Local Government Energy Audit Report

DOT North Region Headquarters

October 11, 2023

Prepared for:

State of New Jersey DOT

200 Stierli Court

Mount Arlington, New Jersey 07856

Prepared by:

TRC

317 George Street

New Brunswick, New Jersey 08901

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 1

1.1 Planning Your Project 4

Pick Your Installation Approach 4
Options from Your Utility Company 4
Prescriptive and Custom Rebates 4
Direct Install 4
Engineered Solutions 4
Options from New Jersey's Clean Energy Program 5

2 Existing Conditions 6

2.1 Site Overview 6

Recent Improvements and Facility Concerns 6

2.2 Building Occupancy 6
2.3 Building Envelope 7
2.4 Lighting Systems 8
2.5 Air Handling Systems 10

Water Source Heat Pumps 10
Air Handling Units (AHUs) 12

2.6 General Building Exhaust Air Systems 13
2.7 Heating Hot Water Systems 13
2.8 Building Automation System (BAS) 14
2.9 Domestic Hot Water 14
2.10 Plug Load and Vending Machines 15
2.11 Water-Using Systems 15

3 Energy Use and Costs 16

3.1 Electricity 18
3.2 Natural Gas 19
3.3 Benchmarking 20

Tracking Your Energy Performance 21

4 Energy Conservation Measures 22

4.1 Lighting 25

ECM 1: Retrofit Fluorescent Fixtures with LED Lamps and Drivers 25
ECM 2: Retrofit Fixtures with LED Lamps 25

4.2 Lighting Controls 26

ECM 3: Install Occupancy Sensor Lighting Controls 26
ECM 4: Install High/Low Lighting Controls 26

4.3 Variable Frequency Drives (VFD) 27

ECM 5: Install VFDs on Constant Volume (CV) Fans 27
ECM 6: Install VFDs on Cooling Tower Fans 27
ECM 7: Install VFDs on WSHP Circulation Pump 28

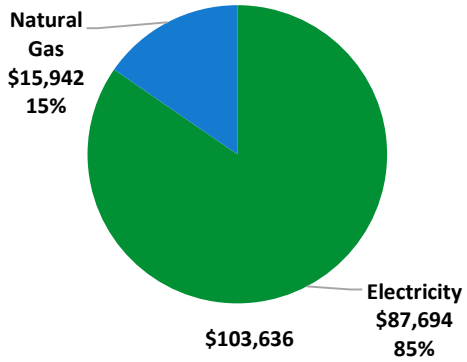
4.4 Unitary HVAC 28
ECM 8: Install High Efficiency Heat Pumps 28
4.5 Gas-Fired Heating 29
ECM 9: Install High Efficiency Hot Water Boilers 29
4.6 HVAC Improvements 29
ECM 10: Install Pipe Insulation 29
4.7 Domestic Water Heating 30
ECM 11: Install Low-Flow DHW Devices 30
4.8 Food Service & Refrigeration Measures 30
ECM 12: Vending Machine Control 30
4.9 Custom Measures 31
ECM 13: Replace Gas Fired Water Heater with Heat Pump Water Heater 31
5 Energy Efficient Best Practices 33
Energy Tracking with ENERGY STAR Portfolio Manager 33
Weatherization 33
Doors and Windows 33
Lighting Maintenance 34
Lighting Controls 34
Motor Controls 34
Motor Maintenance 34
Fans to Reduce Cooling Load 34
Thermostat Schedules and Temperature Resets 34
AC System Evaporator/Condenser Coil Cleaning 35
HVAC Filter Cleaning and Replacement 35
Ductwork Maintenance 35
Boiler Maintenance 35
Label HVAC Equipment 36
Optimize HVAC Equipment Schedules 36
Water Heater Maintenance 36
Water Conservation 37
Procurement Strategies 37
6 On-site Generation 38
6.1 Solar Photovoltaic 39
6.2 Combined Heat and Power 44
7 Electric Vehicles (EV) 45
7.1 Electric Vehicle Charging 45
8 Project Funding and Incentives 47
8.1 Utility Energy Efficiency Programs 48
Prescriptive and Custom 48
Direct Install 48
Engineered Solutions 49
8.2 New Jersey's Clean Energy Programs 50
Large Energy Users 50

Combined Heat and Power 51
Successor Solar Incentive Program (SuSI) 52
Energy Savings Improvement Program 53
9 Project Development 54
10 Energy Purchasing and Procurement Strategies 55
10.1 Retail Electric Supply Options 55
10.2 Retail Natural Gas Supply Options 55
Appendix A: Equipment Inventory & Recommendations A-1
Appendix B: ENERGY STAR Statement of Energy Performance B-1
Appendix C: Additional Scope C-1
Appendix D: Glossary D-1

1 EXECUTIVE SUMMARY

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

BUILDING PERFORMANCE REPORT

Annual Utilities	Costs: $103,636 Electricity: 605,480 kWh Natural Gas: 9,610 Therms	
ENERGY STAR® Benchmarking Score	70 *(1-100 scale)*	Congratulations, your building performs better than the national average. This report has suggestions about how to keep your building running efficiently, further improve performance, and lower your energy bills even more.

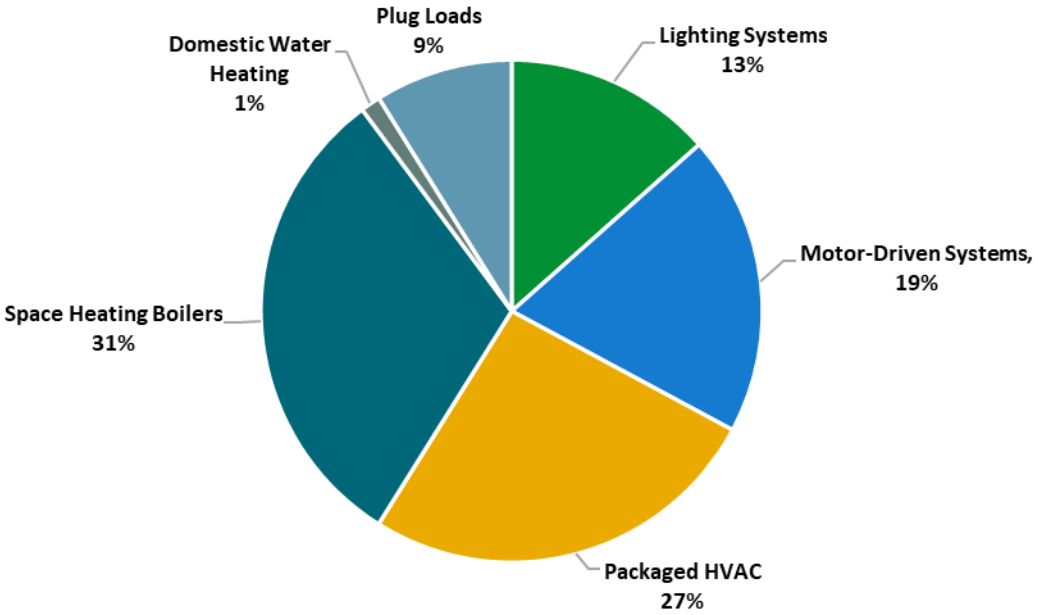


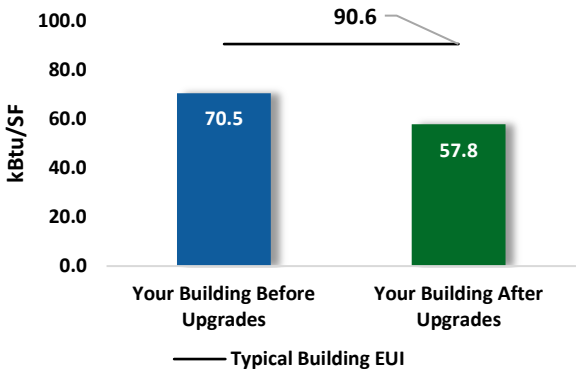
Figure 1 - Energy Use by System

POTENTIAL IMPROVEMENTS

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

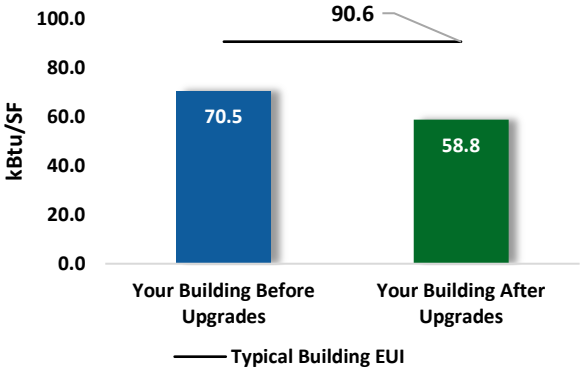
Scenario 1: Full Package (All Evaluated Measures)

Installation Cost	$208,347
Potential Rebates & Incentives[1]	$16,646
Annual Cost Savings	$19,324
Annual Energy Savings	Electricity: 116,524 kWh Natural Gas: 1,475 Therms
Greenhouse Gas Emission Savings	67 Tons
Simple Payback	9.9 Years
Site Energy Savings (All Utilities)	18%



Scenario 2: Cost Effective Package[2]

Installation Cost	$130,319
Potential Rebates & Incentives	$14,470
Annual Cost Savings	$18,555
Annual Energy Savings	Electricity: 115,569 kWh Natural Gas: 1,095 Therms
Greenhouse Gas Emission Savings	65 Tons
Simple Payback	6.2 Years
Site Energy Savings (all utilities)	17%



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			**34,923**	**9.2**	**-7**	**$4,937**	**$14,278**	**$2,814**	**$11,464**	**2.3**	**34,313**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	135	0.1	0	$19	$174	$20	$154	8.1	132
ECM 2	Retrofit Fixtures with LED Lamps	Yes	34,789	9.1	-7	$4,918	$14,104	$2,794	$11,310	2.3	34,180
Lighting Control Measures			**21,806**	**5.5**	**-5**	**$3,083**	**$18,851**	**$2,950**	**$15,901**	**5.2**	**21,424**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	19,505	5.1	-4	$2,757	$16,922	$1,865	$15,057	5.5	19,164
ECM 4	Install High/Low Lighting Controls	Yes	2,301	0.4	0	$325	$1,929	$1,085	$844	2.6	2,261
Variable Frequency Drive (VFD) Measures			**56,885**	**11.5**	**0**	**$8,239**	**$66,852**	**$7,000**	**$59,852**	**7.3**	**57,283**
ECM 5	Install VFDs on Constant Volume (CV) Fans	Yes	18,960	4.9	0	$2,746	$21,530	$2,200	$19,330	7.0	19,093
ECM 6	Install VFDs on Cooling Tower Fans	Yes	7,808	-0.8	0	$1,131	$21,476	$2,400	$19,076	16.9	7,863
ECM 7	Install VFDs on WSHP Circulation Pump	Yes	30,117	7.4	0	$4,362	$23,846	$2,400	$21,446	4.9	30,327
Unitary HVAC Measures			**4,557**	**0.0**	**0**	**$660**	**$75,178**	**$2,176**	**$73,002**	**110.6**	**4,589**
ECM 8	Install High Efficiency Heat Pumps	No	4,557	0.0	0	$660	$75,178	$2,176	$73,002	110.6	4,589
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**112**	**$1,850**	**$29,607**	**$1,584**	**$28,023**	**15.1**	**13,057**
ECM 9	Install High Efficiency Hot Water Boilers	Yes	0	0.0	112	$1,850	$29,607	$1,584	$28,023	15.1	13,057
HVAC System Improvements			**0**	**0.0**	**3**	**$53**	**$61**	**$8**	**$53**	**1.0**	**371**
ECM 10	Install Pipe Insulation	Yes	0	0.0	3	$53	$61	$8	$53	1.0	371
Domestic Water Heating Upgrade			**0**	**0.0**	**7**	**$111**	**$135**	**$64**	**$71**	**0.6**	**784**
ECM 11	Install Low-Flow DHW Devices	Yes	0	0.0	7	$111	$135	$64	$71	0.6	784
Food Service & Refrigeration Measures			**1,954**	**0.2**	**0**	**$283**	**$535**	**$50**	**$485**	**1.7**	**1,968**
ECM 12	Vending Machine Control	Yes	1,954	0.2	0	$283	$535	$50	$485	1.7	1,968
Custom Measures			**-3,601**	**0.0**	**38**	**$109**	**$2,850**	**$0**	**$2,850**	**26.1**	**823**
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater	No	-3,601	0.0	38	$109	$2,850	$0	$2,850	26.1	823
TOTALS (COST EFFECTIVE MEASURES)			**115,569**	**26.4**	**110**	**$18,555**	**$130,319**	**$14,470**	**$115,849**	**6.2**	**129,200**
TOTALS (ALL MEASURES)			**116,524**	**26.4**	**148**	**$19,324**	**$208,347**	**$16,646**	**$191,701**	**9.9**	**134,612**

* - 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).

Figure 2 – Evaluated Energy Improvements

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

1.1 Planning Your Project

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

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

Pick Your Installation Approach

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

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. It 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 DOT North Region Headquarters. 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 May 3, 2023, TRC performed an energy audit at DOT North Region Headquarters located in Mount Arlington, New Jersey. TRC met with Steven Bilenki to review the facility operations and help focus our investigation on specific energy-using systems.

The State of New Jersey Department of Transportation North Region Headquarters located at 200 Stierli Court in Mount Arlington is a two-story, 42,938 square foot building built in 1980. The facility includes a main lobby reception area, enclosed and large open offices, conference rooms, mail rooms, lobbies, electrical and mechanical rooms, storage rooms, and closets.

Lighting is mainly provided by LED fixtures and linear fluorescent T8 fixtures. Heating and cooling are provided mainly by water source heat pumps (WSHPs) with the heating system supplemented by a gas-fired hot water boiler.

Recent Improvements and Facility Concerns

At the time of the visit, lighting systems in corridors, offices, and closets had been retrofitted to LED sources. Since the visit even more LED retrofits have happened throughout the facility.

Facility concern include high electric bills.

2.2 Building Occupancy

The facility is occupied year-round, from Monday to Friday except on holidays. Typical weekday occupancy is 125 staff. It should be noted that the energy and economic analysis for this building is based on the use of the building during the utility billing period, and that results will vary based on changes to building use patterns.

Building Name	Weekday/Weekend	Operating Schedule
DOT North Region Headquarters - General Operating Hours	Weekday	7:30 AM - 4:00 PM
	Weekend	Closed

Figure 3 - Building Occupancy Schedule

2.3 Building Envelope

Building walls are stone covered stucco over structural steel with a glass panel façade that appears in good condition. The roof is supported with steel trusses and finished with a white membrane that is in good condition.

The glass panel walls incorporate windows in some locations; they are slightly tinted to match the appearance of the surrounding wall area and for reduction of solar glare. The entrance glass doors feature a subtle tint, and aluminum framed doors are set in a "storefront" framing system.

Overall, the building envelope is in good condition with no signs of uncontrolled moisture, air leakage, or other energy-compromising issues.

Building Walls

Entrance Door

Roof

2.4 Lighting Systems

The primary interior lighting system uses 32-Watt linear fluorescent T8 lamps and LED fixtures. There are a few 40-Watt T12 fixtures and some LED linear tubes and LED lamps.

Fixture types include 1-lamp, 2-lamp, or 4-lamp, 4-foot-long troffer, recessed, surface mounted fixtures and 2-foot fixtures with U-bend linear tube lamps. Typically, T8 fluorescent lamps use electronic ballasts and T12 fluorescent lamps use magnetic ballasts. The fluorescent T12 fixtures are found in the second-floor boiler room while LED lamps are found in the elevator. LED linear tubes are found in restrooms and staircases. Open areas, offices, and stairways are illuminated by linear fluorescent T8s. Additional open areas and offices are illuminated with fluorescent T8 U-bend lamps. Remaining spaces are lit with linear fluorescent lamps.

Most fixtures are in fair or good condition. Exit signs use LED sources. Interior lighting levels were generally sufficient. Light fixtures in spaces are controlled by manual wall switches.

Exterior fixtures include LED pole mounted and wall pack fixtures. Recessed fixtures have been retrofitted to operate LED PAR lamps. Exterior lighting is controlled by photocells.

Linear T12 Fluorescents

Linear T8 Fluorescents

U-Bend T8 Fluorescents

Linear T8 and LED Fixtures

LED Exit Sign

LED Lamps

Exterior LED Lamp and LED Poles

Wall Switches

Ceiling Mounted Occupancy Sensor

2.5 Air Handling Systems

Water Source Heat Pumps

The building is mainly heated and cooled by 40 water source heat pumps (WSHPs). The WSHPs vary in size and are all mounted above the ceiling. They were not fully accessible during the audit. The capacities and efficiencies have been estimated based on the spaces served. The older units are equipped with compressors that use R-22 refrigerant while the new units are equipped with R-410A refrigerant. The distribution system is a standard closed loop where the loop piping runs inside the building and includes a heat adder (gas-fired boiler), a cooling tower (heat rejecter), pumps, and controls. The units are controlled by a Reliable Controls building automation system (BAS). Some of the original WSHPs have been replaced according to the site. We have evaluated the replacement of eight old units with new efficient WSHPs as the site could not precisely provide the number of old WSHPs that have been replaced.

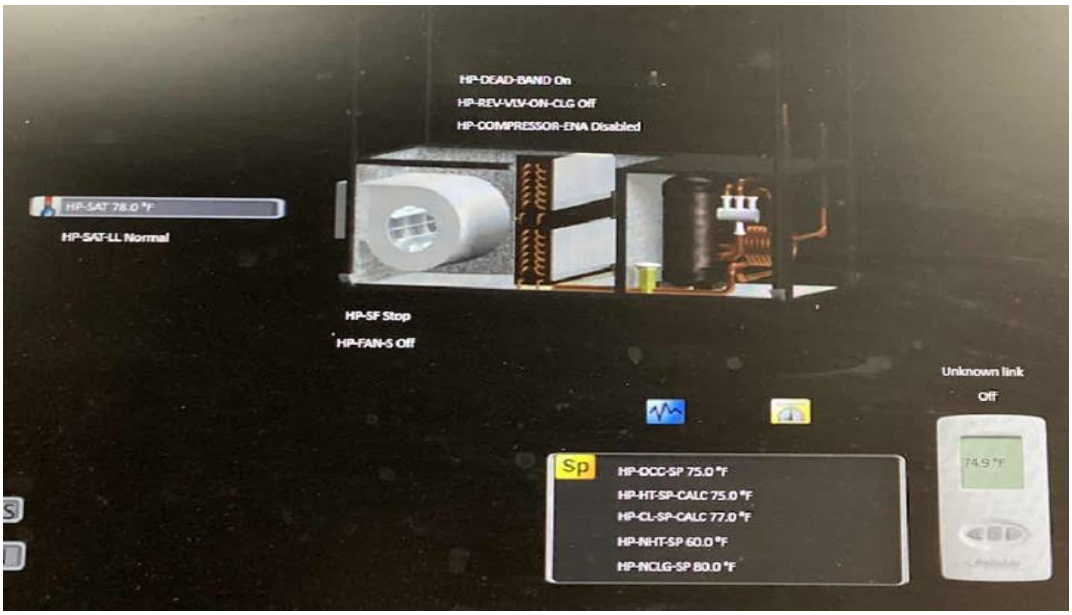
The condenser water system consists of a two-cell cooling tower equipped with one, 25 hp and one, 7.5 hp constant flow fan. The cooling tower is original to the building and appears in good condition. The unit is located on the ground floor. Water is circulated to WSHPs by two, 15 hp constant flow based mounted water circulation pumps located in the mechanical room. The pumps run in automatic lead-lag scheme.

The building cooling and heating temperature setpoint is 70°F.

Nameplate

Above Ceiling Mounted WSHP

15 hp Water Circulation Pumps



BAS Screenshot – WSHP

Cooling Tower

Air Handling Units (AHUs)

Two make-up air (MUA) units labeled “1st floor” and “2nd floor” supply the building with tempered fresh air to offset air that is exhausted by exhaust fans and by other mechanical means. They each have a 5 hp supply fan motor and 3 hp return fan motor that operate at constant speed. The unit appears in fair condition and is controlled by the BAS.

MAU – 1st Floor

Return Fan Label

Supply and Return Fan Motors

2.6 General Building Exhaust Air Systems

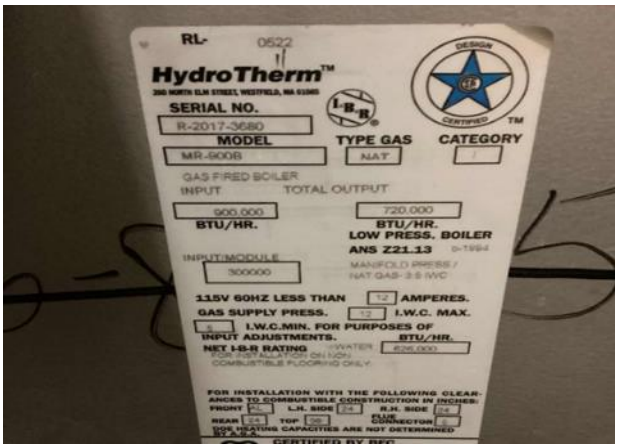
The mail room, restrooms, conference room, closets, and other areas are exhausted by motor driven exhaust fans. Equipment is in good condition and controlled by BAS.

Exhaust Fans

2.7 Heating Hot Water Systems

A 720 MBh gas-fired hot water boiler is used as a heat adder to supplement the WSHP heating loop when the temperature approaches the lower limit.

Water source heat pump units are connected to a water distribution loop which circulates water throughout the building to transfer heat from one area to another. This common water loop provides what is essentially a heat-recovery system. Units providing heating extract heat from loop water while units providing cooling reject heat to the loop. The boiler is in poor condition and has been evaluated for replacement. The heating hot water loop is controlled by the BAS.

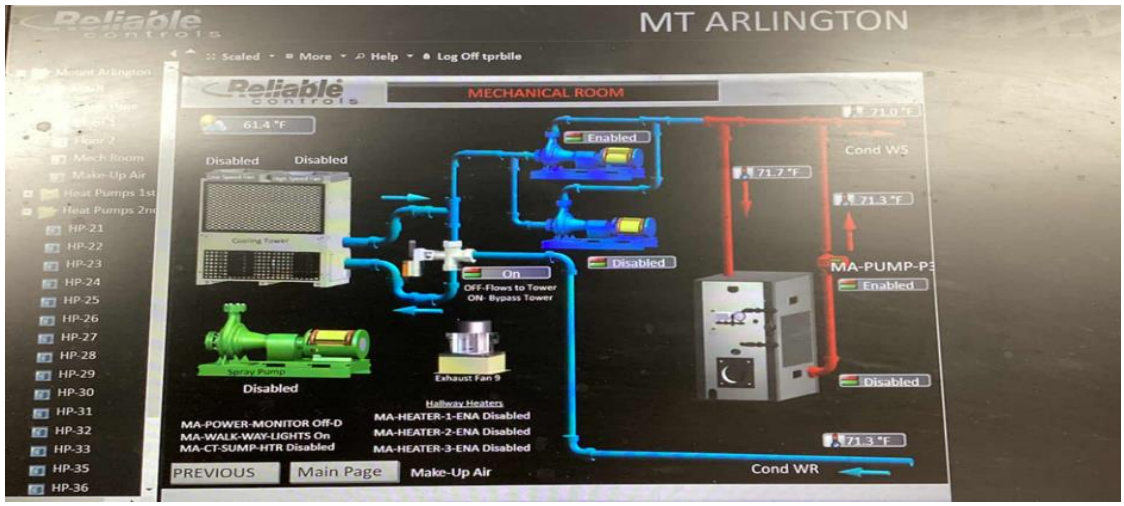


720 MBh Gas-Fired Boiler

2.8 Building Automation System (BAS)

A Reliable Controls BAS controls the HVAC equipment, boiler, cooling tower, WSHPs, and MA Heater. The BAS provides equipment scheduling control and monitors and controls space temperatures, supply air temperatures, humidity, heating water loop temperatures, and condenser water loop temperatures.

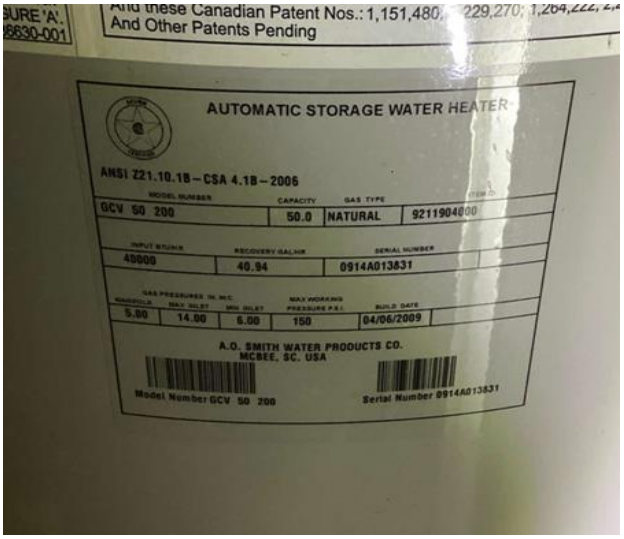
Site staff expressed an interest in expanding the level of control provided by the BAS or by replacing the BAS. They also indicated an interest in receiving additional training.



BAS Screenshot – Mechanical Room

2.9 Domestic Hot Water

Hot water is produced by a 50-gallon 40 MBh gas-fired storage water heater. This unit is in the 2nd floor boiler room. The domestic hot water pipes are not insulated. A fractional hp circulation pump distributes continuously distributes heated water to end uses.



Domestic Water Heater

2.10 Plug Load and Vending Machines

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

There are 120 computer workstations throughout the facility. Plug loads include general café and office equipment such as copiers, printers, microwaves, coffee machines, paper shredders, mini refrigerators, televisions, and water coolers. There are three residential-style refrigerators throughout the building that are used to store food and beverages. These vary in condition and efficiency. The first-floor lab has temperature control devices.

There are two vending machines in the lunchroom - one refrigerated and one non-refrigerated. Vending machines are not equipped with occupancy-based controls.

Temperature Control Devices

Vending Machines

2.11 Water-Using Systems

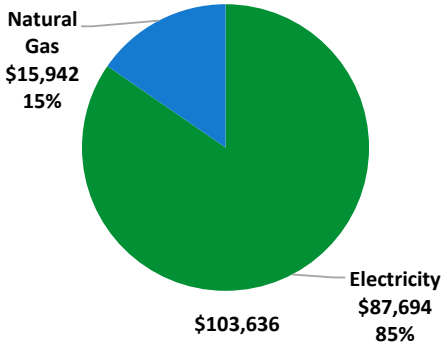
There are several restrooms with toilets, urinals, and sinks. Faucet flows are rated as high. Toilets are rated at 2.0 gallons per flush (gpf) and urinals are rated at 2.0 gpf.

Typical Restroom Sink

3 Energy Use and Costs

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

Utility Summary		
Fuel	**Usage**	**Cost**
Electricity	605,480 kWh	$87,694
Natural Gas	9,610 Therms	$15,942
Total		**$103,636**



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

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

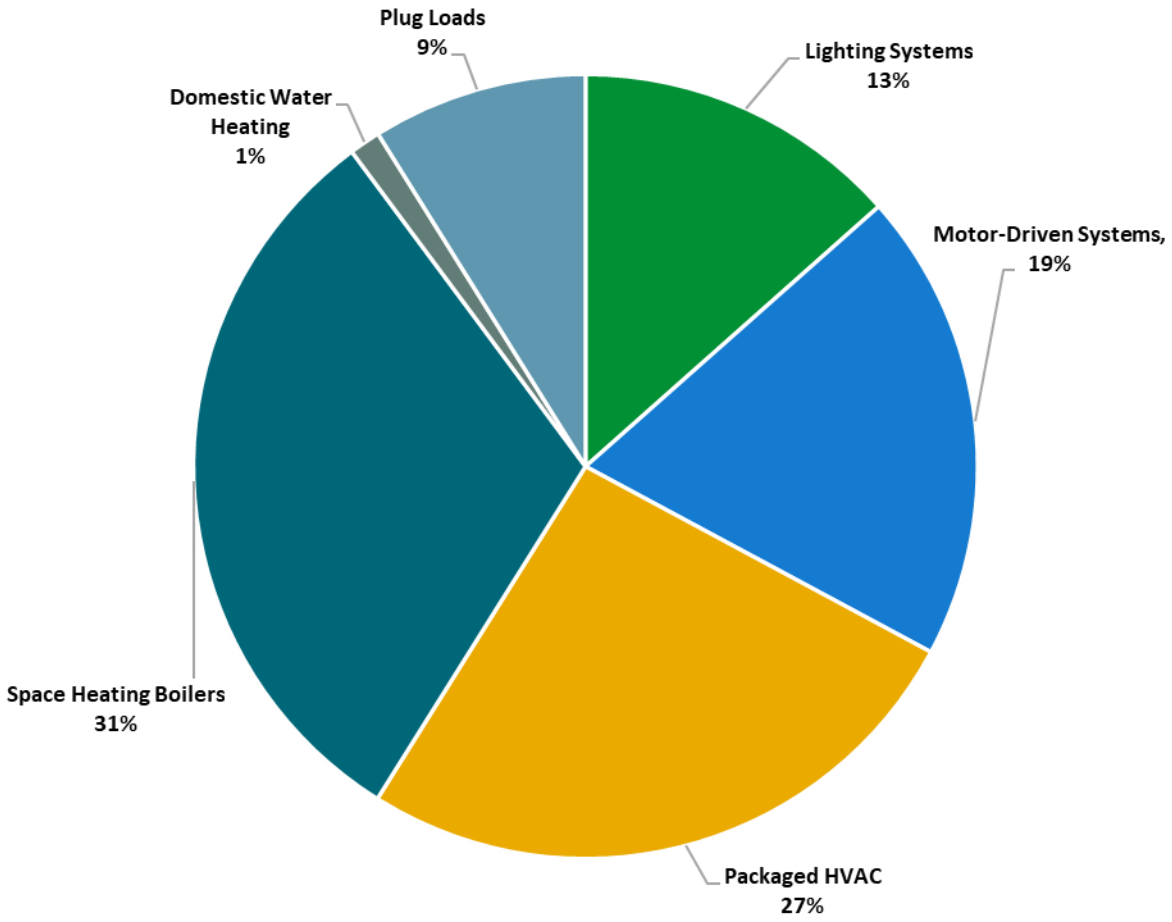
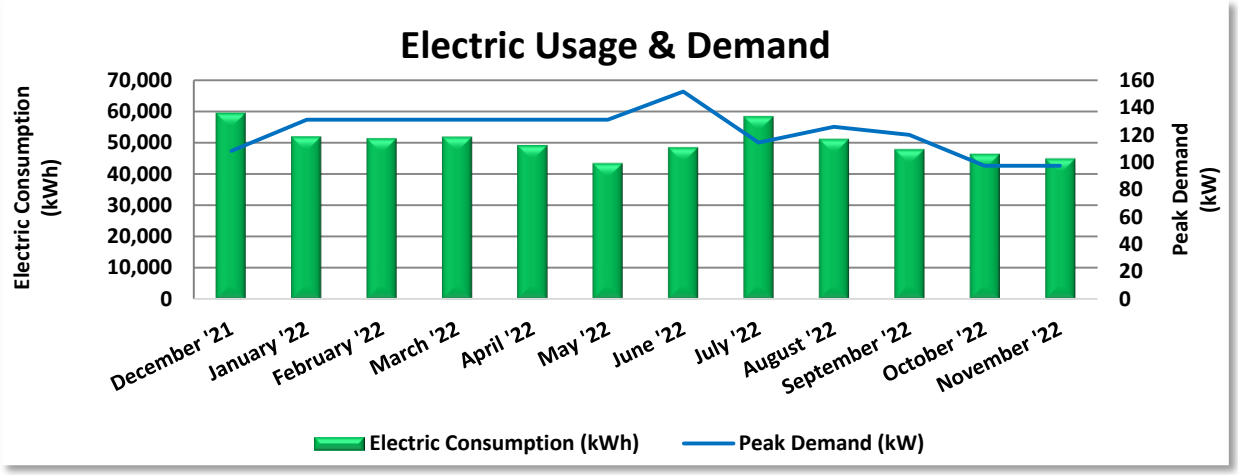


Figure 4 - Energy Balance

3.1 Electricity

JCP&L delivers electricity under rate class General Service Secondary 3 Phase JC_GS3_01D, with electric production provided by Champion, a third-party supplier.



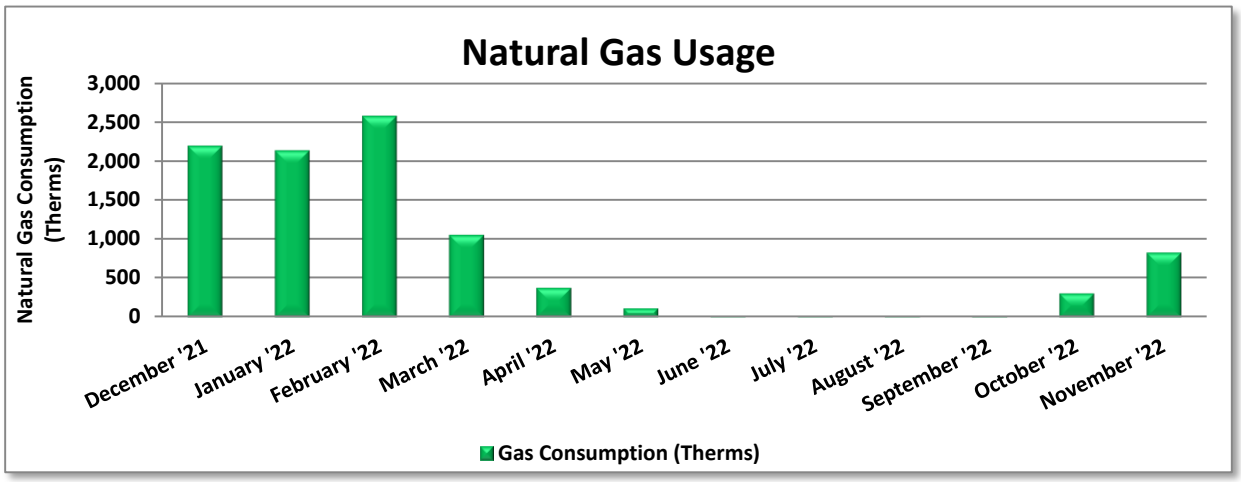
Electric Billing Data					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
12/22/21	29	59,403	108	$800	$6,786
1/25/22	34	51,874	131	$968	$7,629
2/22/22	28	51,336	131	$968	$7,561
3/24/22	30	51,778	131	$968	$7,617
4/25/22	32	49,149	131	$968	$7,286
5/25/22	30	43,370	131	$968	$6,559
6/24/22	30	48,411	152	$1,202	$7,536
7/27/22	33	58,371	115	$907	$8,519
8/25/22	29	51,103	126	$998	$7,567
9/23/22	29	47,852	120	$951	$7,122
10/25/22	32	46,341	98	$720	$6,727
11/22/22	28	44,833	98	$720	$6,545
Totals	**364**	**603,821**	**152**	**$11,135**	**$87,454**
Annual	**365**	**605,480**	**152**	**$11,165**	**$87,694**

Notes:

- Peak demand of 152 kW occurred in June '22.
- Average demand over the past 12 months was 123 kW.
- The average electric cost over the past 12 months was $0.145/kWh, which is the blended rate that includes energy supply, distribution, demand, and other charges. This report uses this blended rate to estimate energy cost savings.

3.2 Natural Gas

NJ Natural Gas delivers natural gas under rate class GSL, with natural gas supply provided by UGI, a third-party supplier.



Gas Billing Data			
Period Ending	Days in Period	Natural Gas Usage (Therms)	Natural Gas Cost
12/29/21	30	2,194	$2,194
1/31/22	33	2,135	$2,960
2/28/22	28	2,577	$3,476
3/29/22	29	1,054	$1,721
4/27/22	29	378	$942
5/26/22	29	114	$637
6/27/22	32	4	$512
7/28/22	31	4	$512
8/29/22	32	4	$512
9/27/22	29	10	$398
10/27/22	30	305	$738
11/29/22	33	829	$1,338
Totals	**365**	**9,610**	**$15,942**
Annual	**365**	**9,610**	**$15,942**

Notes:

- The average gas cost for the past 12 months is $1.659/therm, which is the blended rate used throughout the analysis.

3.3 Benchmarking

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

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

Benchmarking Score	70

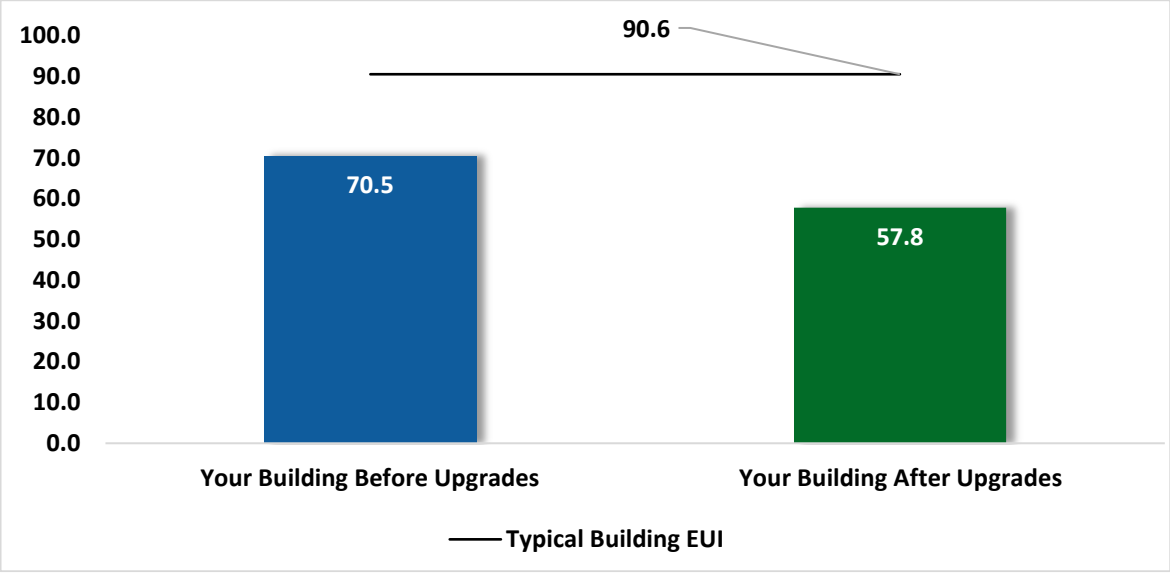


Figure 5 - Energy Use Intensity Comparison[3]

Congratulations, your building performs better than the national average. This report has suggestions about how to keep your building running efficiently, further improve performance, and lower your energy bills even more.

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

[3] Based on all evaluated ECMs

Tracking Your Energy Performance

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

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

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

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

4 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			**34,923**	**9.2**	**-7**	**$4,937**	**$14,278**	**$2,814**	**$11,464**	**2.3**	**34,313**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	135	0.1	0	$19	$174	$20	$154	8.1	132
ECM 2	Retrofit Fixtures with LED Lamps	Yes	34,789	9.1	-7	$4,918	$14,104	$2,794	$11,310	2.3	34,180
Lighting Control Measures			**21,806**	**5.5**	**-5**	**$3,083**	**$18,851**	**$2,950**	**$15,901**	**5.2**	**21,424**
ECM 3	Install Occupancy Sensor Lighting Controls	Yes	19,505	5.1	-4	$2,757	$16,922	$1,865	$15,057	5.5	19,164
ECM 4	Install High/Low Lighting Controls	Yes	2,301	0.4	0	$325	$1,929	$1,085	$844	2.6	2,261
Variable Frequency Drive (VFD) Measures			**56,885**	**11.5**	**0**	**$8,239**	**$66,852**	**$7,000**	**$59,852**	**7.3**	**57,283**
ECM 5	Install VFDs on Constant Volume (CV) Fans	Yes	18,960	4.9	0	$2,746	$21,530	$2,200	$19,330	7.0	19,093
ECM 6	Install VFDs on Cooling Tower Fans	Yes	7,808	-0.8	0	$1,131	$21,476	$2,400	$19,076	16.9	7,863
ECM 7	Install VFDs on WSHP Circulation Pump	Yes	30,117	7.4	0	$4,362	$23,846	$2,400	$21,446	4.9	30,327
Unitary HVAC Measures			**4,557**	**0.0**	**0**	**$660**	**$75,178**	**$2,176**	**$73,002**	**110.6**	**4,589**
ECM 8	Install High Efficiency Heat Pumps	No	4,557	0.0	0	$660	$75,178	$2,176	$73,002	110.6	4,589
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**112**	**$1,850**	**$29,607**	**$1,584**	**$28,023**	**15.1**	**13,057**
ECM 9	Install High Efficiency Hot Water Boilers	Yes	0	0.0	112	$1,850	$29,607	$1,584	$28,023	15.1	13,057
HVAC System Improvements			**0**	**0.0**	**3**	**$53**	**$61**	**$8**	**$53**	**1.0**	**371**
ECM 10	Install Pipe Insulation	Yes	0	0.0	3	$53	$61	$8	$53	1.0	371
Domestic Water Heating Upgrade			**0**	**0.0**	**7**	**$111**	**$135**	**$64**	**$71**	**0.6**	**784**
ECM 11	Install Low-Flow DHW Devices	Yes	0	0.0	7	$111	$135	$64	$71	0.6	784
Food Service & Refrigeration Measures			**1,954**	**0.2**	**0**	**$283**	**$535**	**$50**	**$485**	**1.7**	**1,968**
ECM 12	Vending Machine Control	Yes	1,954	0.2	0	$283	$535	$50	$485	1.7	1,968
Custom Measures			**-3,601**	**0.0**	**38**	**$109**	**$2,850**	**$0**	**$2,850**	**26.1**	**823**
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater	No	-3,601	0.0	38	$109	$2,850	$0	$2,850	26.1	823
TOTALS			**116,524**	**26.4**	**148**	**$19,324**	**$208,347**	**$16,646**	**$191,701**	**9.9**	**134,612**

* - 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).

Figure 6 – All Evaluated ECMs

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**34,923**	**9.2**	**-7**	**$4,937**	**$14,278**	**$2,814**	**$11,464**	**2.3**	**34,313**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	135	0.1	0	$19	$174	$20	$154	8.1	132
ECM 2	Retrofit Fixtures with LED Lamps	34,789	9.1	-7	$4,918	$14,104	$2,794	$11,310	2.3	34,180
Lighting Control Measures		**21,806**	**5.5**	**-5**	**$3,083**	**$18,851**	**$2,950**	**$15,901**	**5.2**	**21,424**
ECM 3	Install Occupancy Sensor Lighting Controls	19,505	5.1	-4	$2,757	$16,922	$1,865	$15,057	5.5	19,164
ECM 4	Install High/Low Lighting Controls	2,301	0.4	0	$325	$1,929	$1,085	$844	2.6	2,261
Variable Frequency Drive (VFD) Measures		**56,885**	**11.5**	**0**	**$8,239**	**$66,852**	**$7,000**	**$59,852**	**7.3**	**57,283**
ECM 5	Install VFDs on Constant Volume (CV) Fans	18,960	4.9	0	$2,746	$21,530	$2,200	$19,330	7.0	19,093
ECM 6	Install VFDs on Cooling Tower Fans	7,808	-0.8	0	$1,131	$21,476	$2,400	$19,076	16.9	7,863
ECM 7	Install VFDs on WSHP Circulation Pump	30,117	7.4	0	$4,362	$23,846	$2,400	$21,446	4.9	30,327
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**112**	**$1,850**	**$29,607**	**$1,584**	**$28,023**	**15.1**	**13,057**
ECM 9	Install High Efficiency Hot Water Boilers	0	0.0	112	$1,850	$29,607	$1,584	$28,023	15.1	13,057
HVAC System Improvements		**0**	**0.0**	**3**	**$53**	**$61**	**$8**	**$53**	**1.0**	**371**
ECM 10	Install Pipe Insulation	0	0.0	3	$53	$61	$8	$53	1.0	371
Domestic Water Heating Upgrade		**0**	**0.0**	**7**	**$111**	**$135**	**$64**	**$71**	**0.6**	**784**
ECM 11	Install Low-Flow DHW Devices	0	0.0	7	$111	$135	$64	$71	0.6	784
Food Service & Refrigeration Measures		**1,954**	**0.2**	**0**	**$283**	**$535**	**$50**	**$485**	**1.7**	**1,968**
ECM 12	Vending Machine Control	1,954	0.2	0	$283	$535	$50	$485	1.7	1,968
TOTALS		**115,569**	**26.4**	**110**	**$18,555**	**$130,319**	**$14,470**	**$115,849**	**6.2**	**129,200**

* - 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).

Figure 7 – Cost Effective ECMs

4.1 Lighting

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**34,923**	**9.2**	**-7**	**$4,937**	**$14,278**	**$2,814**	**$11,464**	**2.3**	**34,313**
ECM 1	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	135	0.1	0	$19	$174	$20	$154	8.1	132
ECM 2	Retrofit Fixtures with LED Lamps	34,789	9.1	-7	$4,918	$14,104	$2,794	$11,310	2.3	34,180

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: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

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

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

Affected Building Areas: T-12 fixtures and boiler room

ECM 2: Retrofit Fixtures with LED Lamps

Replace fluorescent T8 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: open areas, offices, storage rooms and staircase

Additional Notes: It should be noted that the facility has done a significant amount of upgrades to their lighting systems since the site visit. Most lighting sources are now LED.

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		**21,806**	**5.5**	**-5**	**$3,083**	**$18,851**	**$2,950**	**$15,901**	**5.2**	**21,424**
ECM 3	Install Occupancy Sensor Lighting Controls	19,505	5.1	-4	$2,757	$16,922	$1,865	$15,057	5.5	19,164
ECM 4	Install High/Low Lighting Controls	2,301	0.4	0	$325	$1,929	$1,085	$844	2.6	2,261

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

ECM 3: Install Occupancy Sensor Lighting Controls

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

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

Occupancy sensors can be mounted on the wall at existing switch locations, 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: offices, conference rooms, lunchroom, staircases, and open areas

ECM 4: Install High/Low Lighting Controls

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

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

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

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

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

Affected Building Areas: hallways and stairwells

4.3 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		**56,885**	**11.5**	**0**	**$8,239**	**$66,852**	**$7,000**	**$59,852**	**7.3**	**57,283**
ECM 5	Install VFDs on Constant Volume (CV) Fans	18,960	4.9	0	$2,746	$21,530	$2,200	$19,330	7.0	19,093
ECM 6	Install VFDs on Cooling Tower Fans	7,808	-0.8	0	$1,131	$21,476	$2,400	$19,076	16.9	7,863
ECM 7	Install VFDs on WSHP Circulation Pump	30,117	7.4	0	$4,362	$23,846	$2,400	$21,446	4.9	30,327

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

ECM 5: Install VFDs on Constant Volume (CV) Fans

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

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

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

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

Affected Air Handlers: MAU, supply and return fans

ECM 6: Install VFDs on Cooling Tower Fans

Install a VFD to control both cooling tower fan motors. The VFD will allow the cooling tower fan to operate at the minimum speed necessary to maintain the temperature of the condenser water returning to the chiller.

Energy savings result from reducing fan speed (and power) when there is a reduced load on the chiller and outside air wet bulb temperatures are depressed. The magnitude of energy savings is based on the estimated amount of time that the system will operate at reduced load.

ECM 7: Install VFDs on WSHP Circulation Pump

Install VFDs to control water source heat pump circulation and loop pumps. Two-way valves must be used to control flow to individual heat pumps, and the distribution system must have a differential pressure sensor installed. If three-way valves or a bypass leg are used in the distribution loop, they will need to be modified when this measure is implemented.

Energy savings result from reducing water flow to individual heat pumps when they are not in use. As the distribution loop valves close, the differential pressure increases, and the VFD modulates the pump speed to maintain a differential pressure setpoint. Incorporate sensors as required to maintain flow and loop temperatures.

Additional Notes: For VFD measures, it is recommended that you work with your design team, specialists, and contractors to ensure that the measure will work with your existing systems.

4.4 Unitary HVAC

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Unitary HVAC Measures		**4,557**	**0.0**	**0**	**$660**	**$75,178**	**$2,176**	**$73,002**	**110.6**	**4,589**
ECM 8	Install High Efficiency Heat Pumps	4,557	0.0	0	$660	$75,178	$2,176	$73,002	110.6	4,589

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

ECM 8: Install High Efficiency Heat Pumps

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

Affected Units: eight 4-ton water source heat pumps serving first floor

4.5 Gas-Fired Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**112**	**$1,850**	**$29,607**	**$1,584**	**$28,023**	**15.1**	**13,057**
ECM 9	Install High Efficiency Hot Water Boilers	0	0.0	112	$1,850	$29,607	$1,584	$28,023	15.1	13,057

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 replacing the boiler on a one-for-one basis with equipment of the same capacity using a condensing boiler. 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.

4.6 HVAC Improvements

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
HVAC System Improvements		**0**	**0.0**	**3**	**$53**	**$61**	**$8**	**$53**	**1.0**	**371**
ECM 10	Install Pipe Insulation	0	0.0	3	$53	$61	$8	$53	1.0	371

ECM 10: Install Pipe Insulation

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

Affected Systems: domestic hot water piping

4.7 Domestic Water Heating

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**7**	**$111**	**$135**	**$64**	**$71**	**0.6**	**784**
ECM 11	Install Low-Flow DHW Devices	0	0.0	7	$111	$135	$64	$71	0.6	784

ECM 11: Install Low-Flow DHW Devices

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

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

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

Additional cost savings may result from reduced water usage.

4.8 Food Service & Refrigeration Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Food Service & Refrigeration Measures		**1,954**	**0.2**	**0**	**$283**	**$535**	**$50**	**$485**	**1.7**	**1,968**
ECM 12	Vending Machine Control	1,954	0.2	0	$283	$535	$50	$485	1.7	1,968

ECM 12: 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 they 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.

4.9 Custom Measures

#	Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated M&L Cost ($)	Estimated Incentive ($)*	Estimated Net M&L Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Custom Measures		**-3,601**	**0.0**	**38**	**$109**	**$2,850**	**$0**	**$2,850**	**26.1**	**823**
ECM 13	Replace Gas Fired Water Heater with Heat Pump Water Heater	-3,601	0.0	38	$109	$2,850	$0	$2,850	26.1	823

ECM 13: Replace Gas Fired Water Heater with Heat Pump Water Heater

We evaluated replacing the gas fired water heater with a heat pump water heater. A gas fired water heater uses a burner to heat water. Air source heat pump water heaters (HPWH) 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.*[4]

[4] 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[5]. 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 in order 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 [6]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.

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

[6] 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.

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

Weatherization

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

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

Lighting Maintenance

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

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

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 Controls

Electric motors often run unnecessarily, and this is an overlooked opportunity to save energy. These motors should be identified and turned off when appropriate. For example, exhaust fans often run unnecessarily when ventilation requirements are already met. Whenever possible, use automatic devices such as twist timers or occupancy sensors to turn off motors when they are not needed.

Motor Maintenance

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

Fans to Reduce Cooling Load

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

Thermostat Schedules and Temperature Resets

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

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.

Label HVAC Equipment

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

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

Optimize HVAC Equipment Schedules

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

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

Water Heater Maintenance

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

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

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

- For water heaters more than three years old, have a technician inspect the sacrificial anode annually.

Water Conservation

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

For more information regarding water conservation go to the EPA's WaterSense website[8] or download a copy of EPA's "WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities"[9] to get ideas for creating a water management plan and best practices for a wide range of water using systems.

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

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

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

Procurement Strategies

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

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

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

6 On-site Generation

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

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

6.1 Solar Photovoltaic

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

An additional study for solar photovoltaic for DOT's North Region Headquarters is provided below.

Executive Summary

This section summarizes projected energy and cost impacts, as well as design considerations, for a proposed 450 kW-DC carport solar photovoltaic (PV) system and 300 kWh battery energy storage system (BESS) for the NJDOT North Region Headquarters site located at 200 Stierli Ct, Mt Arlington, NJ 07856. Please note this is a feasibility study and all cost/savings values are solely estimates and not for design level application.

Two pieces of equipment contribute to the system:

- 450 kW Carport Solar PV System: The carport-mounted solar panels are strategically positioned to make the most efficient use of the parking space, maximizing the coverage of solar energy generation. This setup also works towards achieving Net Zero Energy consumption for the site.
- 300 kWh BESS: The battery was sized to maximize the system's financial return by storing excess energy generation and discharging at peak utility cost periods. Additionally, it was sized to power the site for two hours during the event of an outage.

Equipment	Estimated Max Demand Savings (kW)	Estimated Annual Energy Generation (kWh)	Estimated Annual GHG Reduction ($MT\text{-}CO_2e$)	Estimated Annual Cost Savings ($)	Estimated Gross Project Cost ($)	Total Incentives ($)	Net Project Cost ($)	Simple Payback Period[10] (yr.)
450 kW Solar PV	21	604,794	120	$64,167	$2,455,075	$1,350,291	$1,104,784	17.2
300 kWh Battery	58	0	0	$690	$363,925	$200,159	$163,766	237.3
Total	58	604,794	120	$64,857	$2,819,000	$1,550,450	$1,268,550	19.6

Project Summary Table

[10] Simple payback is computed as the "Net Project Cost" divided by the "Estimated Annual Cost Savings".

Equipment	Estimated Gross Project Cost ($)	ITC Rebate (1)	MACRS Rebate (2)	Net Project Cost
450 kW Solar PV	$2,455,075	$736,523	$613,769	$1,104,784
300 kWh Battery	$363,925	$109,177	$90,981	$163,766
Total	$2,819,000	$845,700	$704,750	$1,268,550

Incentive Summary Table

Some incentives are available to reduce the project cost:

1. Federal Income Tax Credit (ITC): As of the passage of the 2022 Inflation Reduction Act, the ITC refund can be claimed by non-taxable entities as a cash rebate. The ITC is equal to 30% of the system cost and is scheduled to persist until 2033.
2. Modified Accelerated Cost Recovery System (MACRS): As of the passage of the 2022 Inflation Reduction Act, the MACRS refund can be claimed by non-taxable entities as a cash rebate. This rebate allows 85% of the system cost to be claimed as equipment depreciation at Year 1, approximately equivalent to 25% of the system cost.

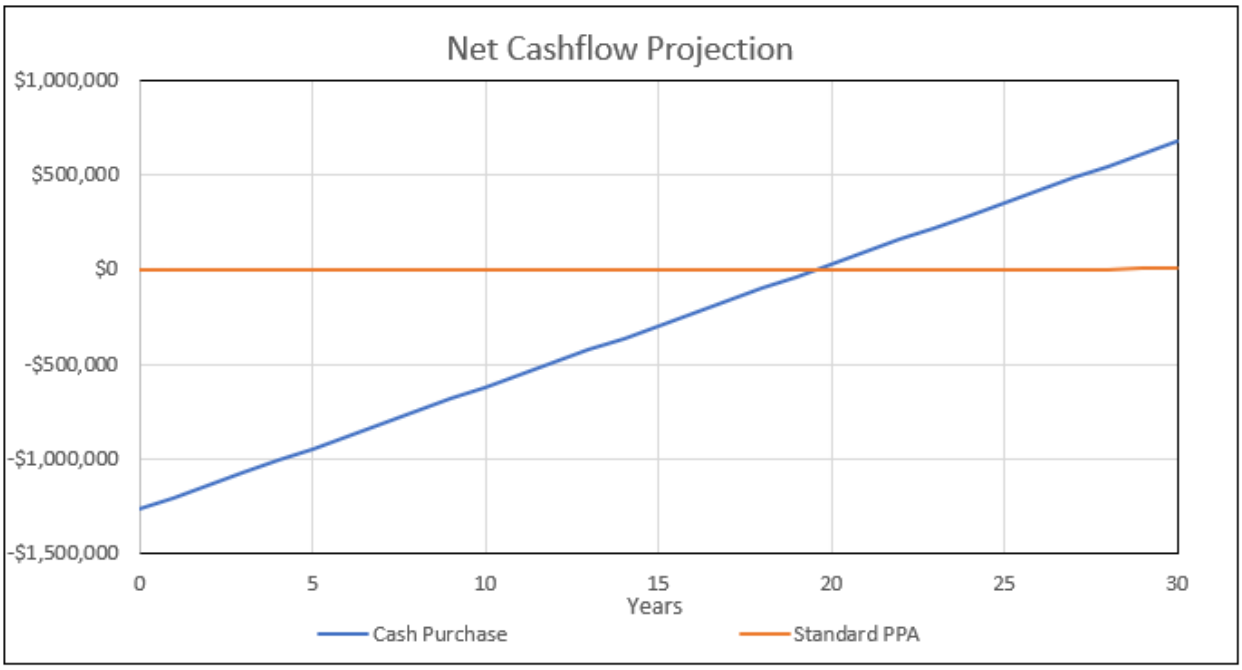
Ownership Models

This report explores two ownership models: Cash Purchase and Power Purchase Agreement (PPA).

- Cash Purchase: In this case, the entire system is purchased upfront by the customer.
- Standard Power Purchase Agreement: In this scenario, a third party installs and owns the system, and sells electricity to the customer at a reduced rate. Calculations assume the owner charges a 3% interest rate on the system. In the table below, the interest rate is factored in as an offset to the "Annual Savings ($)". Return on Investment (ROI) is null because there is no cost to the customer.

Ownership Plan	Upfront Gross Project Cost ($)	Year 1 Cost After Rebates ($)	Annual Savings ($)	Lifetime 30-Year Cost Savings ($)	30-Year ROI
Cash Purchase	$2,819,000	$1,268,550	$64,857	$1,945,709	153%
PPA	$0	$0	$136	$4,095	-

Ownership Model Table



Ownership Model Life Cycle Comparison

Emergency Backup System Sizing

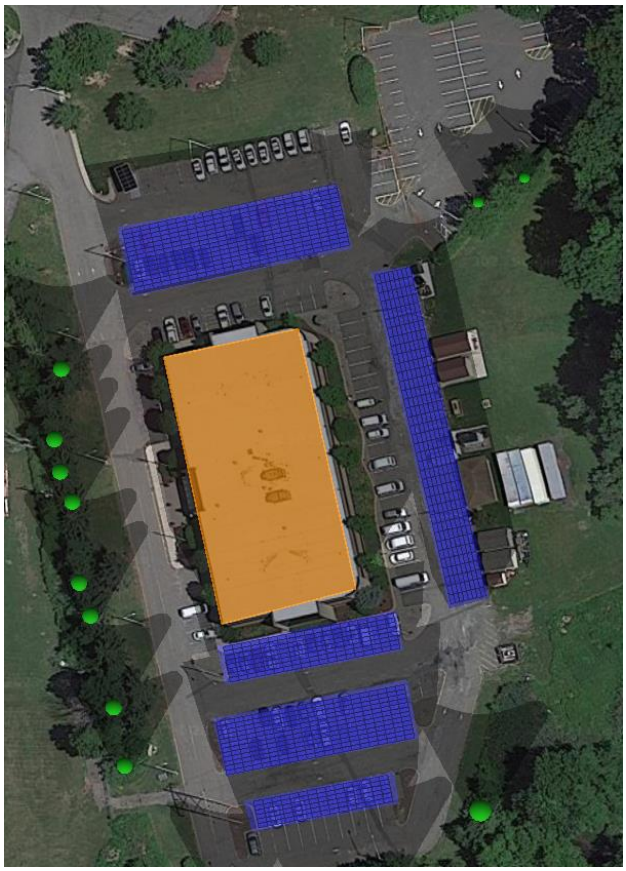
As per the most recent 12-month utility data, peak demand is around 150 kW. Therefore, a 300-kWh emergency backup system would be sufficient to power the site for two hours at peak demand.

PV System Sizing

TRC modeled the proposed solar PV system using HelioScope, a meteorologically and location-dependent solar resource, to estimate its available size and component quantities. The software accounts for building shading, tree shading, panel angles, and appropriate spacing. Please note that the PV system has been sized for achieving Net Zero Energy consumption for the site and there is also extra capacity available to support an additional 130 kW of carport-mounted PV panels.

Project Coordination

As per TRC's cost analysis, some of the cost associated with installing the battery system (i.e., trenching, wiring and site preparation) can be shared with PV installation work. The cost estimate assumes the projects will be implemented concurrently.



Solar PV Layout Figure – HelioScope Design

Energy Generation and Management

A HelioScope model was developed to establish approximate PV system sizing. The output was entered into Energy Toolbase® (ETB), a TOU BESS and utility cost analysis tool that compares the generation profile vs the building's monthly consumption data. Because the site's energy generation rate structure and energy delivery rate structure are provided by different firms, ETB's estimate of baseline utility cost varied from available billing data by 8%, potentially due to rate schedule changes. ETB outputs were supplemented with worksheet calculations to true up the difference.

Cost savings were finalized by applying an 0.5% annual maintenance cost penalty to the solar PV system, and an 0.25% annual maintenance cost penalty to the BESS. The ETB analysis was used to simulate BESS operation throughout the year and to calculate utility cost savings with hourly utility rate sensitivity.

Project Cost

Project cost estimates were calculated using RS Means 2022 Construction Cost Catalogue, along with vendor quotes and guidelines available from the modeling software. Costs include contingencies and markups for all potential project tasks, including design, permitting, taxes, and a 30% contingency for infrastructure upgrades. A line-by-line breakdown of the costs considered is provided in Appendix C.

At a high level, average system costs are $5.46/Watt solar PV, and $1,213/kWh BESS, based on the gross project cost. Please note that while detailed, cost estimates are still at the feasibility stage. Costs may vary by 30% relative to engineering assessments of the electrical and structural infrastructure.

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

6.2 Combined Heat and Power

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

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

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

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

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

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

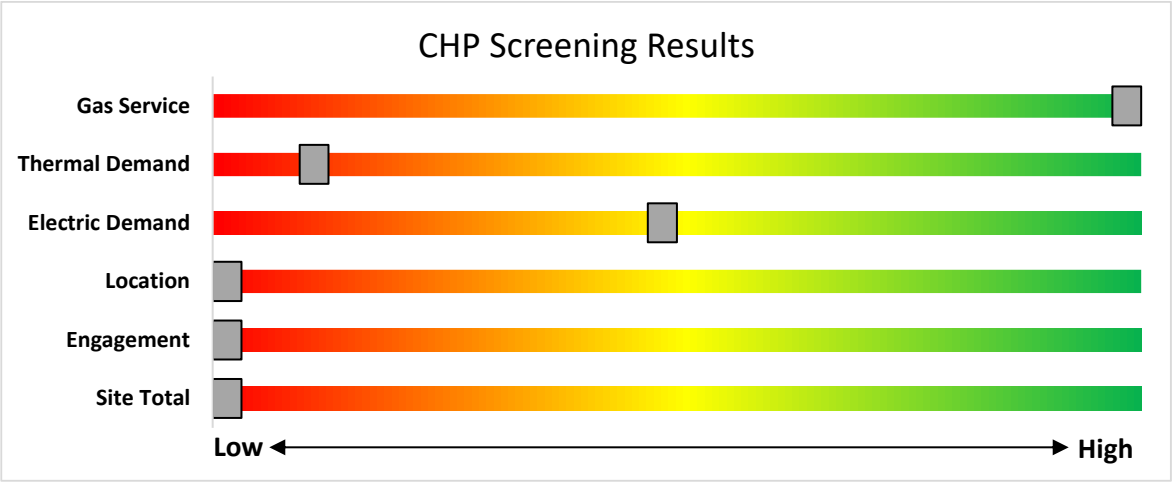


Figure 8 - Combined Heat and Power Screening

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

7 Electric Vehicles (EV)

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.

7.1 Electric Vehicle Charging

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

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

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

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

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

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

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

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

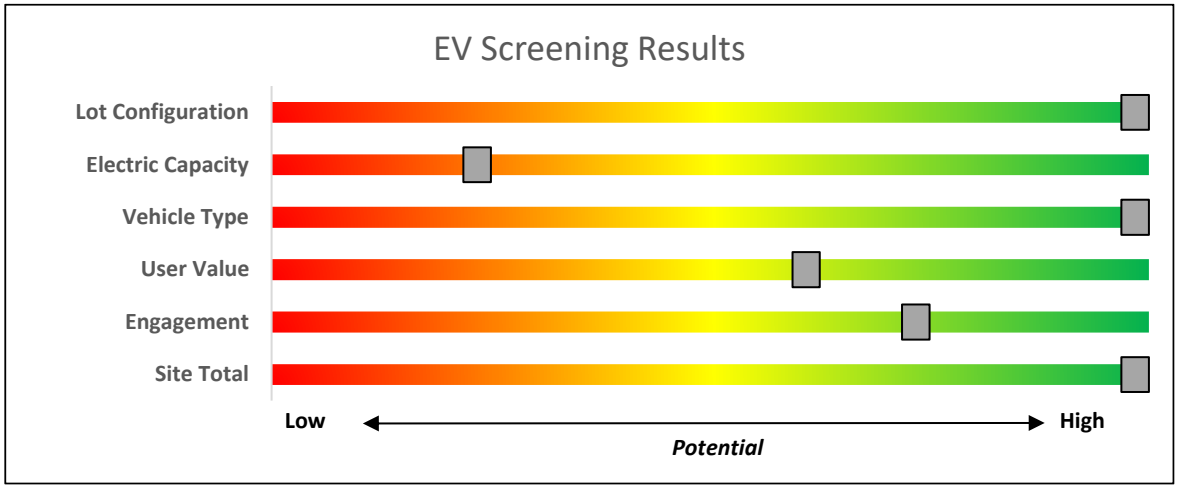


Figure 9 – EV Charger Screening

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) or Public Service Electric & Gas Company (PSE&G), 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 or PSE&G, up to 90% of the combined charger purchase and installation costs. Please check ACE or PSE&G program eligibility requirements before purchasing EV charging equipment, as additional conditions on types of eligible chargers may apply for utility incentives.

Both Jersey Central Power & Light (JCP&L) and Rockland Electric (RECO) have filed proposals for EV charging programs. BPU staff is currently reviewing those proposals.

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

8 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.

8.1 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.

8.2 New Jersey's Clean Energy Programs

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 that annually contribute at least $200,000 to the NJCEP aggregate of all buildings/sites. This equates to roughly $5 million in 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 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

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

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

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

How to Participate

You 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 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 Program

The Competitive Solar Incentive (CSI) Program will provide competitively set incentives for grid supply projects and net metered non-residential projects greater than 5MW (dc). The program is currently under development. For updates, please continue to check the Solar Proceedings page on the New Jersey's Clean Energy Program website.

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 photovoltaics 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 into 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.

9 Project Development

Energy conservation measures (ECMs) have been identified for your site, and their energy and economic analyses are provided within this LGEA report. 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.

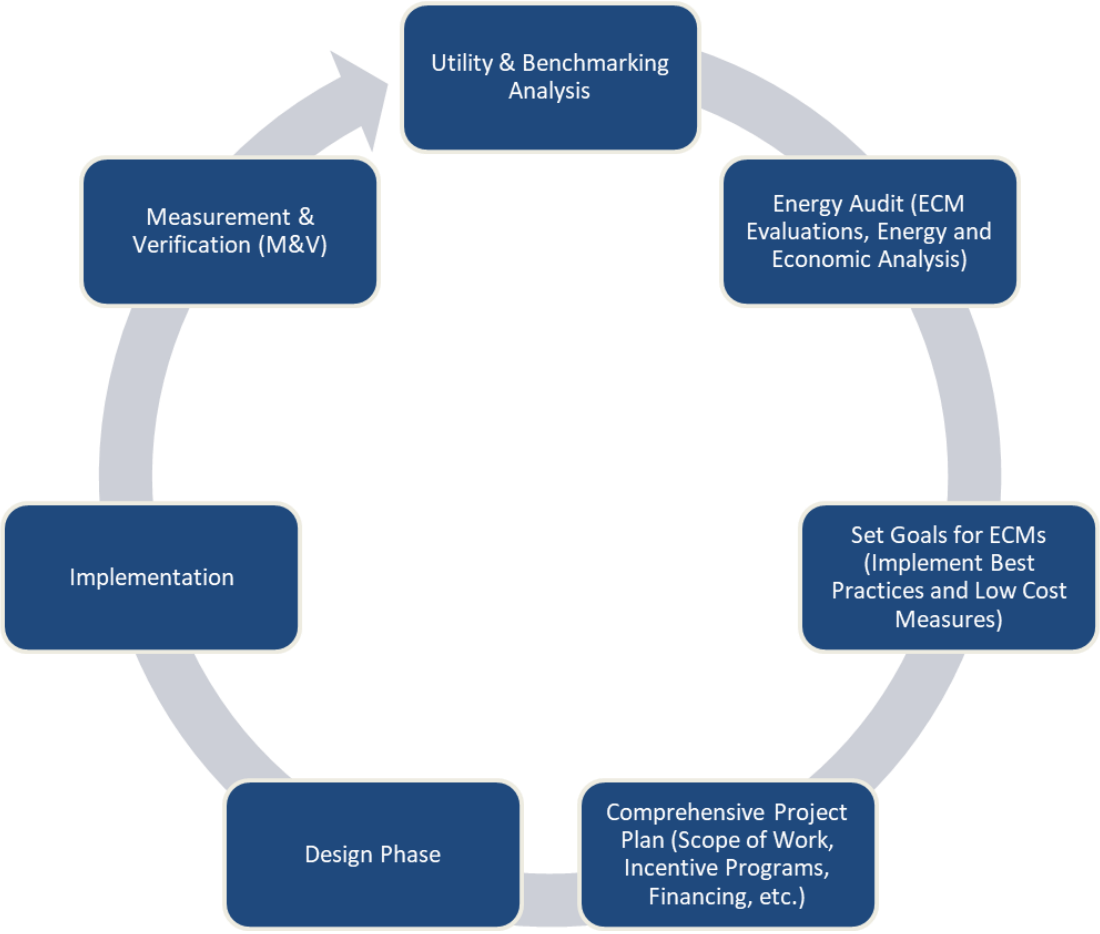


Figure 10 – Project Development Cycle

10 Energy Purchasing and Procurement Strategies

10.1 Retail Electric Supply Options

Energy deregulation in New Jersey has increased energy buyers' options by separating the function of electricity distribution from that of electricity supply. 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[11].

10.2 Retail Natural Gas Supply Options

The natural gas market in New Jersey is also deregulated. Most customers that remain with the utility for natural gas service pay rates that are market based and 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[12].

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

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

APPENDIX A: EQUIPMENT INVENTORY & RECOMMENDATIONS

Lighting Inventory & Recommendations

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
1st Floor - Closet	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	34	1,000	2	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	1,000	0.0	19	0	$3	$41	$6	13.3
1st Floor Electrical Closet	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	1,000		None	No	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	49	1,000	0.0	0	0	$0	$0	$0	0.0
1st Floor Electrical Meter Room	2	LED - Fixtures: Ambient 1x4 Fixture	Wall Switch	S	50	1,200	3	None	Yes	2	LED - Fixtures: Ambient 1x4 Fixture	Occupancy Sensor	50	828	0.0	41	0	$6	$142	$20	21.1
1st Floor Elevator Closet	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	S	15	1,000		None	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	1,000	0.0	0	0	$0	$0	$0	0.0
1st Floor Lab	5	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	3,320	3	None	Yes	5	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,291	0.1	221	0	$31	$0	$0	0.0
1st Floor Lab	13	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320	3	None	Yes	13	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,291	0.2	721	0	$102	$331	$35	2.9
1st Floor Lab - Closet	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	1,000		None	No	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	49	1,000	0.0	0	0	$0	$0	$0	0.0
1st Floor Lab Closet #2	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	1,000		None	No	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	49	1,000	0.0	0	0	$0	$0	$0	0.0
1st Floor Local Aid Open Area	2	Exit Signs: 2 W - LED	None		2	8,760		None	No	2	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
1st Floor Local Aid Open Area	4	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	3,320	3	None	Yes	4	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,291	0.0	177	0	$25	$0	$0	0.0
1st Floor Local Aid Open Area	44	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320	3	None	Yes	44	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,291	0.6	2,441	-1	$345	$992	$105	2.6
1st Floor Local Aid Open Area	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	34	3,320	2	Relamp	No	1	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	3,320	0.0	62	0	$9	$41	$6	4.0
1st Floor Local Aid Open Area	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.1	482	0	$68	$469	$65	5.9
1st Floor Materials - Open Area	27	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	27	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	1.1	4,338	-1	$613	$1,908	$340	2.6
1st Floor Mechanical Room	2	LED - Fixtures: Ambient 1x4 Fixture	Wall Switch	S	50	1,200	3	None	Yes	2	LED - Fixtures: Ambient 1x4 Fixture	Occupancy Sensor	50	828	0.0	41	0	$6	$142	$20	21.1
1st Floor Men Restroom	3	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	S	39	2,290		None	No	3	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,290	0.0	0	0	$0	$0	$0	0.0
1st Floor Men Restroom	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	S	15	2,290		None	No	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,290	0.0	0	0	$0	$0	$0	0.0
1st Floor Men Restroom #2	3	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	S	49	2,290		None	No	3	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,290	0.0	0	0	$0	$0	$0	0.0
1st Floor Men Restroom #2	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	S	15	2,290		None	No	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,290	0.0	0	0	$0	$0	$0	0.0
1st Floor Multi-Purpose Room	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320		None	No	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	49	3,320	0.0	0	0	$0	$0	$0	0.0
1st Floor Multi-Purpose Room	2	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	34	3,320	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	2,291	0.0	163	0	$23	$224	$32	8.4
1st Floor Storage Closet	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	1,000		None	No	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	49	1,000	0.0	0	0	$0	$0	$0	0.0
1st Floor Women Restroom	3	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	S	39	2,290		None	No	3	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,290	0.0	0	0	$0	$0	$0	0.0
1st Floor Women Restroom	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	S	15	2,290		None	No	4	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,290	0.0	0	0	$0	$0	$0	0.0
2nd Floor - Communications Center	1	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	3,320		None	No	1	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	39	3,320	0.0	0	0	$0	$0	$0	0.0

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
2nd Floor - Communications Center	3	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	50	3,320	3	None	Yes	3	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	50	2,291	0.0	170	0	$24	$142	$20	5.1
2nd Floor - Electrical Closet	1	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	1,000		None	No	1	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	39	1,000	0.0	0	0	$0	$0	$0	0.0
2nd Floor - Emergency Operations Center	12	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	3,320	3	None	Yes	12	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,291	0.1	530	0	$75	$331	$35	3.9
2nd Floor Boiler Room	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	S	80	1,200	1, 3	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	828	0.1	158	0	$22	$316	$40	12.3
2nd Floor Men Restroom	4	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	S	39	2,290		None	No	4	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,290	0.0	0	0	$0	$0	$0	0.0
2nd Floor Men Restroom	9	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	S	15	2,290		None	No	9	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,290	0.0	0	0	$0	$0	$0	0.0
2nd Floor Telephone Closet	1	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	1,000		None	No	1	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	39	1,000	0.0	0	0	$0	$0	$0	0.0
2nd Floor Women Restroom	4	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	S	39	2,290		None	No	4	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,290	0.0	0	0	$0	$0	$0	0.0
2nd Floor Women Restroom	9	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	S	15	2,290		None	No	9	LED - Linear Tubes: (1) 4' Lamp	Occupancy Sensor	15	2,290	0.0	0	0	$0	$0	$0	0.0
Construction Open Area	1	Exit Signs: 2 W - LED	None		2	8,760		None	No	1	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
Construction Open Area	4	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320	3	None	Yes	4	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,291	0.1	222	0	$31	$0	$0	0.0
Construction Open Area	30	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	30	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	1.2	4,820	-1	$681	$2,046	$370	2.5
Corridor - 1st Floor	4	Exit Signs: 2 W - LED	None		2	8,760		None	No	4	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
Corridor - 1st Floor	23	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	5,500	4	None	Yes	23	LED - Fixtures: Ambient 2x2 Fixture	High/Low Control	39	3,795	0.3	1,682	0	$238	$1,102	$805	1.3
Corridor - Design & Survey	3	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	5,500	4	None	Yes	3	LED - Fixtures: Ambient 2x2 Fixture	High/Low Control	39	3,795	0.0	219	0	$31	$276	$105	5.5
Corridor - Design & Survey	2	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	5,500	4	None	Yes	2	LED - Fixtures: Ambient 2x4 Fixture	High/Low Control	49	3,795	0.0	184	0	$26	$0	$0	0.0
Corridor - Design & Survey	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	34	5,500	2, 4	Relamp	Yes	1	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	3,795	0.0	135	0	$19	$41	$6	1.8
Design & Survey Open Area	48	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320	3	None	Yes	48	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,291	0.7	2,663	-1	$376	$1,323	$140	3.1
Design & Survey Open Area	5	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	34	3,320	2, 3	Relamp	Yes	5	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	2,291	0.1	407	0	$57	$536	$65	8.2
Electrical Open Area	12	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	3,320	3	None	Yes	12	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,291	0.1	530	0	$75	$331	$35	3.9
Electrical Open Area	24	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	24	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	1.0	3,856	-1	$545	$1,769	$310	2.7
Electrical Open Area	7	U-Bend Fluorescent - T8: 2' T8U (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	7	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,291	0.3	1,054	0	$149	$972	$105	5.8
Elevator	30	LED Lamps: (1) 7W MR16 Plug-In Lamp	Wall Switch	S	7	3,320		None	No	30	LED Lamps: (1) 7W MR16 Plug-In Lamp	Wall Switch	7	3,320	0.0	0	0	$0	$0	$0	0.0
Executive Director Open Area	3	Exit Signs: 2 W - LED	None		2	8,760		None	No	3	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
Executive Director Open Area	4	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	34	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	2,291	0.1	325	0	$46	$164	$24	3.1

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Executive Director Open Area	35	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	35	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	1.5	5,623	-1	$795	$2,608	$455	2.7
Executive Director Open Area	4	U-Bend Fluorescent - T8: 2' T8U (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,291	0.2	602	0	$85	$366	$40	3.8
Exterior Flag	2	LED - Fixtures: Decorative: Other	Photocell		29	4,380		None	No	2	LED - Fixtures: Decorative: Other	Photocell	29	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior PAR	5	LED Lamps: (1) 23W PAR38 Screw-In Lamp	Photocell		23	4,380		None	No	5	LED Lamps: (1) 23W PAR38 Screw-In Lamp	Photocell	23	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Pole	17	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Photocell		150	4,380		None	No	17	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Photocell	150	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Pole	2	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Photocell		300	4,380		None	No	2	LED - Fixtures: Outdoor Pole/Arm-Mounted Area/Roadway Fixture	Photocell	300	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Short Pole	11	LED - Fixtures: Outdoor Pole/Arm-Mounted Decorative Fixture	Photocell		15	4,380		None	No	11	LED - Fixtures: Outdoor Pole/Arm-Mounted Decorative Fixture	Photocell	15	4,380	0.0	0	0	$0	$0	$0	0.0
Exterior Wall Pack	1	LED - Fixtures: Wall Pack	Photocell		15	4,380		None	No	1	LED - Fixtures: Wall Pack	Photocell	15	4,380	0.0	0	0	$0	$0	$0	0.0
Garage 1	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	128	3,320	2	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	3,320	0.1	256	0	$36	$92	$20	2.0
Garage 2	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	128	3,320	2	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	3,320	0.1	256	0	$36	$92	$20	2.0
Garage 3	1	Linear Fluorescent - T8: 4' T8 (32W) - 4L	Wall Switch	S	128	3,320	2	Relamp	No	1	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	3,320	0.1	256	0	$36	$92	$20	2.0
Maintenance Open Area	2	Exit Signs: 2 W - LED	None		2	8,760		None	No	2	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
Maintenance Open Area	4	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch	S	34	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	2,291	0.1	325	0	$46	$164	$24	3.1
Maintenance Open Area	51	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	51	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	2.1	8,193	-2	$1,158	$3,677	$650	2.6
Maintenance Open Area	1	U-Bend Fluorescent - T8: 2' T8U (32W) - 2L	Wall Switch	S	64	3,320	2	Relamp	No	1	LED - Linear Tubes: (2) U-Lamp	Wall Switch	33	3,320	0.0	113	0	$16	$92	$10	5.1
Right of Way Open Area	2	Exit Signs: 2 W - LED	None		2	8,760		None	No	2	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
Right of Way Open Area	20	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	20	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.8	3,213	-1	$454	$1,585	$270	2.9
Right of Way Open Area	7	U-Bend Fluorescent - T8: 2' T8U (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	7	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,291	0.3	1,054	0	$149	$972	$105	5.8
Room 1001	1	Exit Signs: 2 W - LED	None		2	8,760		None	No	1	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
Room 1001	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.2	643	0	$91	$515	$75	4.8
Room 1007B	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.1	321	0	$45	$234	$40	4.3
Room 1034A - Conference Room	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.1	321	0	$45	$234	$40	4.3
Room 1034A - Conference Room	2	U-Bend Fluorescent - T8: 2' T8U (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) U-Lamp	Occupancy Sensor	33	2,291	0.1	301	0	$43	$325	$40	6.7
Room 1034B - Conference Room	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Occupancy Sensor	S	64	2,290	2	Relamp	No	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,290	0.1	353	0	$50	$185	$40	2.9
Room 1055	4	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320	3	None	Yes	4	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,291	0.1	222	0	$31	$142	$20	3.9

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Room 1065 - Break Room	2	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320	3	None	Yes	2	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,291	0.0	111	0	$16	$142	$20	7.8
Room 1066 - Storage	2	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	1,000		None	No	2	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	49	1,000	0.0	0	0	$0	$0	$0	0.0
Room 1066 - Storage	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	1,000	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	690	0.1	97	0	$14	$234	$20	15.7
Room 1067 - Plotter	2	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320	3	None	Yes	2	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,291	0.0	111	0	$16	$142	$20	7.8
Room 1069 - Main/ Copy	4	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320	3	None	Yes	4	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,291	0.1	222	0	$31	$142	$20	3.9
Room 1070 - Lunchroom	6	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320	3	None	Yes	6	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	49	2,291	0.1	333	0	$47	$331	$35	6.3
Room 1071 - Conference Room	2	Exit Signs: 2 W - LED	None		2	8,760		None	No	2	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
Room 1071 - Conference Room	16	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	50	3,320	3	None	Yes	16	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	50	2,291	0.2	906	0	$128	$661	$70	4.6
Room 1072	2	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	3,320		None	No	2	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	39	3,320	0.0	0	0	$0	$0	$0	0.0
Room 109A	3	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	3	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.1	482	0	$68	$469	$65	5.9
Room 2002A - Conference Room	4	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	50	3,320	3	None	Yes	4	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	50	2,291	0.1	226	0	$32	$142	$20	3.8
Room 2002B - Conference Room	4	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	50	3,320	3	None	Yes	4	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	50	2,291	0.1	226	0	$32	$142	$20	3.8
Room 2007	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.2	643	0	$91	$515	$75	4.8
Room 2007A	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.2	643	0	$91	$515	$75	4.8
Room 2009	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.2	643	0	$91	$515	$75	4.8
Room 2010	2	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.1	321	0	$45	$234	$40	4.3
Room 2023A	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.2	643	0	$91	$515	$75	4.8
Room 2024 - AVA	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	49	3,320		None	No	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	49	3,320	0.0	0	0	$0	$0	$0	0.0
Room 2075	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.2	643	0	$91	$515	$75	4.8
Room 2150	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.2	643	0	$91	$515	$75	4.8
Room 2152 - Kitchenette	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	50	3,320		None	No	1	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	50	3,320	0.0	0	0	$0	$0	$0	0.0
Room 2171	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.2	643	0	$91	$515	$75	4.8
Room 2188	4	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	S	64	3,320	2, 3	Relamp	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	2,291	0.2	643	0	$91	$515	$75	4.8
Room 2191 - Copy Room	2	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	3,320	3	None	Yes	2	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,291	0.0	88	0	$12	$331	$35	23.7
Room 2191 - Copy Room	2	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	50	3,320	3	None	Yes	2	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	50	2,291	0.0	113	0	$16	$142	$20	7.6

	Existing Conditions						Proposed Conditions								Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Light Level	Watts per Fixture	Annual Operating Hours	ECM #	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Room 2192	4	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	50	3,320	3	None	Yes	4	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	50	2,291	0.1	226	0	$32	$142	$20	3.8
Room 2193	6	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	S	39	2,290		None	No	6	LED - Fixtures: Ambient 2x2 Fixture	Occupancy Sensor	39	2,290	0.0	0	0	$0	$0	$0	0.0
Room 2194 - Storage	2	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	S	39	1,000		None	No	2	LED - Fixtures: Ambient 2x2 Fixture	Wall Switch	39	1,000	0.0	0	0	$0	$0	$0	0.0
Room 2194 - Storage	2	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	50	1,000		None	No	2	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	50	1,000	0.0	0	0	$0	$0	$0	0.0
Room 2195	3	LED - Fixtures: Ambient 2x4 Fixture	Wall Switch	S	50	3,320	3	None	Yes	3	LED - Fixtures: Ambient 2x4 Fixture	Occupancy Sensor	50	2,291	0.0	170	0	$24	$142	$20	5.1
Staircase North	1	Exit Signs: 2 W - LED	None		2	8,760		None	No	1	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
Staircase North	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	3,320	4	None	Yes	3	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,291	0.0	98	0	$14	$276	$105	12.3
Staircase South	1	Exit Signs: 2 W - LED	None		2	8,760		None	No	1	Exit Signs: 2 W - LED	None	2	8,760	0.0	0	0	$0	$0	$0	0.0
Staircase South	2	LED - Linear Tubes: (2) 4' Lamps	Wall Switch		29	3,320	4	None	Yes	2	LED - Linear Tubes: (2) 4' Lamps	High/Low Control	29	2,291	0.0	66	0	$9	$276	$70	22.2
Staircase South	1	Linear Fluorescent - T8: 2' T8 (17W) - 2L	Wall Switch		34	3,320	2, 4	Relamp	Yes	1	LED - Linear Tubes: (2) 2' Lamps	High/Low Control	17	2,291	0.0	81	0	$11	$41	$6	3.1

Motor Inventory & Recommendations

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
Garage 1	Garage 1	1	Electric Resistance Heat		17.06		1 COP	MARKEL		W		No							0.0	0	0	$0	$0	$0	0.0
Ceiling	1st Floor WSHP - Various Spaces	8	Water Source HP	4.00	38.00	15.02	3.49 COP			B	8	Yes	8	Water Source HP	4.00	38.00	15.00	4.5 COP	0.0	4,557	0	$660	$75,178	$2,176	110.6
Ceiling	1st Floor WSHP - Various Spaces	9	Water Source HP	5.00	46.00	14.55	3.29 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Ceiling	1st Floor WSHP - Various Spaces	2	Water Source HP	3.00	25.00	15.80	3.2 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Ceiling	1st Floor WSHP - Various Spaces	1	Water Source HP	2.00	19.00	15.87	3.29 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Ceiling	2nd Floor WSHP - Various Spaces	3	Water Source HP	3.00	25.00	15.80	3.2 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Ceiling	2nd Floor WSHP - Various Spaces	11	Water Source HP	4.00	38.00	15.02	3.49 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Ceiling	2nd Floor WSHP - Various Spaces	5	Water Source HP	5.00	46.00	14.55	3.29 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Ceiling	2nd Floor WSHP - Various Spaces	1	Water Source HP	2.00	19.00	15.87	3.29 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Vestibule #1	MA Heater 1 - Vestibule #1	1	Electric Resistance Heat		17.06		1 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Vestibule #2	MA Heater 2 - Vestibule #2	1	Electric Resistance Heat		17.06		1 COP			W		No							0.0	0	0	$0	$0	$0	0.0
Vestibule #3	MA Heater 3 - Vestibule #3	1	Electric Resistance Heat		17.06		1 COP			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
2nd Floor Boiler Room	DOT North	1	Non-Condensing Hot Water Boiler	720	HydroTherm	MR-900B	B	9	Yes	1	Condensing Hot Water Boiler	720	91.00%	Et	0.0	0	112	$1,850	$29,607	$1,584	15.1

Pipe Insulation Recommendations

		Recommendation Inputs			Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Affected	ECM #	Length of Uninsulated Pipe (ft)	Pipe Diameter (in)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
2nd Floor Boiler Room	2nd Floor Boiler Room	10	4	2.00	0.0	0	3	$53	$61	$8	1.0

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
2nd Floor Boiler Room	DOT North	1	Storage Tank Water Heater (≤ 50 Gal)	A.O. SMITH	GCV 50 200	B		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
1st Floor Men Restroom	11	3	Faucet Aerator (Lavatory)	2.00	0.50	0.0	0	1	$21	$25	$12	0.6
1st Floor Women Restroom	11	3	Faucet Aerator (Lavatory)	2.00	0.50	0.0	0	1	$21	$25	$12	0.6
2nd Floor Men Restroom	11	5	Faucet Aerator (Lavatory)	2.00	0.50	0.0	0	2	$35	$42	$20	0.6
2nd Floor Women Restroom	11	5	Faucet Aerator (Lavatory)	2.00	0.50	0.0	0	2	$35	$42	$20	0.6

Plug Load Inventory

	Existing Conditions					
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?	Manufacturer	Model
Various Spaces	8	Coffee Machine	900	No		
Various Spaces	120	Desktop	270	No		
Various Spaces	7	Microwave	1,000	No		
Various Spaces	5	Paper Shredder	150	No		
Various Spaces	25	Printer (Medium/Small)	400	No		
Various Spaces	5	Refrigerator (Mini)	180	No		
Various Spaces	3	Refrigerator (Residential)	400	No		
Various Spaces	14	Television	220	No		
Various Spaces	4	Water Cooler	92	No		
1st Floor Lab	2	Temperature Controller	1,500	No		

Vending Machine Inventory & Recommendations

	Existing Conditions		Proposed Conditions		Energy Impact & Financial Analysis						
Location	Quantity	Vending Machine Type	ECM #	Install Controls?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Estimated M&L Cost ($)	Total Incentives	Simple Payback w/ Incentives in Years
Lunchroom	1	Non-Refrigerated	12	Yes	0.0	343	0	$50	$268	$0	5.4
Lunchroom	1	Refrigerated	12	Yes	0.2	1,612	0	$233	$268	$50	0.9

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.

LEARN MORE AT energystar.gov

ENERGY STAR® Statement of Energy Performance

70

ENERGY STAR® Score[1]

DOT - North Region Headquarters

Primary Property Type: Office
Gross Floor Area (ft²): 42,938
Built: 1980

For Year Ending: October 31, 2022
Date Generated: June 11, 2023

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
DOT - North Region Headquarters 200 Stierli Court Mt. Arlington, New Jersey 07856	State of New Jersey 428 East State Street Trenton, NJ 08625 (609) 940-4129	New Jersey Board of Public Utilities State Energy Services 44 South Clinton Ave Trenton, NJ 08625 6096339666 BPU.EnergyServices@bpu.nj.gov

Property ID: 25132826

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
70.6 kBtu/ft²

Source EUI
158 kBtu/ft²

Annual Energy by Fuel

Natural Gas (kBtu)	973,196 (32%)
Electric - Grid (kBtu)	2,058,321 (68%)

National Median Comparison

National Median Site EUI (kBtu/ft²)	90.6
National Median Source EUI (kBtu/ft²)	202.7
% Diff from National Median Source EUI	-22%

Annual Emissions

Total (Location-Based) GHG Emissions (Metric Tons CO2e/year)	231

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: ADDITIONAL SCOPE

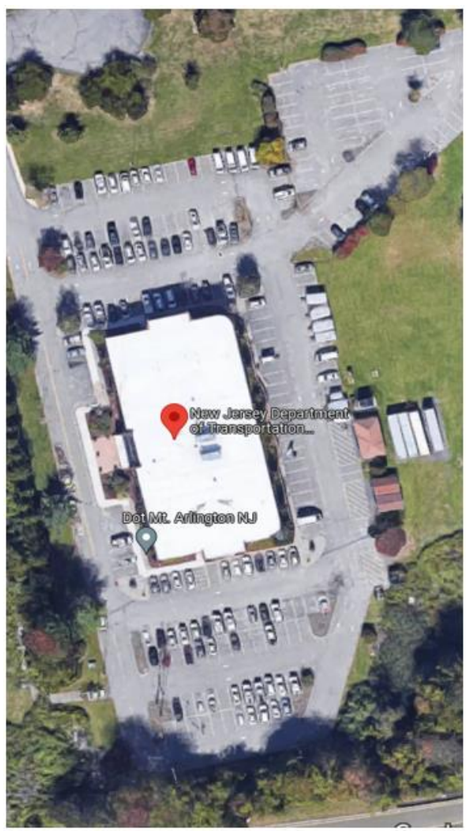
Summary

Solar kW	Battery kWh
450	300

DER	Gross Project Cost ($)	Energy Generation (kWh)	Demand Reduction (kW)	GHG Reduction (MT CO2)	Total Annual Utility Cost Savings ($/yr)	New Maintenance Penalty ($/yr)	Net Annual Cost Savings ($/yr)	Incentives (ITC) ($)	Depreciation (MACRS) ($)	Net Project Cost ($)	Net Simple Payback (yr)
450 kW Solar PV	$2,455,075	604,794	21	120.4	$76,442	$12,275	$64,167	$736,523	$613,769	$1,104,784	17.2
300 kWh Battery	$363,925	0	37	0.0	$1,600	$910	$690	$109,177	$90,981	$163,766	237.3
Total	$2,819,000	604,794	58	120.4	$78,042	$13,185	$64,857	$845,700	$704,750	$1,268,550	19.6

PPA Alternative:	$136	Annual Utility Savings

Baseline kWh	590,079
Saved kWh	604,794
% NZE	102%
NZE Solar Size kW	439



Equipment	Estimated Max Demand Savings (kW)	Estimated Annual Energy Generation (kWh)	Estimated Annual GHG Reduction (MT-CO_2e)	Estimated Annual Cost Savings ($)	Estimated Gross Project Cost ($)	Total Incentives ($)	Net Project Cost ($)	Simple Payback Period (yr)
450 kW Solar PV	21	604,794	120	$64,167	$2,455,075	$1,350,291	$1,104,784	17.2
300 kWh Battery	37	0	0	$690	$363,925	$200,159	$163,766	237.3
Total	58	604,794	120	$64,857	$2,819,000	$1,550,450	$1,268,550	19.6

Ownership Plan	Upfront Cost	Year 1 Cost After Rebates	Annual Savings	Lifetime 30-Year Cost Savings ($)	30-Year ROI
Cash Purchase	$2,819,000	$1,268,550	$64,857	$1,945,709	153%
PPA	$0	$0	$136	$4,095	-

Equipment	Estimated Gross Project Cost ($)	ITC Rebate	MACRS Rebate	Net Project Cost
450 kW Solar PV	$2,455,075	$736,523	$613,769	$1,104,784
300 kWh Battery	$363,925	$109,177	$90,981	$163,766
Total	$2,819,000	$845,700	$704,750	$1,268,550

Costing

New PV + BESS

System Description	Quantity	Unit	Equipment Cost per Unit ($)	Labor Cost Per Unit ($)	Material Cost Per Unit ($)	Total Material Cost ($)	Total Equipment Cost ($)	Total Labor Cost ($)	Total Cost ($)	Source	Notes
Solar Array											
PV Modules (LG 400 W)	450,000	Watts DC			$0.45	$202,500	$ -	$ -	$202,500	PV size from ETB, cost from NREL report	https://www.nrel.gov/docs/fy22osti/83586.pdf
Inverter, 24 kW	16	Ea.		$400	$4,300	$68,800	$ -	$25,626	$94,426	Inverter size from Helioscope - Cost from online quote Labor - 4 Hrs Electrician per unit	https://sunwatts.com/24kw-fronius-symo-advanced-24-0-3-480v-3-phase-string-inverter/
Carport Structure and Racking Cost/Labor/Installation	450,000	Watts DC		$1.21	$1.00	$450,000	$ -	$544,995	$994,995	Energy ToolBase	
PV String Combiner Panels	9	Ea.		$100.10	$568	$4,974	$ -	$1,752	$6,725	Online Quote Labor - 1 Hrs. Electrician per unit	https://www.solaris-shop.com/sma-cu1000-us-11-string-combiner-w-disconnect/ Each 1000V combiner box with disconnect switch can accommodate 8 strings total Project site has up to 70 strings
Electrical BOS Carport	2,185	m^2	$ -	$ -	$50.00	$109,250	$ -	$ -	$109,250	assumed the same cost as the ground mounted https://www.nrel.gov/docs/fy22osti/83586.pdf	U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2022
Carport Linear LED Surface Mount Lighting Fixture	11	Ea.		$100.10	$61.83	$675	$ -	$1,094	$1,769	RS Means Line #: 26 51 13 44 2010 https://www.1000bulbs.com/product/217486/PLT-90093.html	(1) Electrician to install
Installation rental equipment carport	2,185	m^2	$14.60	$ -	$ -	$ -	$31,901	$ -	$31,901	assumed the same cost as the ground mounted https://www.nrel.gov/docs/fy22osti/83586.pdf	U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2022
Battery Storage System											
Li-ion Battery + cabinet	300	kWh		$ -	$393	$117,900	$ -	$ -	$117,900	https://www.nrel.gov/docs/fy22osti/83586.pdf	U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2022
Battery Installation - Labor and equipment	300	kWh		$265	$ -	$ -	$ -	$79,500	$79,500	https://www.nrel.gov/docs/fy22osti/83586.pdf	U.S. Solar Photovoltaic System and Energy Storage Cost Benchmarks, With Minimum Sustainable Price Analysis: Q1 2022 2.91 hrs. @ RS Means labor rate
Electrical BOS	300	kWh	$ -	$ -	$ 69	$20,749	$ -	$ -	$20,500	https://www.nrel.gov/docs/fy22osti/83586.pdf	
Trenching/Site Prep and Wiring											
Schedule 80 PVC Piping 6" Diameter	100	LF	$ -	$45	$ 53.00	$5,300	$ -	$4,524	$9,824	RS means - 221113742560	
Trenching and Backfill 12" wide, 36" Deep	2	Day.	$425	$1,836.40	$ -	$ -	$850	$3,673	$4,523	Includes B-54 Crew - reference 312316142850	(2) Days of work (2) Laborers (1) 40 HP Chain Trencher (1) Light Equip Operator
Soil Excavation, Removal, loading, and hauling	50	L.C.Y	$ 6.80	$6.15	$ -	$ -	$339	$308	$647	Includes B-34D Crew - reference 312323204304	Includes (1) Truck Driver (1) Truck Tractor (1) Dump Trailer

Backfill and Asphalt Paving 8" Thick	1	Day.	$3,428	$6,777.20	$30.00	$3,213	$ 3,428	$6,777	$13,418	Includes B-25 Crew - reference 32 11 26 13 0560	1 Day of Filling Trench and Repaving Asphalt Includes (1) Labor Foreman (7) Laborers (3) Equipment Operators (1) Asphalt Paver, 130 H.P. (1) Tandem Roller, 10 Ton (1) Roller, Pneum. Wheel, 12 Ton
Other Costs											
New ATS - 1200 Amp	1	Ea.		$1,182.00	$23,339.20	$23,339	$ -	$1,182	$24,521	RS means - 263623100070	-
Permitting, inspection, and interconnection	1	Ea.	$6,377	$ -			$6,377	$ -	$6,377	https://www.nrel.gov/docs/fy22osti/83586.pdf	For construction permits fee, interconnection study fees for existing substation, testing, and commissioning For standalone systems - (Rooftop - $105/kW-DC, Ground mount - $46/kW-DC, Battery - $13.6/kWh) For PV+Storage combined - Battery PII*1.02 = $20.84/kWh*1.02
User Training	8	Hr.	$ -	$150	$ -	$ -	$ -	$1,200	$1,200	-	
Total						**$1,010,700**	**$42,900**	**$674,600**	**$1,719,975**		

Markup	Cost
System Cost	$1,719,975
Tax (6.625%)	$66,959
O&P Cost (10%)	$171,998
EPC Markup (10%)	$171,998
Contingency (30%)	$515,993
2023 Inflation Markup (10%)	$171,998
Total Cost	$2,819,000

Battery Cost	$357,133	
Solar Cost	$2,409,259	
Electrical Upgrades, Permitting and Misc…	$52,608	
Battery Cost with Elec Upgrades	$363,925	$1,213
Solar Cost with Elec Upgrades	$2,455,075	$5.46

PPA Analysis

	Income			Net		
Year	Cash Purchase	Standard PPA	PPA with Year 10 Buyout	Cash Purchase	Standard PPA	PPA with Year 10 Buyout
0	-$1,268,550	$0	$0	-$1,268,550	$0	$0
1	$64,857	$136	$136	-$1,203,693	$136	$136
2	$64,857	$136	$136	-$1,138,836	$273	$273
3	$64,857	$136	$136	-$1,073,979	$409	$409
4	$64,857	$136	$136	-$1,009,122	$546	$546
5	$64,857	$136	$136	-$944,265	$682	$682
6	$64,857	$136	$136	-$879,408	$819	$819
7	$64,857	$136	$136	-$814,551	$955	$955
8	$64,857	$136	$136	-$749,694	$1,092	$1,092
9	$64,857	$136	$136	-$684,837	$1,228	$1,228
10	$64,857	$136	$136	-$619,980	$1,365	$1,365
11	$64,857	$136	-$649,690	-$555,123	$1,501	-$648,325
12	$64,857	$136	$64,857	-$490,266	$1,638	-$583,468
13	$64,857	$136	$64,857	-$425,409	$1,774	-$518,611
14	$64,857	$136	$64,857	-$360,552	$1,911	-$453,754
15	$64,857	$136	$64,857	-$295,695	$2,047	-$388,897
16	$64,857	$136	$64,857	-$230,838	$2,184	-$324,040
17	$64,857	$136	$64,857	-$165,981	$2,320	-$259,183
18	$64,857	$136	$64,857	-$101,124	$2,457	-$194,326
19	$64,857	$136	$64,857	-$36,268	$2,593	-$129,469
20	$64,857	$136	$64,857	$28,589	$2,730	-$64,612
21	$64,857	$136	$64,857	$93,446	$2,866	$245
22	$64,857	$136	$64,857	$158,303	$3,003	$65,102
23	$64,857	$136	$64,857	$223,160	$3,139	$129,959
24	$64,857	$136	$64,857	$288,017	$3,276	$194,816
25	$64,857	$136	$64,857	$352,874	$3,412	$259,673
26	$64,857	$136	$64,857	$417,731	$3,549	$324,530
27	$64,857	$136	$64,857	$482,588	$3,685	$389,386
28	$64,857	$136	$64,857	$547,445	$3,822	$454,243
29	$64,857	$136	$64,857	$612,302	$3,958	$519,100
30	$64,857	$136	$64,857	$677,159	$4,095	$583,957

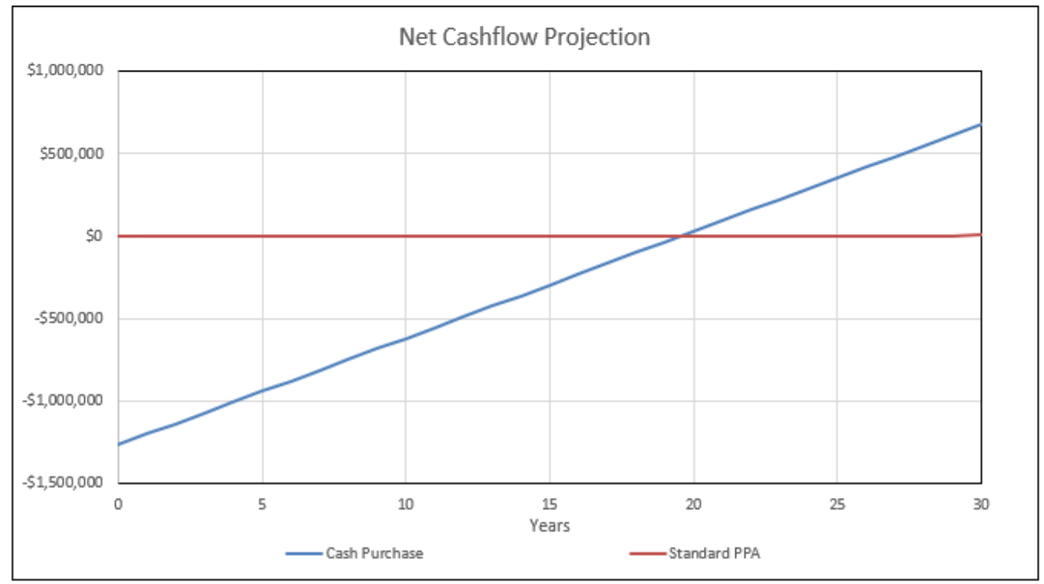
Cash Purchase	
Gross Project Cost	$2,819,000
Rebates	-$845,700
85% Depreciation	-$704,750
n/a	$0
Final Cost	$1,268,550
Utility Savings	$64,857
Payback	19.6
Financial Life (yr)	30
ROI (Over EUL)	153%

Battery Cost:	$363,925
Solar Cost:	$2,455,075

Standard PPA	
Gross Project Cost	$2,819,000
Rebates	-$845,700
85% Depreciation	-$704,750
n/a	$0
Final Cost	$1,268,550
Financial Life (yr)	30
Interest Rate	3.0%
Annual Income from Loan	$64,720
Utility Savings	$64,857
Annual Savings	$136

Battery Cost:	$363,925
Solar Cost:	$2,455,075

PPA with Year 10 Buyout	
Gross Project Cost	$2,819,000
Rebates	-$845,700
85% Depreciation	-$704,750
n/a	$0
Final Cost	$1,268,550
Financial Life (yr)	30
Interest Rate	3.0%
Years 1-10	
Contractor's Income	$64,720
Utility Savings	$64,857
Customer Savings	$136
Years 11-30	
Contractor O&P	15%
Buyout Cost	$714,547
Utility Savings	$64,857
Year 11-25 Payback	11.0
Lifetime Savings	$1,298,504
ROI (Over RUL)	182%



ETB Outputs

					Raw Utility Info				8% Cost Markup			
Bill Date Ranges			Energy Before PV/ESS (kWh)	Max Demand Before PV/ESS (kW)	Charges Before PV/ESS ($)				Charges Before PV/ESS ($)			
Start Date	End Date	Season	Total	NC / Max	Other	Energy	Demand	Total	Other	Energy	Demand	Total
1/23/2022	2/23/2022	W	50080	131	14.69	5795.11	892.98	6702.78	15.8652	6258.719	964.4184	7239.002
2/23/2022	3/23/2022	W	50560	131	14.69	5850.12	892.98	6757.79	15.8652	6318.13	964.4184	7298.413
3/23/2022	4/23/2022	W	48000	131	14.69	5556.75	892.98	6464.42	15.8652	6001.29	964.4184	6981.574
4/23/2022	5/23/2022	W	42400	131	14.69	4915.01	892.98	5822.68	15.8652	5308.211	964.4184	6288.494
5/23/2022	6/1/2022	W	10730	152	4.26	1285.72	304.25	1594.23	4.6008	1388.578	328.59	1721.768
6/1/2022	6/23/2022	S	36789	152	10.43	4271.33	798.13	5079.89	11.2644	4613.036	861.9804	5486.281
6/23/2022	7/23/2022	S	57440	115	14.69	6634.71	831.6	7481	15.8652	7165.487	898.128	8079.48
7/23/2022	8/23/2022	S	50240	126	14.69	5810.72	918.72	6744.13	15.8652	6275.578	992.2176	7283.66
8/23/2022	9/23/2022	S	46880	120	14.69	5426.19	871.2	6312.08	15.8652	5860.285	940.896	6817.046
9/23/2022	10/1/2022	S	10528	98	3.92	1265.92	185.86	1455.69	4.2336	1367.194	200.7288	1572.145
10/1/2022	10/23/2022	W	34592	98	10.77	4020.23	476.26	4507.26	11.6316	4341.848	514.3608	4867.841
10/23/2022	11/23/2022	W	43680	98	14.69	5061.69	649.44	5725.82	15.8652	5466.625	701.3952	6183.886
11/23/2021	12/23/2021	W	57920	108	14.69	6693.55	723.24	7431.48	15.8652	7229.034	781.0992	8025.998
12/23/2021	1/23/2022	W	50240	131	14.69	5813.45	892.98	6721.12	15.8652	6278.526	964.4184	7258.81
Subtotal			590079		176.28	68400.49	10223.59	0	190.3824	73872.53	11041.4772	0
Adjustments			0		0	0	0	0	0	0	0	0
Total			590079		176.28	68400.49	10223.59	78800.36	190.3824	73872.53	11041.4772	85104.39
Bill Date Ranges			Energy After PV & Before ESS (kWh)	Max Demand After PV & Before ESS (kW)	Charges After PV & Before ESS ($)				Charges After PV & Before ESS ($)			
Start Date	End Date	Season	Total	NC / Max	Other	Energy	Demand	Total	Other	Energy	Demand	Total
1/23/2022	2/23/2022	W	10941	131	14.69	1309.9	892.98	2217.57	15.8652	1414.692	964.4184	2394.976
2/23/2022	3/23/2022	W	5562	131	14.69	693.48	892.98	1601.15	15.8652	748.9584	964.4184	1729.242
3/23/2022	4/23/2022	W	-4755	131	14.69	-601	892.98	306.67	15.8652	-649.08	964.4184	331.2036
4/23/2022	5/23/2022	W	-29421	94	14.69	-3427.65	619.92	-2793.04	15.8652	-3701.86	669.5136	-3016.48
5/23/2022	6/1/2022	W	-6322	99	4.26	-780.58	190.69	-585.62	4.6008	-843.026	205.9452	-632.47
6/1/2022	6/23/2022	S	-17347	86	10.43	-2046.31	427.17	-1608.72	11.2644	-2210.01	461.3436	-1737.42
6/23/2022	7/23/2022	S	-8313	86	14.69	-1012.42	601.92	-395.81	15.8652	-1093.41	650.0736	-427.475
7/23/2022	8/23/2022	S	-18109	85	14.69	-2133.52	594	-1524.83	15.8652	-2304.2	641.52	-1646.82
8/23/2022	9/23/2022	S	-16322	86	14.69	-1929.01	601.92	-1312.4	15.8652	-2083.33	650.0736	-1417.39
9/23/2022	10/1/2022	S	444	89	3.92	77.92	166.85	248.69	4.2336	84.1536	180.198	268.5852
10/1/2022	10/23/2022	W	6709	90	10.77	824.92	432.96	1268.66	11.6316	890.9136	467.5968	1370.153
10/23/2022	11/23/2022	W	7289	98	14.69	891.39	649.44	1555.52	15.8652	962.7012	701.3952	1679.962
11/23/2021	12/23/2021	W	32609	108	14.69	3792.99	723.24	4530.92	15.8652	4096.429	781.0992	4893.394
12/23/2021	1/23/2022	W	22320	131	14.69	2613.9	892.98	3521.57	15.8652	2823.012	964.4184	3803.296
Subtotal			-14715		176.28	-1725.99	8580.03	0	190.3824	-1864.07	9266.4324	0
Adjustments			0		0	0	0	0	0	0	0	0
Total			-14715		176.28	-735.75	8580.03	8020.56	190.3824	-794.61	9266.4324	8662.205
Bill Date Ranges			Energy After PV/ESS (kWh)	Max Demand After PV/ESS (kW)	Charges After PV/ESS ($)				Charges After PV/ESS ($)			
Start Date	End Date	Season	Total	NC / Max	Other	Energy	Demand	Total	Other	Energy	Demand	Total
1/23/2022	2/23/2022	W	12411	89	14.69	1478.36	583.02	2076.07	15.8652	1596.629	629.6616	2242.156
2/23/2022	3/23/2022	W	6800	93	14.69	835.35	612.54	1462.58	15.8652	902.178	661.5432	1579.586
3/23/2022	4/23/2022	W	-3631	89	14.69	-472.19	583.02	125.52	15.8652	-509.965	629.6616	135.5616
4/23/2022	5/23/2022	W	-28273	69	14.69	-3296.09	435.42	-2845.98	15.8652	-3559.78	470.2536	-3073.66
5/23/2022	6/1/2022	W	-6146	64	4.26	-760.41	115.7	-640.44	4.6008	-821.243	124.956	-691.675
6/1/2022	6/23/2022	S	-16397	66	10.43	-1937.59	314.76	-1612.41	11.2644	-2092.6	339.9408	-1741.4
6/23/2022	7/23/2022	S	-6281	69	14.69	-779.87	467.28	-297.9	15.8652	-842.26	504.6624	-321.732
7/23/2022	8/23/2022	S	-16345	63	14.69	-1931.64	419.76	-1497.19	15.8652	-2086.17	453.3408	-1616.97
8/23/2022	9/23/2022	S	-14819	66	14.69	-1757	443.52	-1298.79	15.8652	-1897.56	479.0016	-1402.69
9/23/2022	10/1/2022	S	855	55	3.92	150.05	95.04	249.01	4.2336	162.054	102.6432	268.9308
10/1/2022	10/23/2022	W	7906	70	10.77	962.1	324.72	1297.59	11.6316	1039.068	350.6976	1401.397
10/23/2022	11/23/2022	W	9032	69	14.69	1091.13	435.42	1541.24	15.8652	1178.42	470.2536	1664.539
11/23/2021	12/23/2021	W	34264	87	14.69	3982.64	568.26	4565.59	15.8652	4301.251	613.7208	4930.837
12/23/2021	1/23/2022	W	23766	94	14.69	2779.61	619.92	3414.22	15.8652	3001.979	669.5136	3687.358
Subtotal			3142		176.28	344.44	6018.38	0	190.3824	371.9952	6499.8504	0
Adjustments			0		0	0	0	0	0	0	0	0
Total			3142		176.28	344.44	6018.38	6539.1	190.3824	371.9952	6499.8504	7062.228

Energy Toolbase

PV SYSTEM DETAILS

GENERAL INFORMATION

Facility: Meter #1
Address: 200 Stierli Ct Mt Arlington NJ 07856

SOLAR PV EQUIPMENT DESCRIPTION

Solar Panels: (1126) LG Electronics LG400N2W-V5_R12
Inverters: (16) SMA Sunny Tripower 24000TL-US STPTL-US12-30-DUS173127

SOLAR PV EQUIPMENT TYPICAL LIFESPAN

Solar Panels: Greater than 30 Years
Inverters: 15 Years

SOLAR PV SYSTEM RATING

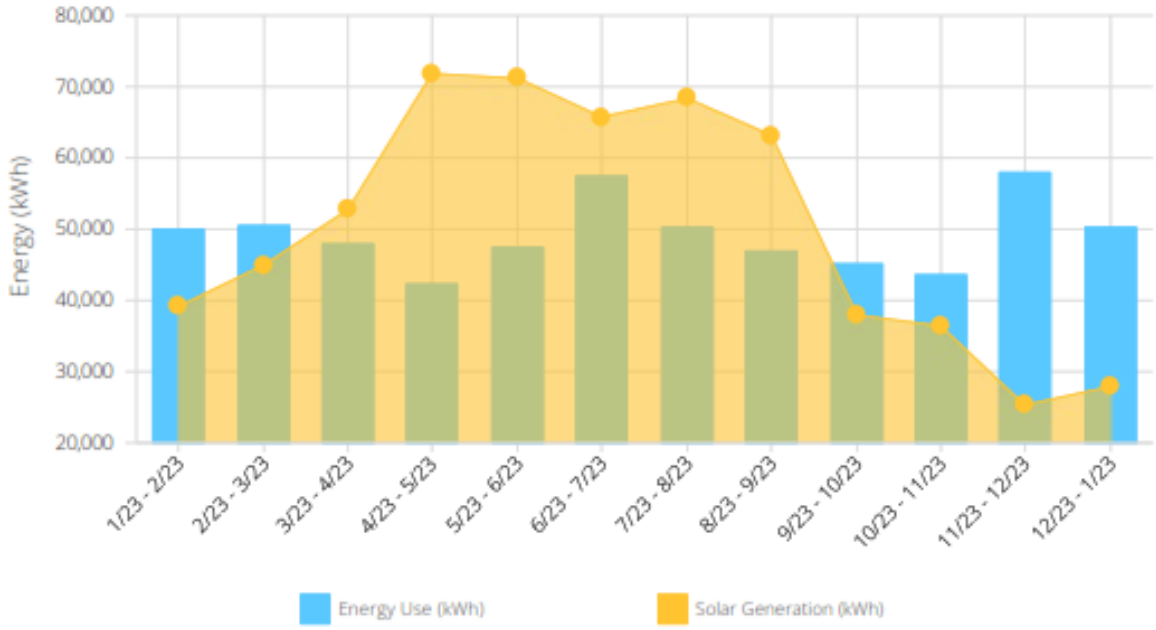
Power Rating: 450,400 W-DC
Power Rating: 384,236 W-AC-CEC

ENERGY CONSUMPTION MIX

Annual Energy Use: 590,079 kWh

Utility -14,712 kWh (0.00%)
Solar PV 604,791 kWh (100.00%)

MONTHLY ENERGY USE VS SOLAR GENERATION



energy toolbase

ENERGY STORAGE SYSTEM (ESS) DETAILS

GENERAL INFORMATION

Facility: Meter #1
Address: Mt Arlington NJ 07856

ESS EQUIPMENT DESCRIPTION

Battery Banks: 150kw/300kWh Energy Storage System
Inverters: 150kw/300kWh Energy Storage System

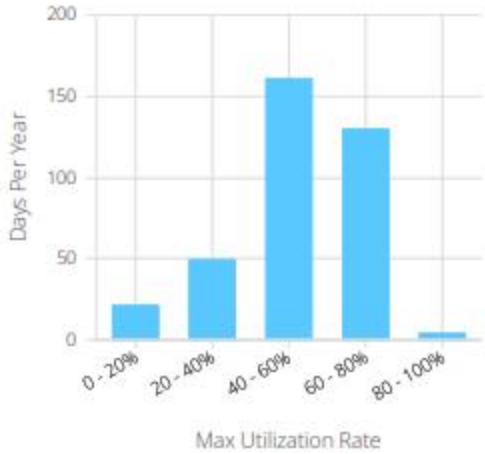
ESS EQUIPMENT TYPICAL LIFESPAN

Battery Banks: 15 Years
Inverters: 15 Years

ESS SYSTEM RATINGS

Energy Capacity: 300.0 kWh
Power Rating: 150.0 kW

ENERGY STORAGE ANNUAL UTILIZATION



Energy Output and Demand Savings From Solar PV and Energy Storage				
Date Range	ESS Energy Discharge (kWh)	Solar PV Generation (kWh)	ESS Energy as % of PV Energy	Total Demand Savings
1/23/2022 - 2/23/2022	3,828	39,139	9.78%	$310
2/23/2022 - 3/23/2022	3,222	44,998	7.16%	$280
3/23/2022 - 4/23/2022	2,926	52,755	5.55%	$310
4/23/2022 - 5/23/2022	2,988	71,820	4.16%	$458
5/23/2022 - 6/23/2022	3,047	71,187	4.28%	$672
6/23/2022 - 7/23/2022	5,285	65,754	8.04%	$364
7/23/2022 - 8/23/2022	4,606	68,349	6.74%	$499
8/23/2022 - 9/23/2022	3,801	63,201	6.01%	$428
9/23/2022 - 10/23/2022	4,174	37,966	10.99%	$242
10/23/2022 - 11/23/2022	4,625	36,391	12.71%	$214
11/23/2021 - 12/23/2021	4,360	25,311	17.23%	$155
12/23/2021 - 1/23/2022	3,715	27,920	13.31%	$273
Total	46,577	604,791	7.70%	$4,205

ENVIRONMENTAL BENEFITS

OVER THE NEXT 20 YEARS, YOUR SYSTEM WILL DO MORE THAN JUST SAVE YOU MONEY. ACCORDING TO THE EPA'S GREENHOUSE GAS EQUIVALENCIES CALCULATOR (SOURCE), YOUR SOLAR PV SYSTEM WILL HAVE THE IMPACT OF REDUCING:

9,477
tons of CO2 Offset

21,542,655
Miles Driven By Cars

142,126
Trees Planted

APPENDIX D: GLOSSARY

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

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

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