,481
Total		**$160,034**



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

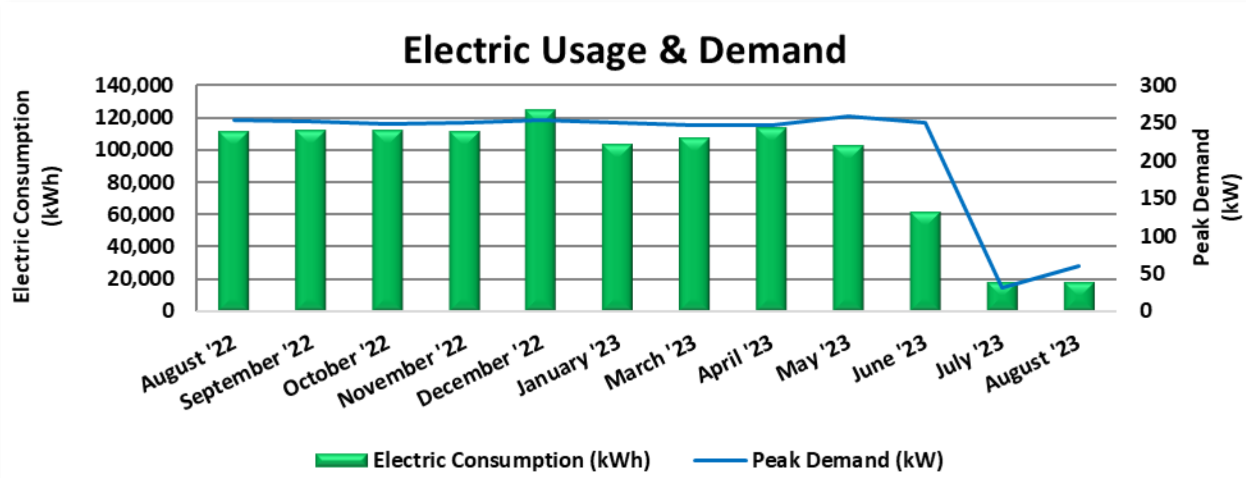
The energy auditor collects information regarding equipment operating hours, capacity, efficiency, and other operational parameters from facility staff, drawings, and on-site observations. This information is used as the inputs to calculate the existing conditions energy use for the site. The calculated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



Energy Balance by System

3.1 Electricity

PSE&G delivers electricity under rate class Large Power and Lighting Secondary (LPLS).



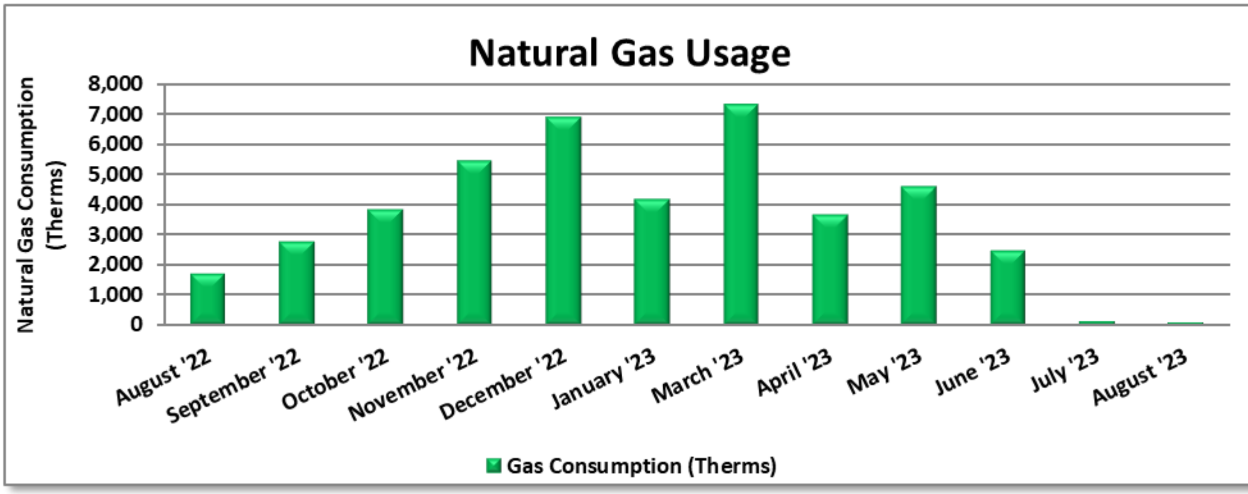
Electric Billing Data					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
9/15/22	29	112,029	255	$1,138	$12,505
10/15/22	30	112,467	252	$1,127	$11,247
11/14/22	30	112,905	250	$1,115	$9,345
12/15/22	31	111,718	250	$1,118	$10,270
1/18/23	34	125,637	253	$1,132	$12,016
2/15/23	28	104,162	250	$1,117	$10,043
3/17/23	30	108,101	247	$1,104	$10,570
4/18/23	32	113,850	248	$1,107	$11,202
5/17/23	29	103,254	259	$1,163	$10,408
6/16/23	30	62,102	251	$1,190	$9,238
7/18/23	32	17,843	31	$153	$2,466
8/16/23	29	18,116	60	$296	$2,935
Totals	**364**	**1,102,184**	**259**	**$11,760**	**$112,245**
Annual	**365**	**1,105,212**	**259**	**$11,793**	**$112,553**

Notes:

- Peak demand of 259 kW occurred in May '23.
- Average demand over the past 12 months was 217 kW.
- The average electric cost over the past 12 months was $0.102/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.
- Abnormalities can be accounted for by meter estimates and corrections on actual meter readings.

3.2 Natural Gas

PSE&G delivers natural gas under rate class General Service Gas Heating (GSG (HTG).



Gas Billing Data			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
9/15/22	29	1,691	$2,434
10/14/22	29	2,756	$4,011
11/14/22	31	3,822	$5,365
12/15/22	31	5,416	$7,144
1/18/23	34	6,892	$8,748
2/15/23	28	4,175	$4,620
3/17/23	30	7,300	$6,697
4/19/23	33	3,662	$2,871
5/17/23	28	4,595	$3,304
6/16/23	30	2,475	$1,655
7/18/23	32	107	$266
8/16/23	29	54	$235
Totals	**364**	**42,946**	**$47,350**
Annual	**365**	**43,064**	**$47,481**

Notes:

- The average gas cost for the past 12 months is $1.103/therm, which is the blended rate used throughout the analysis.
- Abnormalities can be accounted for by meter estimates and corrections on actual meter readings.

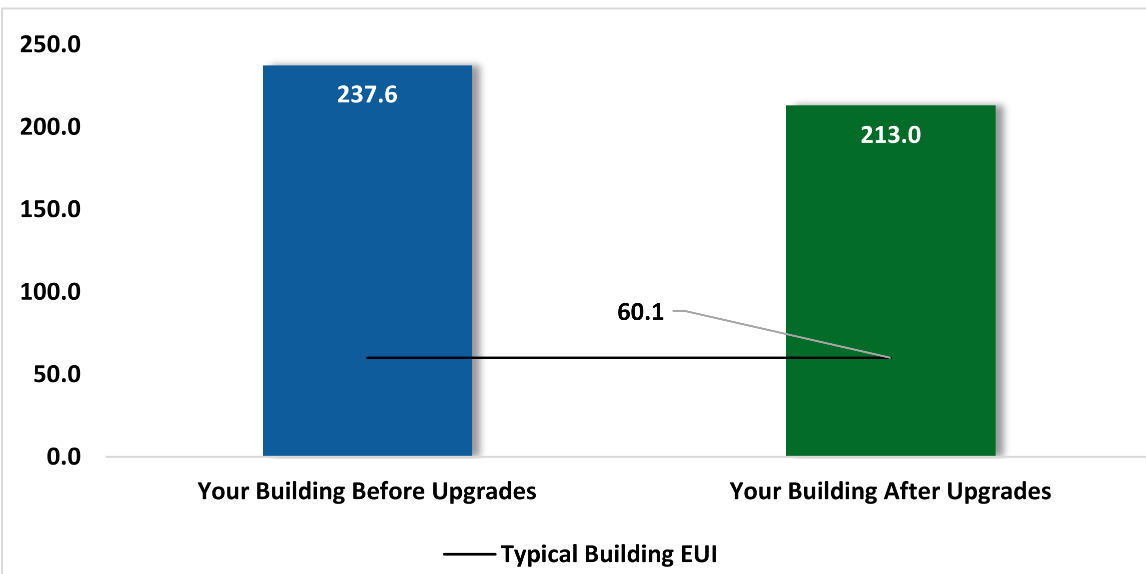
3.3 Benchmarking

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.



Energy Use Intensity Comparison[4]

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

[4] Based on all evaluated ECMs

Tracking your Energy Performance

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

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

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

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

3.4 Understanding Your Utility Bills

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

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

Why Utility Bills Vary

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

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

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

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

4 Energy Conservation Measures

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

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

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

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

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

#	Energy Conservation Measure	Cost Effective?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**125,358**	**27.1**	**-25**	**$12,490**	**$51,330**	**$5,670**	**$45,660**	**3.7**	**123,296**
ECM 1	Install LED Fixtures	Yes	110,602	23.9	-22	$11,020	$45,120	$4,940	$40,180	3.6	108,786
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	13,079	2.9	-3	$1,303	$5,400	$610	$4,790	3.7	12,859
ECM 3	Retrofit Fixtures with LED Lamps	Yes	1,677	0.4	0	$167	$810	$120	$690	4.1	1,652
Lighting Control Measures			**3,111**	**0.7**	**-1**	**$310**	**$4,000**	**$670**	**$3,330**	**10.8**	**3,055**
ECM 4	Install Occupancy Sensor Lighting Controls	Yes	2,703	0.6	-1	$269	$3,720	$460	$3,260	12.1	2,655
ECM 5	Install High/Low Lighting Controls	Yes	408	0.1	0	$41	$280	$210	$70	1.7	400
Variable Frequency Drive (VFD) Measures			**102,028**	**20.9**	**4**	**$10,440**	**$64,100**	**$6,200**	**$57,900**	**5.5**	**103,265**
ECM 6	Install VFDs on Chilled Water Pumps	Yes	70,288	14.8	0	$7,158	$39,000	$3,900	$35,100	4.9	70,780
ECM 7	Install VFDs on Kitchen Hood Fan Motors	No	5,001	0.0	4	$559	$4,700	$100	$4,600	8.2	5,559
ECM 8	Install VFDs on Process/Pool Filtration Pumps	Yes	26,738	6.1	0	$2,723	$20,400	$2,200	$18,200	6.7	26,925
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**44**	**$486**	**$11,900**	**$400**	**$11,500**	**23.6**	**5,166**
ECM 9	Install High Efficiency Hot Water Boilers	Yes	0	0.0	44	$486	$11,900	$400	$11,500	23.6	5,166
Domestic Water Heating Upgrade			**0**	**0.0**	**3**	**$37**	**$950**	**$140**	**$810**	**22.1**	**389**
ECM 10	Install Low-Flow DHW Devices	Yes	0	0.0	3	$37	$950	$140	$810	22.1	389
Food Service & Refrigeration Measures			**3,445**	**0.4**	**0**	**$351**	**$1,350**	**$100**	**$1,250**	**3.6**	**3,469**
ECM 11	Vending Machine Control	Yes	3,445	0.4	0	$351	$1,350	$100	$1,250	3.6	3,469
Custom Measures			**-1,294**	**0.0**	**14**	**$22**	**$7,600**	**$0**	**$7,600**	**345.5**	**336**
ECM 12	Replace Gas Fired Water Heater with Heat Pump Water Heater	No	-1,294	0.0	14	$22	$7,600	$0	$7,600	345.5	336
TOTALS			**232,649**	**49.1**	**40**	**$24,135**	**$141,230**	**$13,180**	**$128,050**	**5.3**	**238,977**

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

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

All Evaluated ECMs

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**125,358**	**27.1**	**-25**	**$12,490**	**$51,330**	**$5,670**	**$45,660**	**3.7**	**123,296**
ECM 1	Install LED Fixtures	110,602	23.9	-22	$11,020	$45,120	$4,940	$40,180	3.6	108,786
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	13,079	2.9	-3	$1,303	$5,400	$610	$4,790	3.7	12,859
ECM 3	Retrofit Fixtures with LED Lamps	1,677	0.4	0	$167	$810	$120	$690	4.1	1,652
Lighting Control Measures		**3,111**	**0.7**	**-1**	**$310**	**$4,000**	**$670**	**$3,330**	**10.8**	**3,055**
ECM 4	Install Occupancy Sensor Lighting Controls	2,703	0.6	-1	$269	$3,720	$460	$3,260	12.1	2,655
ECM 5	Install High/Low Lighting Controls	408	0.1	0	$41	$280	$210	$70	1.7	400
Variable Frequency Drive (VFD) Measures		**97,027**	**20.9**	**0**	**$9,881**	**$59,400**	**$6,100**	**$53,300**	**5.4**	**97,705**
ECM 6	Install VFDs on Chilled Water Pumps	70,288	14.8	0	$7,158	$39,000	$3,900	$35,100	4.9	70,780
ECM 8	Install VFDs on Process/Pool Filtration Pumps	26,738	6.1	0	$2,723	$20,400	$2,200	$18,200	6.7	26,925
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**44**	**$486**	**$11,900**	**$400**	**$11,500**	**23.6**	**5,166**
ECM 9	Install High Efficiency Hot Water Boilers	0	0.0	44	$486	$11,900	$400	$11,500	23.6	5,166
Domestic Water Heating Upgrade		**0**	**0.0**	**3**	**$37**	**$950**	**$140**	**$810**	**22.1**	**389**
ECM 10	Install Low-Flow DHW Devices	0	0.0	3	$37	$950	$140	$810	22.1	389
Food Service & Refrigeration Measures		**3,445**	**0.4**	**0**	**$351**	**$1,350**	**$100**	**$1,250**	**3.6**	**3,469**
ECM 11	Vending Machine Control	3,445	0.4	0	$351	$1,350	$100	$1,250	3.6	3,469
TOTALS		**228,942**	**49.1**	**22**	**$23,554**	**$128,930**	**$13,080**	**$115,850**	**4.9**	**233,081**

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

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

Cost Effective ECMs

4.1 Lighting

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**125,358**	**27.1**	**-25**	**$12,490**	**$51,330**	**$5,670**	**$45,660**	**3.7**	**123,296**
ECM 1	Install LED Fixtures	110,602	23.9	-22	$11,020	$45,120	$4,940	$40,180	3.6	108,786
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	13,079	2.9	-3	$1,303	$5,400	$610	$4,790	3.7	12,859
ECM 3	Retrofit Fixtures with LED Lamps	1,677	0.4	0	$167	$810	$120	$690	4.1	1,652

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

ECM 1: Install LED Fixtures

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

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

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

Affected Building Areas: lobby, ice rink, and building exterior

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Retrofit fluorescent fixtures by removing the T12 fluorescent tubes and magnetic 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 3: Retrofit Fixtures with LED Lamps

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

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

Affected Building Areas: all areas with fluorescent fixtures with T8 tubes, offices, and rink exterior

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		**3,111**	**0.7**	**-1**	**$310**	**$4,000**	**$670**	**$3,330**	**10.8**	**3,055**
ECM 4	Install Occupancy Sensor Lighting Controls	2,703	0.6	-1	$269	$3,720	$460	$3,260	12.1	2,655
ECM 5	Install High/Low Lighting Controls	408	0.1	0	$41	$280	$210	$70	1.7	400

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: locker rooms, mechanical rooms, offices, restrooms, and Zamboni room

ECM 5: Install High/Low Lighting Controls

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

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

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

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

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

Affected Building Areas: lobby

4.3 Variable Frequency Drives (VFD)

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**102,028**	**20.9**	**4**	**$10,440**	**$64,100**	**$6,200**	**$57,900**	**5.5**	**103,265**
ECM 6	Install VFDs on Chilled Water Pumps	70,288	14.8	0	$7,158	$39,000	$3,900	$35,100	4.9	70,780
ECM 7	Install VFDs on Kitchen Hood Fan Motors	5,001	0.0	4	$559	$4,700	$100	$4,600	8.2	5,559
ECM 8	Install VFDs on Process/Pool Filtration Pumps	26,738	6.1	0	$2,723	$20,400	$2,200	$18,200	6.7	26,925

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

<u>ECM 6: Install VFDs on Chilled Water Pumps</u>

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

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

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

Affected Pumps: condenser water pump and glycol circulation pumps

<u>ECM 7: Install VFDs on Kitchen Hood Fan Motors</u>

We evaluated installing VFDs and sensors to control the kitchen hood fan motor(s). The air flow of the hood is varied based on two key inputs: temperature and smoke/cooking fumes. The VFD controls the amount of exhaust (and kitchen make-up air) based on temperature—the lower the temperature the lower the flow. If the optic sensor is triggered by smoke or cooking fumes, the speed of the fan ramps up to 100%. Energy savings result from reducing the hood fan speed (and power) when conditions allow for reduced air flow.

ECM 8: Install VFDs on Pool Filtration Pumps

Install VFDs to control process pump(s). Process flow requirements vary considerably based on the requirements of the process. For example, pool filtration requirements may be linked to pool occupancy, in which case high- and low-speed operation may be all that is required. In some cases, sensors will be required to optimize flow. Other pumping applications may require water level or other sensing devices to optimize pump operations. If the system has fixed head requirements (e.g., well pumps or open systems with an elevated tank or pond) the pump speed will have to be controlled to maintain the minimum fixed head requirement for the system.

Energy savings result from reducing the pump speed during low demand periods. Ensure that your control system includes the sensors and inputs required to optimize water flow in your water supply.

4.4 Gas-Fired Heating Boiler

#	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**	**44**	**$486**	**$11,900**	**$400**	**$11,500**	**23.6**	**5,166**
ECM 9	Install High Efficiency Hot Water Boilers	0	0.0	44	$486	$11,900	$400	$11,500	23.6	5,166

ECM 9: Install 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.

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

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

4.5 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**	**3**	**$37**	**$950**	**$140**	**$810**	**22.1**	**389**
ECM 10	Install Low-Flow DHW Devices	0	0.0	3	$37	$950	$140	$810	22.1	389

ECM 10: Install Low-Flow DHW Devices

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

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

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

4.6 Food Service and Refrigeration Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Food Service & Refrigeration Measures		**3,445**	**0.4**	**0**	**$351**	**$1,350**	**$100**	**$1,250**	**3.6**	**3,469**
ECM 11	Vending Machine Control	3,445	0.4	0	$351	$1,350	$100	$1,250	3.6	3,469

ECM 11: Vending Machine Control

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

4.7 Custom Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Custom Measures		**-1,294**	**0.0**	**14**	**$22**	**$7,600**	**$0**	**$7,600**	**345.5**	**336**
ECM 12	Replace Gas Fired Water Heater with Heat Pump Water Heater	-1,294	0.0	14	$22	$7,600	$0	$7,600	345.5	336

ECM 12: Replace Gas Fired Water Heater with Heat Pump Water Heater

We evaluated replacing existing the gas water heaters with heat pump water heaters (HPWH).

A gas fired water heater uses a burner to heat water. Air source heat pump water heaters use a refrigeration cycle to transfer heat from the surrounding air to the domestic water. Water heater efficiency is rated by the uniform energy factor (UEF). For a relative comparison of water heater UEFs, the criteria for certifying a water heater in the ENERGY STAR program are provided below. These values indicate that HPWH heaters are significantly more efficient than gas fired water heaters.

There are two types of HPWH: those integrated with the heat pump and storage tank in the same unit, and those that are split into two sections (with the storage tank separate from the heat pump). The measure considers an integrated HPWH.

ENERGY STAR Uniform Energy Factor (UEF) Criteria for Certified Water Heaters *

Water Heater Type	*Minimum UEF*	*Other*
Integrated HPWH	3.3	
Integrated HPWH	2.2	120 Volt, 15 Amp circuit
Split System HPWH	2.2	
Gas Fired Storage	0.64	≤ 55-gal, Medium Draw Pattern
Gas Fired Storage	0.68	≤ 55-gal, High Draw Pattern
Gas Fired Storage	0.78	> 55-gal, Medium Draw Pattern
Gas Fired Storage	0.80	> 55-gal, High Draw Pattern
Gas Fired Storage	0.80	Residential Duty
Gas Fired Instantaneous	0.87	

** Note: Uniform Energy Factor (UEF): The newest measure of water heater overall efficiency. The higher the UEF value is, the more efficient the water heater. UEF is determined by the Department of Energy's test method outlined in 10 CFR Part 430, Subpart B, Appendix E.*[5]

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

HPWH reject cold air. As such, they need to be installed in an unconditioned space of about 750 cubic feet with good ventilation[6]. Ideal locations are garages, large enclosed, unconditioned storage areas, or areas with excess heat such as a furnace or boiler room. The HPWH will also produce condensate so accommodations for draining the condensate need to be provided.

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

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

Switching from a gas fired water heater to a HPWH has the potential to reduce the sites overall greenhouse gas emissions. If the electricity for the HPWH is provided by an on-site photovoltaic (PV) system then there are essentially no greenhouse gas (GHG) emissions. A 2016 study conducted at Cornell[7] calculated the kg of methane (CH_4) and carbon dioxide (CO_2) produced per GJ of water heated. The study compared HPWH to gas and electric fired, storage and tankless water heaters. The study also considered electricity produced from natural gas and coal fired electric plants. In all cases the study found that HPWHs produced less methane than all of the other water heaters. The study also found that HPWH produced less carbon dioxide than electric resistance water heaters but more carbon dioxide than tankless gas water heaters and about the same amount of carbon dioxide as storage gas water heaters. The summary tables provide the reduction in CO2 equivalent emissions based on the typical New Jersey electric utility.

Affected Units: locker rooms and pool storage tank water heater.

4.8 Measures for Future Consideration

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

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

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

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

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

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

Installation of a Building Automation System

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

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

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

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

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

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

Upgrade to a Heat Pump System

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

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

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

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

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

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

5 ENERGY EFFICIENT BEST PRACTICES

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

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

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

Energy Tracking with ENERGY STAR Portfolio Manager

You've heard it before—you cannot manage what you do not measure. ENERGY STAR Portfolio Manager is an online tool that you can use to measure and track energy and water consumption, as well as greenhouse gas emissions[8] . Your account has already been established. Now you can continue to keep tabs on your energy performance every month.

Weatherization

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

Doors and Windows

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

Lighting Maintenance

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

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-

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

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.

Lighting Controls

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

Motor Maintenance

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

Fans to Reduce Cooling Load

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

Thermostat Schedules and Temperature Resets

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

AC System Evaporator/Condenser Coil Cleaning

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

HVAC Filter Cleaning and Replacement

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

Ductwork Maintenance

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

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

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

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

Boiler Maintenance

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

Furnace Maintenance

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

Water Heater Maintenance

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

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

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

Refrigeration Equipment Maintenance

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

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

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

Procurement Strategies

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

6 WATER BEST PRACTICES

Getting Started

The commercial and institutional sector is the second largest consumer of publicly supplied water in the United States, accounting for 17% of the withdrawals from public water supplies[9]. In New Jersey, excluding water used for power generation, approximately 80% of total water use was attributed to potable supply during the period of 2009 to 2018. Water withdrawals for potable supply have not changed noticeably during the period from 1990 to 2018[10].

Water management planning serves as the foundation for any successful water reduction effort. It is the first step a commercial or institutional facility owner or manager should take to achieve and sustain long-term water savings. Understanding how water is used within a facility is critical for the water management planning process. A water assessment provides a comprehensive account of all known water uses at the facility. It allows the water management team to establish a baseline from which progress and program success can be measured. It also enables the water management team to set achievable goals and identify and prioritize specific projects based on the relative savings opportunities and project cost-effectiveness.

Water conservation devices may significantly reduce your water and sewer usage costs. Any reduction in water use reduces grid-level electricity use since a significant amount of electricity is used to treat and deliver water from reservoirs to end users.

For more information regarding water conservation or additional details regarding the practices shown below go to the EPA's WaterSense website[11] or download a copy of EPA's "WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities"[12] to get ideas for creating a water management plan and best practices for a wide range of water using systems.

Water Metering and Submetering

Tracking a facility's total water use, as well as specific end uses, is a key component of a facility's water-efficiency efforts. Accurately measuring water use can help facility managers identify areas for targeted reductions and track progress from water-efficiency upgrades. If possible, install meters to measure all water conveyed to the facility, regardless of the source. Each source should be metered separately. Consider developing a metering plan and installing separate submeters to measure specific end uses. There are many types and sizes of meters intended for different uses. Installing the correct type and size of meter are critical to accurate water measurement. Sub-metering applications may include:

- Individual tenant spaces
- Cooling tower make-up and blowdown water supply
- Water lines serving other HVAC systems including water circulating loops.
- Make up water supply for steam boiler plants with a capacity of 500,000 Btu/hr. or greater.
- Systems or equipment that use single pass cooling water.
- Irrigation systems

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

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

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

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

- Roof spray systems (for irrigating vegetated roofs or thermal conditioning)
- Ornamental water features
- Indoor and outdoor pools and spas
- Industrial water using processes.

Leak Detection and Repair

Identifying and repairing leaks and other water use anomalies within a facility's water distribution system or from processes or equipment can keep a facility from wasting significant quantities of water. Examples of common leaks include leaking toilets and faucets, drip irrigation malfunctions, stuck float valves, and broken distribution lines. Reading meters, installing failure abatement technologies, and conducting visual and auditory inspections are important best practices to detect leaks. Train building occupants, employees, and visitors to report any leaks that they detect. To reduce unnecessary water loss, detected leaks should be repaired quickly. Repairing leaks in water distribution that is pressurized by on-site pumps or in heated or chilled water piping will also reduce energy use.

Toilets and Urinals

Toilets and urinals are considered sanitary fixtures and are found in most facilities. High efficiency fixtures are at least 20% more efficient than available standard products. Leaking or damaged equipment is a substantial source of water waste. Train users to report continuously flushing, leaking, or otherwise improperly operating equipment to the appropriate personnel. Depending on the age of the equipment and the frequency of use, it may be cost effective to replace older inefficient fixtures with current generation WaterSense labeled equipment.

Commercial facilities typically use tank toilets or wall-mount flushometers. Educate and inform users with restroom signage and other means to avoid flushing inappropriate objects. For tank toilets, periodically check to ensure fill valves are working properly and that water level is set correctly. Annually test toilets to ensure the flappers are not worn or allowing water to seep from the tank into the bowl and down the sewer. Control stops and piston valves on flushometer toilets should be checked at least annually.

Most urinals use water to flush liquid. These standard single-user fixtures are present in most facilities. Non-water urinals use a specially designed trap that allows liquid waste to drain out of the fixture through a trap seal, and into the drainage system. Flushing urinals should be inspected at least annually for proper valve and sensor operation. For non-water urinals, follow maintenance practices as directed by the manufacturer to ensure products perform as expected. Non-water urinals can be considered during urinal replacement, however, review the condition and design of the existing plumbing system and the expected usage patterns to ensure that these products will provide the anticipated performance.

Faucets and Showerheads

Faucets and showerheads are sanitary fixtures that generally dispense heated water. Reducing water use by these fixtures translates into a reduction of site fuel or electric use depending on how water is heated. High efficiency fixtures are at least 20% more efficient than available standard products. Leaking or damaged equipment is a substantial source of water waste. Train users to report continuously dripping, leaking, or otherwise improperly operating equipment to the appropriate personnel. Depending on the age of the equipment and the frequency of use, it may be cost effective to replace older fixtures with current generation WaterSense labeled equipment.

Faucets are used for a variety of purposes, and standard flow rates are dictated by the intended use. Public use lavatory faucets and kitchen faucets are subject to maximum flow rates while service sinks are not. Periodically inspect faucet aerators for scale buildup to ensure flow is not being restricted. Clean or replace the aerator or other spout end device as needed. Check and adjust automatic sensors (where installed) to ensure they are operating properly to avoid faucets running longer than necessary. Post materials in restrooms and kitchens to ensure user awareness of the facility's water-efficiency goals. Remind users to turn off the tap when they are done and to consider turning the tap off during sanitation activities when it is not being used. Consider installing lavatory and kitchen faucet fixtures with reduced flow. Federal standards limit kitchen and restroom faucet flows to 2.2 gpm. To qualify for a WaterSense label a faucet cannot exceed 1.5 gpm.

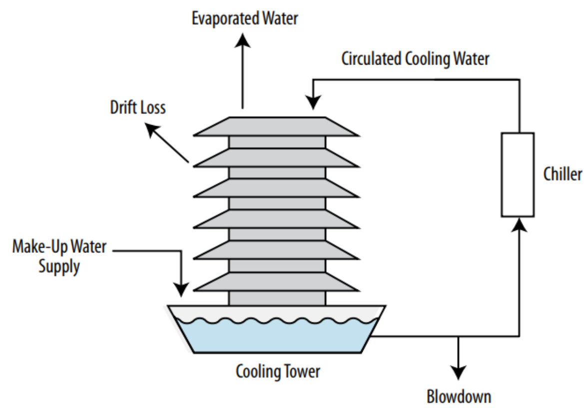
Effective in 1992, the maximum allowable flow rate for all showerheads sold in the United States is 2.5 gpm. Since this standard was enacted, many showerheads have been designed to use even less water. WaterSense labeled equipment is designed to use 2.0 gpm, or less. For optimum showerhead efficiency, the system pressure should be tested to make sure that it is between 20 and 80 pounds per square inch (psi). Verify that plumbing lines are routed through a shower valve to prevent water pressure fluctuations. Periodically inspect showerheads for scale buildup to ensure flow is not being restricted. In general, replace showerheads with 2.5 gpm flow rates or higher with WaterSense labeled models. Note: Use of poor performing replacement reduced flow showerheads may result in increased use if the duration of use is increased to compensate for reduced performance. WaterSense labeled showerheads are independently certified to meet or exceed minimum performance requirements for spray coverage and force.

Cooling Towers

Cooling towers dissipate heat from recirculating water used to cool chillers, air conditioning equipment, or other process equipment. By design, they use significant amounts of water. However, facilities can save substantial amounts of water by optimizing the operation and maintenance of cooling tower systems.

Evaporation is the primary function of the tower and is the method that transfers heat from the cooling tower system to the environment. Tower water evaporation is not typically targeted for water-efficiency efforts because it is fundamental to the cooling process. However, improving the energy efficiency of the systems that use the cooling water will reduce the evaporative load on the tower. The rate of evaporation from a cooling tower is typically equal to approximately one percent of the rate of recirculating water flow for every 10°F in temperature drop that the cooling tower achieves.

The main water loss in a cooling tower system is due to blowdown. When water evaporates from the tower, dissolved solids (e.g., calcium, magnesium, chloride, silica) are left behind. As more water evaporates, the concentration of total dissolved solids (TDS) increases. If the concentration gets too high, the TDS can cause scale to form within the system or can lead to corrosion. The concentration of TDS is controlled by removing (i.e., bleeding or blowing down) a portion of the water that has high TDS concentration and replacing that water with make-up water, which has a lower concentration of TDS. Water can also be lost to "drift." Drift is water that is carried away from the tower as mist or small droplets. Drift can vary from 0.05 to 0.2% of the flow rate through the cooling tower. Properly operated towers and associated piping should not have leaks or overflows. However, an overflow drain is provided within the tower in case of malfunction and subsequent overflow.



Cooling Tower System

A key parameter used to evaluate cooling tower operation is cycles of concentration (sometimes referred to as "cycles" or "concentration ratio"). Cycles of concentration is the ratio of the concentration of TDS (i.e., conductivity) in the blowdown water divided by the conductivity of the make-up water. Since TDS enter the system in the make-up water and exit the system in the blowdown water, the cycles of concentration are also approximately equal to the ratio of volume of make-up water to blowdown water. See the figure below.

Cycles of Concentration (Cycles) = Blowdown Conductivity (ppm of TDS) / Make-up Conductivity (ppm of TDS)

Cycles of Concentration (Cycles) = Make-up water gal / Blowdown Water gal

Cycles of Concentration

To use water efficiently in the cooling tower system, the cycles must be maximized. This is accomplished by minimizing the amount of blowdown required, thus reducing make-up water demand. The degree to which the cycles can be maximized depends on the water chemistry within the cooling tower and the water chemistry of the make-up water supply. As the cycles are increased, the amount of TDS that stays within the system also increases. If the cycles calculated based on gallons of make-up water and blowdown are more than 10% higher than the value calculated using conductivity that can indicate that the tower is losing water due to leaks, overflow, or excess drift.

For optimum cooling tower water efficiency, there are several operations, maintenance, and user education strategies to consider.

- Implement energy-efficiency measures to reduce the heat load to the tower which will reduce the cooling tower water use.
- Implement a comprehensive air handler coil maintenance program to reduce the load on the chilled water system.
- Properly maintain and clean heat exchangers, condensers, and evaporator coils to prevent scale, biological growth, and sediment from building up in the tubes.
- If available, have operations and maintenance personnel read the conductivity, make-up, and blowdown flow meters regularly to identify problems and determine when to adjust.
- Keep a detailed log of make-up and blowdown quantities, conductivity, and cycles of concentration and monitor trends to spot deterioration in performance.

- Make sure the tower fill valve cuts off cleanly when the tower basin is full to minimize wasted water from leaks.
- Calculate and understand the cooling tower's cycles. Check the ratio of make-up water to blowdown water. Then check the ratio of blowdown and make-up conductivity. These ratios should match the target cycles. If both ratios are not about the same, check the tower for leaks. If the tower is not maintaining target cycles, check the conductivity controller, the make-up water valve, and the blowdown valve for proper operation.
- Maximize the cycles of concentration. Many systems operate at two to four cycles of concentration, while six cycles or more might be possible.

	New Cycles of Concentration										
Initial Cycles of Concentration		2	2.5	3	3.5	4	5	6	7	8	9	10
	1.5	33%	44%	50%	53%	56%	58%	60%	61%	62%	63%	64%
	2.0	--	17%	25%	30%	33%	38%	40%	42%	43%	44%	45%
	2.5	--	--	10%	16%	20%	25%	28%	30%	31%	33%	34%
	3.0	--	--	--	7%	11%	17%	20%	22%	24%	25%	26%
	3.5	--	--	--	--	5%	11%	14%	17%	18%	20%	21%
	4.0	--	--	--	--	--	6%	10%	13%	14%	16%	17%
	5.0	--	--	--	--	--	--	4%	7%	9%	10%	11%
	6.0	--	--	--	--	--	--	--	3%	5%	6%	7%

Make-up Water % Saved by Increasing Cycles of Concentration

There are also retrofits to consider if the cooling tower system is not already equipped with these items.

- Install flow meters on the make-up and blowdown water lines.
- Install conductivity meters or purchase a handheld meter to take conductivity measurements.
- Install a conductivity controller to automatically control blowdown.
- Install an automated chemical feed system for towers over 100-ton capacity. The chemical feed system will monitor conductivity, control blowdown, and add chemicals based on make-up water flow.

Consider reusing "wastewater" from other systems as make-up water for the cooling tower. One good source is the condensate from large cooling coils. This reuse is particularly appropriate because the condensate has a low mineral content and is generated in greatest quantities when cooling tower loads are the highest. Work with the water treatment vendor to ensure that the alternative sources identified are a good match for the cooling tower.

Contact the water utility to determine if the facility can receive a sanitary sewer charge deduction associated with the potable water lost to evaporation. If the utility agrees to provide this deduction, calculate the difference between the city-supplied potable make-up water and the blowdown water that is discharged to the sanitary sewer to determine how much cooling tower water is evaporating rather than being discharged to the sewer.

Pools and Spas

A large volume of water is used to fill commercial pools or spas. Much of this water is often lost in day-to-day operation due to evaporation, leaking, and splashing. Ongoing pool or spa maintenance also creates significant losses in filter cleaning and mineral buildup control.

Because evaporation, filter cleaning, and mineral buildup control represent the greatest uses of water for commercial pools and spas, they also provide the most significant opportunities to achieve water savings.

The California Urban Water Conservation Council (CUWCC) estimates that water evaporation, filter backwashing, and mineral buildup control account for 56%, 23%, and 21% of pool water use, respectively. Water losses from leaks and splashing are not included in this estimate because they are difficult to quantify.

Water continually escapes pools and spas due to evaporation from the pool/spa surface. The rate of evaporation will depend upon several factors, including water temperature, the pool's ambient conditions (e.g., indoor or outdoor), the extent of convection over the pool's open surface, and the surface area of water that comes in contact with air. The table below provides an overview of evaporation losses for various pool sizes, as estimated by CUWCC. As noted below the annual loss from evaporation can be greater than the spa or pool volume.

Pool Type	Pool Volume (gal)	Water Loss (gal/yr)
Spa	1,100	6,300
Hotel (in ground)	34,000	40,000
Public (in ground)	150,000	160,000
Olympic (in ground)	860,000	570,000

Evaporation Water Losses by Pool Type

To control evaporation, consider the following:

- Do not heat pools above 79°F to reduce water evaporation rates.
- Limit the use of sprays, waterfalls, and other features.
- Use pool covers to reduce evaporation rates during periods in which the pool is not in use.

All swimming pools require pool filtration systems to keep the water free of particulate matter. As debris builds up on the filter, water flow becomes restricted and reduces filter efficiency, performance, and sanitation. For this reason, filters must be cleaned regularly. The rule of thumb is that filter cleaning is necessary after the filter pressure has increased by 5 to 10 pounds per square inch (psi). Most pool filters are cleaned by backwashing the filter. Consider the following regarding filter cleaning:

- Clean filter media only as necessary and not on a set schedule (i.e., clean only when the filter is no longer operating effectively).
- Utilize the sight glass if one is installed to monitor the visual quality of the backwash water running through the filter to determine when backwashing is complete.
- Install a pool filter pressure gauge. This will provide a means for determining when filter cleaning is necessary.

Pools and spas must be drained of some water on a regular basis to control mineral salt concentrations that gradually build up. The frequency of these events can be reduced by prolonging the useful life of the water by considering the following:

- Maintain proper pH, alkalinity, and hardness levels to avoid the need to drain the pool or to avoid using excess make-up water to correct water quality issues.
- When draining the pool, perform a partial drain rather than a full drain.

To check your pool for leaks and prevent them from occurring, actively monitor the pool's water levels. If the pool is losing more than two inches of water per week, it could be leaking. In addition, actively monitor for leaks around the pump seals, pipe joints, piping in filtration system suction or return lines, pool liners, and along the pool edges. Repair leaks as soon as they are identified.

7 On-Site Generation

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

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

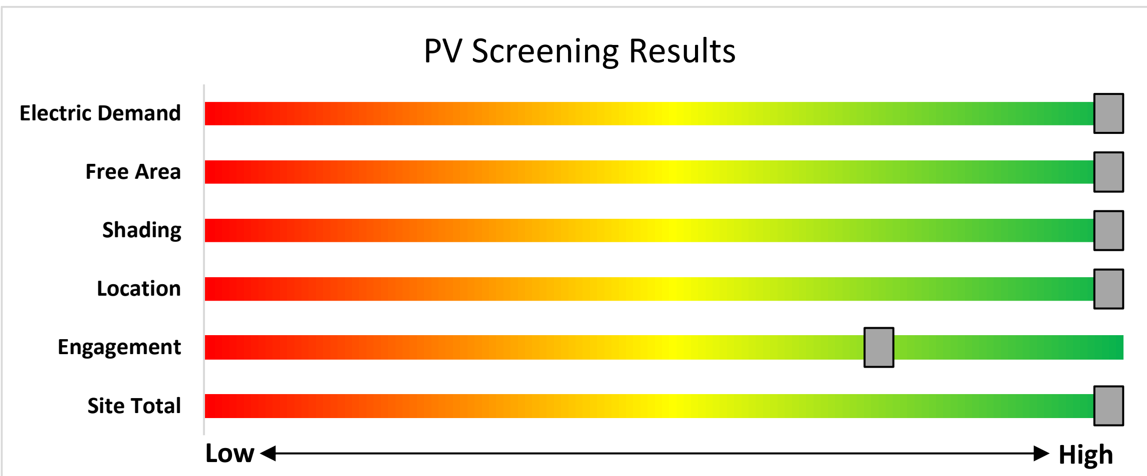
7.1 Solar Photovoltaic

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

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

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

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



Potential	High	
System Potential	129	kW DC STC
Electric Generation	153,687	kWh/yr
Displaced Cost	$15,650	/yr
Installed Cost	$335,400	

Photovoltaic Screening

Successor Solar Incentive Program (SuSI)

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

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

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

7.2 Combined Heat and Power

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

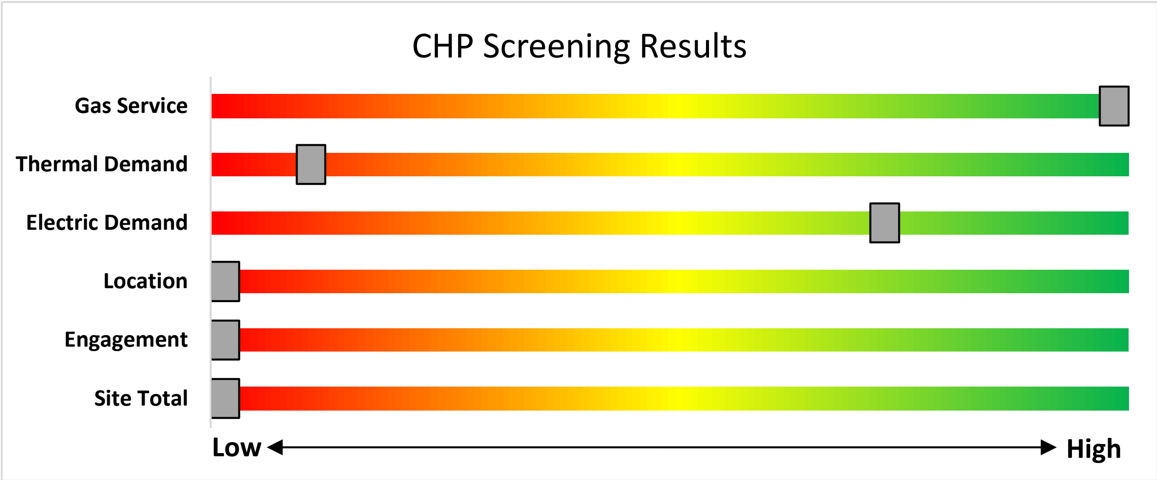
CHP systems typically produce a portion of the electric power used on-site, with the balance of electric power needs supplied by the local utility company. The heat is used to supplement (or replace) existing boilers and provide space heating and/or domestic hot water heating. Waste heat can also be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

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

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

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

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



Combined Heat and Power Screening

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

8 Electric Vehicles

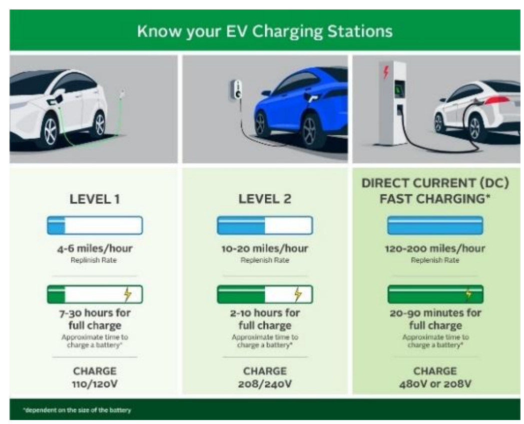
All electric vehicles (EVs) have an electric motor instead of an internal combustion engine. EVs function by plugging into a charge point, taking electricity from the grid, and then storing it in rechargeable batteries. Although electricity production may contribute to air pollution, the U.S. EPA categorizes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

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

8.1 EV Charging

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

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



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

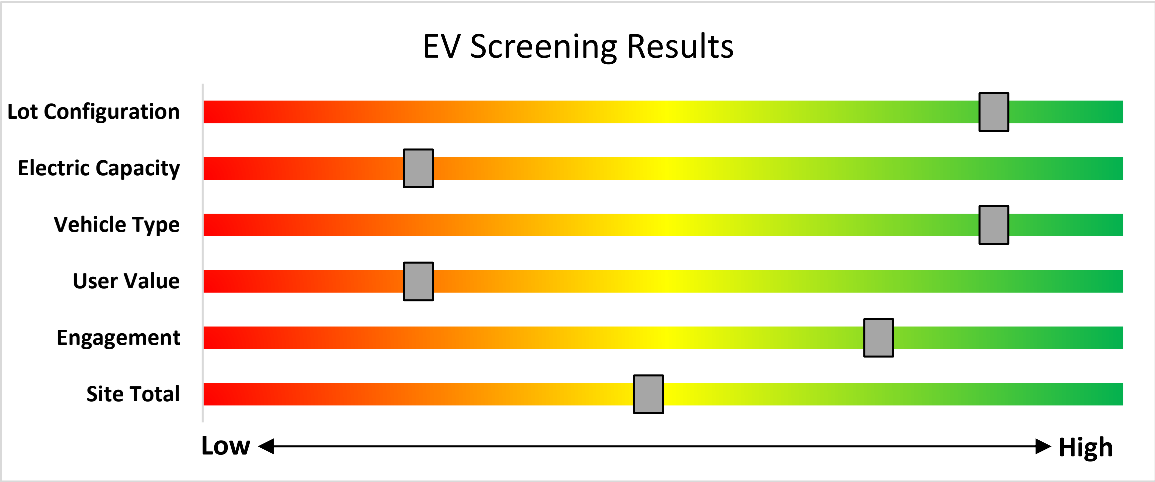
The primary costs associated with installing EV charging are the charger hardware and the cost to extend power from the facility to parking spaces. This may include upgrades to electric panels to serve increased loads.

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

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

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

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



EV Charger Screening

Electric Vehicle Programs Available

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

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

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

9 Project Funding and Incentives

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

NJBPU and NJCEP Administered Programs

New Jersey's cleanenergy program™

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

*State facilities are also eligible for utility programs

Utility Administered Programs

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

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

9.1 New Jersey's Clean Energy Program

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

Large Energy Users

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

Incentives

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

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

How to Participate

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

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

Combined Heat and Power

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

Incentives[13]

Eligible Technology	Size (Installed Rated Capacity)	Incentive ($/Watt)[5]	% of Total Cost Cap per Project	$ Cap per Project
CHPs powered by non-renewable or renewable fuel source, or a combination:[4] - Gas Internal Combustion Engine - Gas Combustion Turbine - Microturbine Fuel Cells ≥60%	≤500 kW[1]	$2.00	30-40%[2]	$2 million
	>500 kW - 1 MW[1]	$1.00		
	> 1 MW - 3 MW[1]	$0.55	30%	$3 million
	>3 MW[1]	$0.35		
Fuel Cells ≥40%	Same as above[1]	Applicable amount above	30%	$1 million
Waste Heat to Power (WHP)[3] Powered by non-renewable fuel source. Heat recovery or other mechanical recovery from existing equipment utilizing new electric generation equipment (e.g. steam turbine)	≤1MW[1]	$1.00	30%	$2 million
	> 1MW[1]	$.50	30%	$3 million

13

1 Incentives are tiered, which means the incentive levels vary based upon the installed rated capacity, as listed in the chart above. For example, a 4 MW CHP system would receive $2.00/watt for the first 500 kW, $1.00/watt for the second 500 kW, $0.55/watt for the next 2 MW and $0.35/watt for the last 1 MW (up to the caps listed).

2 The maximum incentive will be limited to 30% of total project. For CHP projects up to 1 MW, this cap will be increased to 40% where a cooling application is used or included with the CHP system (e.g. absorption chiller).

3 Projects will be eligible for incentives shown above, not to exceed the lesser of % of total project cost per project cap or maximum $ per project cap. Projects installing CHP or FC with WHP will be eligible for incentive shown above, not to exceed the lesser caps of the CHP or FC incentive. Minimum efficiency will be calculated based on annual total electricity generated, utilized waste heat at the host site (i.e. not lost/rejected), and energy input.

4 Systems fueled by a Class 1 Renewable Fuel Source, as defined by N.J.A.C. 14:8-2.5, are eligible for a 30% incentive bonus. If the fuel is mixed, the bonus will be prorated accordingly. For example, if the mix is 60/40 (60% being a Class 1 renewable), the bonus will be 18%. This bonus will be included in the final performance incentive payment, based on system performance and fuel mix consumption data. Total incentive, inclusive of bonus, shall not exceed above stipulated caps.

5 CHP-FC systems located at Critical Facility and incorporating blackstart and islanding technology are eligible for a 25% incentive bonus. This bonus incentive will be paid with the second/Installation incentive payment. Total incentive, inclusive of bonus, shall not exceed above stipulated caps.

How to Participate

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

Successor Solar Incentive Program (SuSI)

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

Administratively Determined Incentive (ADI) Program

The ADI Program provides administratively set incentives for net metered residential projects, net metered non-residential projects 5 MW or less, and all community solar projects.

After the registration is accepted, construction is complete, and a complete final as-built packet has been submitted, the project is issued a New Jersey certification number, which enables it to generate New Jersey SREC- IIs.

Market Segments	Size MW dc	Incentive Value ($/SREC II)	Public Entities Incentive Value - $20 Adder ($/SRECII)
Net Metered Residential	All types and sizes	$90	N/A
Small Net Metered Non-Residential located on Rooftop, Carport, Canopy and Floating Solar	Projects smaller than 1 MW	$100	$120
Large Net Metered Non-Residential located on Rooftop, Carport, Canopy and Floating Solar	Projects 1 MW to 5 MW	$90	$110
Small Net Metered Non-Residential Ground Mount	Projects smaller than 1 MW	$85	$105
Large Net Metered Non-Residential Ground Mount	Projects 1 MW to 5 MW	$80	$100
LMI Community Solar	Up to 5 MW	$90	N/A
Non-LMI Community Solar	Up to 5 MW	$70	N/A
Interim Subsection (t)	All types and sizes	$100	N/A

Eligible projects may generate SREC-IIs for 15 years following the commencement of commercial operations which is defined as permission to operate (PTO) from the Electric Distribution Company. After 15 years, projects may be eligible for a NJ Class I REC.

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

The ADI Program online portal is now open to new registrations.

Competitive Solar Incentive (CSI) Program

The CSI Program opened on April 15, 2023, and will serve as the permanent program within the SuSI Program providing incentives to larger solar facilities. The CSI Program is open to qualifying grid supply solar facilities, non-residential net metered solar installations with a capacity greater than five (5) megawatts ("MW"), and to eligible grid supply solar facilities installed in combination with energy storage.

CSI eligible facilities will only be allowed to register in the CSI program upon award of a bid pursuant to N.J.A.C. 14:8-11.10.

The CSI program structure has separate categories, or tranches, to ensure that a range of solar project types, including those on preferred sites, are able to participate despite potentially different project cost profiles. The Board has approved four tranches for grid supply and large net metered solar and an additional fifth tranche for storage in combination with grid supply solar. The following table lists procurement targets for the first solicitation:

Tranche	Project Type	MW (dc) Targets
Tranche 1.	Basic Grid Supply	140
Tranche 2.	Grid Supply on the Built Environment	80
Tranche 3.	Grid Supply on Contaminated Sites and Landfills	40
Tranche 4.	Net Metered Non- Residential	40
Tranche 5.	*Storage Paired with Grid	160 MWh

*The storage tranche of 160 MWh corresponds to a 4-hour storage pairing of 40 MW of solar

Solar projects help the State of New Jersey reach renewable energy goals outlined in the state's Energy Master Plan.

If you are considering installing solar on your building, visit the following link for more information: https://njcleanenergy.com/renewable-energy/programs/susi-program

Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) serves New Jersey's government agencies by financing energy projects. An ESIP is a type of performance contract, whereby school districts, counties, municipalities, housing authorities, and other public and state entities enter contracts to help finance building energy upgrades. Annual payments are lower than the savings projected from the energy conservation measures (ECMs), ensuring that ESIP projects are cash flow positive for the life of the contract.

ESIP provides government agencies in New Jersey with a flexible tool to improve and reduce energy usage with minimal expenditure of new financial resources. NJCEP incentive programs described above can also be used to help further reduce the total project cost of eligible measures.

How to Participate

This LGEA report is the first step to participating in ESIP. Next, you will need to select an approach for implementing the desired ECMs:

(1) Use an energy services company or "ESCO."
(2) Use independent engineers and other specialists, or your own qualified staff, to provide and manage the requirements of the program through bonds or lease obligations.
(3) Use a hybrid approach of the two options described above where the ESCO is used for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

After adopting a resolution with a chosen implementation approach, the development of the energy savings plan can begin. The ESP demonstrates that the total project costs of the ECMs are offset by the energy savings over the financing term, not to exceed 15 years. The verified savings will then be used to pay for the financing.

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Carefully consider all alternatives to develop an approach that best meets your needs. A detailed program descriptions and application can be found at www.njcleanenergy.com/ESIP.

ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you can use NJCEP incentive programs to help further reduce costs when developing the energy savings plan. Refer to the ESIP guidelines at the link above for further information and guidance on next steps.

Demand Response (DR) Energy Aggregator

Demand Response Energy Aggregator is a program designed to reduce the electric load when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Grid operators call upon curtailment service providers and commercial facilities to reduce electric usage during times of peak demand, making the grid more reliable and reducing transmission costs for all ratepayers. Curtailment service providers provide regular payments to medium and large consumers of electric power for their participation in DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail its electric usage.

Typically, an electric customer must be capable of reducing their electric demand, within minutes, by at least 100 kW or more in order to participate in a DR program. Customers with greater capability to quickly curtail their demand during peak hours receive higher payments. Customers with back-up generators on site may also receive additional DR payments for their generating capacity if they agree to run the generators for grid support when called upon. Eligible customers who have chosen to participate in DR programs often find it to be a valuable source of revenue for their facility, because the payments can significantly offset annual electric costs.

Participating customers can often quickly reduce their peak load through simple measures, such as temporarily raising temperature setpoints on thermostats (so that air conditioning units run less frequently) or agreeing to dim or shut off less critical lighting. This usually requires some level of building automation and controls capability to ensure rapid load reduction during a DR curtailment event. DR program participants may need to install smart meters or may need to also sub-meter larger energy-using equipment, such as chillers, to demonstrate compliance with DR program requirements.

DR does not include the reduction of electricity consumption based on normal operating practice or behavior. For example, if a company's normal schedule is to close for a holiday, the reduction of electricity due to this closure or scaled-back operation is not considered a DR activity in most situations.

The first step toward participation in a DR program is to contact a curtailment service provider. A list of these providers is available on the website of the independent system operator, PJM, and it includes contact information for each company, as well as the states where they have active business[14]. PJM also posts training materials for program members interested in specific rules and requirements regarding DR activity along with a variety of other DR program information[15].

Curtailment service providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities, and they may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract.

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

[15] http://www.pjm.com/training/training-events.aspx.

9.2 Utility Energy Efficiency Programs

The Clean Energy Act, signed into law by Governor Murphy in 2018, requires New Jersey's investor-owned gas and electric utilities to reduce their customers' use by set percentages over time. To help reach these targets the New Jersey Board of Public Utilities approved a comprehensive suite of energy efficiency programs to be run by the utility companies.

Prescriptive and Custom

The Prescriptive and Custom rebate program through your utility provider offers incentives for installing prescriptive and custom energy efficiency measures at your facility. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades. This program serves most common equipment types and sizes.

Equipment Examples

Lighting
Lighting Controls
HVAC Equipment
Refrigeration
Gas Heating
Gas Cooling
Commercial Kitchen Equipment
Food Service Equipment
Variable Frequency Drives
Electronically Commutate Motors
Variable Frequency Drives
Plug Loads Controls
Washers and Dryers
Agricultural
Water Heating

The Prescriptive program provides fixed incentives for specific energy efficiency measures. Prescriptive incentives vary by equipment type. The Custom program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentives.

Direct Install

Direct Install is a turnkey program available to existing small to medium-sized facilities with an average peak electric demand that does not exceed 200 kW or less over the recent 12-month period. You work directly with a pre-approved contractor who will perform a free energy assessment at your facility, identify specific eligible measures, and provide a clear scope of work for installation of selected measures. Energy efficiency measures may include lighting and lighting controls, refrigeration, HVAC, motors, variable speed drives, and controls.

Incentives

The program pays up to 70% of the total installed cost of eligible measures.

How to Participate

To participate in Direct Install, you will work with a participating contractor. The contractor will be paid the measure incentives directly by the program, which will pass on to you in the form of reduced material and implementation costs. This means up to 70% of eligible costs are covered by the Direct Install program, subject to program rules and eligibility, while the remaining percent of the cost is paid to the contractor by the customer.

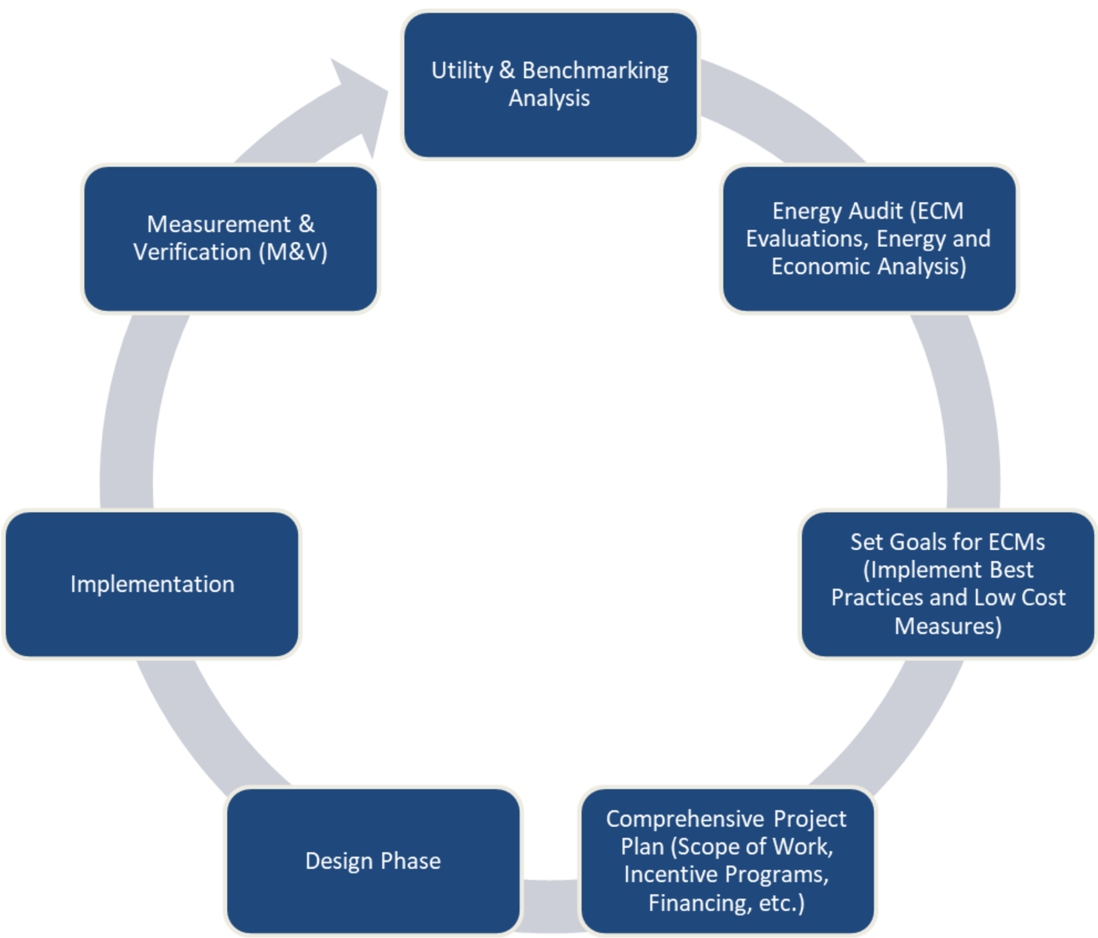
Engineered Solutions

The Engineered Solutions Program provides tailored energy-efficiency assistance and services to municipalities, universities, schools, hospitals, and healthcare facilities (MUSH), non-profit entities, and multifamily buildings. Customers receive expert guided services, including investment-grade energy auditing, engineering design, installation assistance, construction administration, commissioning, and measurement and verification (M&V) services to support the implementation of cost-effective and comprehensive efficiency projects. Engineered Solutions is generally a good option for medium to large sized facilities with a peak demand over 200 kW looking to implement as many measures as possible under a single project to achieve deep energy savings. Engineered Solutions has an added benefit of addressing measures that may not qualify for other programs. Many facilities pursuing an Energy Savings Improvement Program loan also use this program. Incentives for this program are based on project scope and energy savings achieved.

For more information on any of these programs, contact your local utility provider or visit https://www.njcleanenergy.com/transition.

10 Project Development

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



Project Development Cycle

11 Energy Purchasing and Procurement Strategies

11.1 Retail Electric Supply Options

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. Though you may choose a different company from which to buy your electric power, responsibility for your facility's interconnection to the grid and repair to local power distribution will still reside with the traditional utility company serving your region.

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

A list of licensed third-party electric suppliers is available at the NJBPU website[16].

11.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey is also deregulated. Most customers that remain with the utility for natural gas service pay rates that are market based and fluctuate monthly. The utility provides basic gas supply service to customers who choose not to buy from a third-party supplier for natural gas commodity.

A customer's decision about whether to buy natural gas from a retail supplier typically depends on whether a customer prefers budget certainty and/or longer-term rate stability. Customers can secure longer-term fixed prices by signing up for service through a third-party retail natural gas supplier. Many larger natural gas customers may seek the assistance of a professional consultant to assist in their procurement process.

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

A list of licensed third-party natural gas suppliers is available at the NJBPU website[17].

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

[17] 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
Compressor Room	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Compressor Room	7	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	3,500	4	None	Yes	7	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	2,415	0.1	476	0	$47	$330	$40	6.1
Exterior Park	5	LED - Fixtures: Outdoor Post-Mount	Timeclock		50	4,380		None	No	5	LED - Fixtures: Outdoor Post-Mount	Timeclock	50	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Pool	5	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch		88	2,000	2	Relamp & Reballast	No	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,000	0.0	590	0	$60	$440	$50	6.5
Lobby	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
Lobby	6	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	3,500	5	None	Yes	6	LED - Linear Tubes: (4) 4' Lamps	High/Low Control	58	2,415	0.1	408	0	$41	$280	$210	1.7
Lobby	2	Metal Halide: (1) 1000W Lamp	Timeclock	S	1,080	4,380	1	Fixture Replacement	No	2	LED - Fixtures: Low-Bay	Timeclock	75	4,380	1.8	9,508	-2	$946	$1,290	$100	1.3
Locker Room 1	4	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	S	9	3,500		None	No	4	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	9	3,500	0.0	0	0	$0	$0	$0	0.0
Locker Room 2	4	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	S	9	3,500		None	No	4	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	9	3,500	0.0	0	0	$0	$0	$0	0.0
Locker Room 3	6	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.4	1,542	0	$153	$860	$100	5.0
Locker Room 4	7	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	7	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.4	1,799	0	$179	$950	$110	4.7
Locker Room 5	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	S	9	3,500		None	No	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	9	3,500	0.0	0	0	$0	$0	$0	0.0
Locker Room Main	1	Compact Fluorescent: (1) 13W Screw-In Lamp	Wall Switch	S	13	3,500	3	Relamp	No	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	9	3,500	0.0	17	0	$2	$30	$0	17.7
Locker Room Main	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
Locker Room Main	13	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	13	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.8	3,341	-1	$332	$1,480	$170	3.9
Locker Room Private	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
Locker Room Private	4	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	40	3,500		None	No	4	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	40	3,500	0.0	0	0	$0	$0	$0	0.0
Locker Room Private	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,500	0.0	0	0	$0	$0	$0	0.0
Mechanical Pool	5	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.3	1,285	0	$128	$770	$90	5.3
Mechanical Pool Heater	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,500	0.1	223	0	$22	$90	$10	3.6
Office - Enclosed 1	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500		None	No	4	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,500	0.0	0	0	$0	$0	$0	0.0
Office - Enclosed 2	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	S	58	3,500		None	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	3,500	0.0	0	0	$0	$0	$0	0.0
Office - Enclosed 3	1	Incandescent: (1) 60W Screw-In Lamp	Wall Switch	S	60	3,500	3	Relamp	No	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	9	3,500	0.0	195	0	$19	$30	$0	1.5
Office - Enclosed Pool	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.1	514	0	$51	$330	$40	5.7
Rental Room	8	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500	4	None	Yes	8	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.1	272	0	$27	$330	$40	10.7

	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
Rental Room 2	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,500	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	3,500	0.0	212	0	$21	$90	$20	3.3
Restroom - Female 1	2	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,500	3, 4	Relamp	Yes	2	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,415	0.1	297	0	$30	$330	$40	9.8
Restroom - Female Pool	5	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.3	1,285	0	$128	$770	$90	5.3
Restroom - Male 1	2	U-Bend Fluorescent - T8: U T8 (32W) - 2L	Wall Switch	S	62	3,500	3, 4	Relamp	Yes	2	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,415	0.1	297	0	$30	$330	$40	9.8
Restroom - Male Pool	5	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.3	1,285	0	$128	$770	$90	5.3
Restroom - Unisex 1	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	S	9	3,500		None	No	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	9	3,500	0.0	0	0	$0	$0	$0	0.0
Restroom - Unisex 2	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.1	514	0	$51	$330	$40	5.7
Restroom - Unisex 3	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.1	514	0	$51	$330	$40	5.7
Rink	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
Rink	1	Incandescent: (1) 200W Fixture	Wall Switch	S	200	3,500		None	No	1	Incandescent: (1) 200W Fixture	Wall Switch	200	3,500	0.0	0	0	$0	$0	$0	0.0
Rink	32	Metal Halide: (1) 1000W Lamp	Wall Switch	S	1,080	3,500	1	Fixture Replacement	No	32	LED - Fixtures: High-Bay	Wall Switch	300	3,500	22.1	94,349	-20	$9,387	$42,060	$4,800	4.0
Rink Exterior	1	High-Pressure Sodium: (1) 250W Lamp	Timeclock		295	4,380	1	Fixture Replacement	No	1	LED - Fixtures: Downlight Surface Mount	Timeclock	75	4,380	0.0	964	0	$98	$250	$10	2.4
Rink Exterior	1	Incandescent: (1) 60W Screw-In Lamp	Wall Switch		60	3,500	3	Relamp	No	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	9	3,500	0.0	180	0	$18	$30	$0	1.6
Rink Exterior	6	Metal Halide: (1) 250W Lamp	Timeclock		295	4,380	1	Fixture Replacement	No	6	LED - Fixtures: Downlight Surface Mount	Timeclock	75	4,380	0.0	5,782	0	$589	$1,520	$30	2.5
Rink Storage	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,500	0.1	223	0	$22	$90	$10	3.6
Snack Bar	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,500	0.1	223	0	$22	$90	$10	3.6
Snack Bar	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,500	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	3,500	0.0	212	0	$21	$90	$20	3.3
Storage Rink 1	1	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	S	176	1,000		None	No	1	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	1,000	0.0	0	0	$0	$0	$0	0.0
Storage Rink 2	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	1,000		None	No	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	1,000	0.0	0	0	$0	$0	$0	0.0
Storage Rink 3	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	1,000		None	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	1,000	0.0	0	0	$0	$0	$0	0.0
Storage Rink 4	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	S	9	1,000		None	No	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	9	1,000	0.0	0	0	$0	$0	$0	0.0
Storage Rink 5	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	S	9	1,000		None	No	1	LED Lamps: (1) 8.5W Screw-In Lamp	Wall Switch	9	1,000	0.0	0	0	$0	$0	$0	0.0
Zamboni Room	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Zamboni Room	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	S	29	3,500		None	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	3,500	0.0	0	0	$0	$0	$0	0.0
Zamboni Room	6	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	88	3,500	2, 4	Relamp & Reballast	Yes	6	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,415	0.4	1,542	0	$153	$860	$100	5.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Party Room	1	Exit Signs: LED - 2 W Lamp	None		6	8,760		None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.0	0	0	$0	$0	$0	0.0
Party Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,500	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	3,500	0.0	212	0	$21	$90	$20	3.3
Storage Party Room	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	114	3,500	3	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	3,500	0.0	212	0	$21	$90	$20	3.3

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
Clary Anderson Arena	Building Exhaust	9	Exhaust Fan	0.50	70.0%	No	Unknown	Unknown	W	2,745		No	70.0%	No		0.0	0	0	$0	$0	$0	0.0
Snack Bar	Snack Bar	1	Kitchen Hood Exhaust Fan	2.00	85.0%	No	National	Unknown	W	5,250	7	No	86.5%	Yes	1	0.0	5,001	4	$559	$4,700	$100	8.2
Compressor Room	For Snow Pit	2	Heating Hot Water Pump	0.17	65.0%	No	Bell & Gosset	M10711	W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Zamboni Room	Lobby	1	Heating Hot Water Pump	0.17	65.0%	No	Bell & Gosset	M10711	W	2,745		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Compressor Room	Ice Rink	2	Other	150.00	95.8%	No	Toshiba	B1506VLF4BSH	W	3,800		No	95.8%	No		0.0	0	0	$0	$0	$0	0.0
Compressor Room	Ice Rink	2	Other	30.00	94.1%	No	US Motors	J368A	W	3,700	6	No	94.1%	Yes	2	13.9	65,998	0	$6,721	$33,400	$3,000	4.5
Compressor Room	Ice Rink	1	Chilled Water Pump	5.00	89.5%	No	Marathon	JVK 184TTDB8D26AA H	W	2,745	6	No	89.5%	Yes	1	0.9	4,290	0	$437	$5,600	$900	10.8
Exterior Pool	Door	1	Other	0.33	65.0%	No	Cornell	MGRL 33 23E	W	5		No	65.0%	No		0.0	0	0	$0	$0	$0	0.0
Mechanical Pool	Pool	1	Other	20.00	90.2%	No	Unknown	Unknown	B	3,391	8	No	93.0%	Yes	1	4.9	22,174	0	$2,258	$13,800	$1,300	5.5
Mechanical Pool	Pool	1	Other	5.00	87.5%	No	Unknown	Unknown	B	2,745	8	No	89.5%	Yes	1	1.2	4,565	0	$465	$6,600	$900	12.3
Rink Exterior	Ice Rink	1	Other	10.00	89.5%	No	Baltimore Aircoil Company	VC1-165	W	3,391		No	89.5%	No		0.0	0	0	$0	$0	$0	0.0
Storage Rink 3	Sprinkler System	1	Other	1.00	85.5%	No	Marathon	SQN	W	0		No	85.5%	No		0.0	0	0	$0	$0	$0	0.0
Locker Room Main	Locker Room 1 & 2	1	Supply Fan	2.00	86.5%	No	Unknown	Unknown	W	2,745		No	86.5%	No		0.0	0	0	$0	$0	$0	0.0
Rink	Locker Room 3 & 4	1	Supply Fan	2.00	86.5%	No	Unknown	Unknown	W	2,745		No	86.5%	No		0.0	0	0	$0	$0	$0	0.0

Packaged HVAC Inventory & Recommendations

		Existing Conditions									Proposed Conditions								Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Manufacturer	Model	Remaining Useful Life	ECM #	Install High Efficiency System?	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBh)	Cooling Mode Efficiency (SEER/IEER/EER)	Heating Mode Efficiency	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Lobby	Lobby	1	Through-the-Wall Air Conditioner	1.00		10.00		Frigidaire	Unknown	B	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	$0	#N/A
Office - Enclosed 1	Office - Enclosed 1	1	Through-the-Wall Air Conditioner	0.67		12.00		Emerson	EARC8RE1	N	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	$0	#N/A
Locker Room 1	Locker Room 1	1	Unit Heater		17.06		1 COP	Dayton	3UF82A	W		No							0.0	0	0	$0	$0	$0	0.0
Locker Room 2	Locker Room 2	1	Unit Heater		17.06		1 COP	Dayton	3UF82A	W		No							0.0	0	0	$0	$0	$0	0.0
Locker Room Private	Locker Room Private	1	Unit Heater		17.06		1 COP	Dayton	3UF82A	W		No							0.0	0	0	$0	$0	$0	0.0
Rink	Rink	1	Unit Heater		40.00		0.8 AFUE	Unknown	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Rink	Rink	1	Unit Heater		40.00		0.8 AFUE	Modine	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Party Room	Party Room	1	Window Air Conditioner	1.00		12.00		Frigidaire	Unknown	W	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	$0	#N/A
Locker Room Main	Locker Room 1 & 2	1	Forced Air Furnace		60.00		0.8 AFUE	Trane	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Rink	Locker Room 3 & 4	1	Forced Air Furnace		60.00		0.8 AFUE	Unknown	Unknown	W		No							0.0	0	0	$0	$0	$0	0.0
Zamboni Room	Zamboni Room	1	Unit Heater		40.00		0.8 AFUE	Reznor	Unknown	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
Zamboni Room	For Snow Pit	1	Non-Condensing Hot Water Boiler	205	Utica Boilers	MGB250HD	W	9	Yes	1	Non-Condensing Hot Water Boiler	205	85.00%	AFUE	0.0	0	44	$486	$11,900	$400	23.6
Compressor Room	Lobby	1	Non-Condensing Hot Water Boiler	200	Caravan	Unknown	W		No						0.0	0	0	$0	$0	$0	0.0

DHW Inventory & Recommendations

		Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Manufacturer	Model	Remaining Useful Life	ECM #	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Compressor Room	Lobby Restrooms	1	Tankless Water Heater	Noritz	NRC83-DV	W		No						0.0	0	0	$0	$0	$0	0.0
Zamboni Room	Locker Rooms	2	Tankless Water Heater	Noritz	NRC83-DV	W		No						0.0	0	0	$0	$0	$0	0.0
Locker Room Main	Locker Rooms	1	Storage Tank Water Heater (> 50 Gal)	Rheem	G75 -76N	N		No						0.0	0	0	$0	$0	$0	0.0
Mechanical Pool Heater	Pool	1	Storage Tank Water Heater (> 50 Gal)	Rheem	G75 -76N	N		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
Clary Anderson Arena	10	8	Showerhead	2.50	1.50	0.0	0	3	$28	$840	$120	26.0
Clary Anderson Arena	10	1	Faucet Aerator (Lavatory)	1.80	0.50	0.0	0	0	$2	$10	$0	6.2
Clary Anderson Arena	10	11	Faucet Aerator (Kitchen)	2.00	1.50	0.0	0	1	$7	$90	$20	10.3
Clary Anderson Arena	10	1	Faucet Aerator (Kitchen)	2.00	1.50	0.0	0	0	$1	$10	$0	16.2

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
Rink Storage	1	Freezer Chest	Electrolux	Unknown	No		No	0.0	0	0	$0	$0	$0	0.0

Cooking Equipment Inventory & Recommendations

	Existing Conditions					Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Equipment Type	Manufacturer	Model	High Efficiency Equipement?	ECM #	Install High Efficiency Equipment?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Snack Bar	1	Gas Fryer	Unknown	Unknown	No		No	0.0	0	0	$0	$0	$0	0.0
Snack Bar	1	Electric Griddle (≤2 Feet Width)	APW	Unknown	No		No	0.0	0	0	$0	$0	$0	0.0
Snack Bar	2	Food Warmer	Unknown	Unknown	No		No	0.0	0	0	$0	$0	$0	0.0
Snack Bar	1	Small Electric Oven	Unknown	Unknown	No		No	0.0	0	0	$0	$0	$0	0.0

Plug Load Inventory

Location	Existing Conditions					
	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Clary Anderson Arena	2	Coffee Machine	600	No	Unknown	Unknown
Locker Room Private	1	Dehumidifier	80	No	Unknown	Unknown
Clary Anderson Arena	7	Desktop	270	No	Unknown	Unknown
Clary Anderson Arena	3	Fan (Ceiling)	40	No	Unknown	Unknown
Rink	1	Fan (Large)	62	No	Unknown	Unknown
Clary Anderson Arena	1	Fan (Portable)	30	No	Unknown	Unknown
Clary Anderson Arena	4	Laptop	100	No	Unknown	Unknown
Office - Enclosed 2	1	Microwave	1,000	No	Unknown	Unknown
Office - Enclosed 1	1	Paper Shredder	400	No	Unknown	Unknown
Clary Anderson Arena	2	Printer (Medium/Small)	125	No	Unknown	Unknown
Office - Enclosed 1	1	Printer/Copier (Large)	600	No	Unknown	Unknown
Office - Enclosed Pool	2	Refrigerator (Mini)	200	No	Unknown	Unknown
Clary Anderson Arena	4	Refrigerator (Residential)	450	No	Unknown	Unknown
Rink	4	Speakers (Large)	200	No	Unknown	Unknown
Clary Anderson Arena	8	Television	200	No	Unknown	Unknown
Office - Enclosed 2	1	Toaster	700	No	Unknown	Unknown
Office - Enclosed 1	1	Water Cooler	192	No	Unknown	Unknown
Clary Anderson Arena	3	Water Fountain	100	No	Unknown	Unknown
Lobby	1	Claw Machine	100	No	Unknown	Unknown
Office - Enclosed 2	1	Sound System	300	No	Unknown	Unknown
Rental Room	1	Skate Sharpener	300	No	Unknown	Unknown
Snack Bar	2	Hand Driers	1,000	No	Unknown	Unknown
Zamboni Room	2	Machine Shop Tools	300	No	Unknown	Unknown

Vending Machine Inventory & Recommendations

Location	Existing Conditions		Proposed Conditions		Energy Impact & Financial Analysis						
	Quantity	Vending Machine Type	ECM #	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Lobby	2	Non-Refrigerated	11	Yes	0.1	685	0	$70	$540	$0	7.7
Rink	1	Non-Refrigerated	11	Yes	0.0	343	0	$35	$270	$0	7.7
Lobby	2	Glass Fronted Refrigerated	11	Yes	0.3	2,418	0	$246	$540	$100	1.8

APPENDIX B: ENERGY STAR STATEMENT OF ENERGY PERFORMANCE

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

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ENERGY STAR® Statement of Energy Performance

N/A

ENERGY STAR® Score[1]

Clary Anderson Arena & Pool

Primary Property Type: Ice/Curling Rink
Gross Floor Area (ft²): 34,000
Built: 1966

For Year Ending: July 31, 2023
Date Generated: August 28, 2024

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

Property & Contact Information

Property Address	Property Owner	Primary Contact
Clary Anderson Arena & Pool 41 Chestnut Street Montclair, New Jersey 07042	Montclair Township 205 Claremont Avenue Montclair, NJ 07042 (973) 509-5721	Lisa Johnson 205 Claremont Avenue Montclair, NJ 07042 (973) 509-5721 ljohnson@montclairnjusa.org

Property ID: 33926146

Energy Consumption and Energy Use Intensity (EUI)

Site EUI 236.1 kBtu/ft²	**Annual Energy by Fuel**		**Annual Emissions**	
	Natural Gas (kBtu)	4,293,181 (54%)	Total (Location-Based) GHG Emissions (Metric Tons CO2e/ year)	556
	Electric - Grid (kBtu)	3,735,152 (46%)		
Source EUI 440.2 kBtu/ft²	**National Median Comparison**		**Green Power**	
	National Median Site EUI (kBtu/ft²)	60.1	Green Power – Onsite (kWh)	N/A
	National Median Source EUI (kBtu/ft²)	112	Green Power – Offsite (kWh)	0
	% Diff from National Median Source EUI	293%	Percent of RECs Retained	N/A

Signature & Stamp of Verifying Professional

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

LP Signature: ______________________Date: ___________

Licensed Professional

____ ________
,
(____)____-______
____

Professional Engineer or Registered Architect Stamp (if applicable)

APPENDIX C: GLOSSARY

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

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

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