Local Government Energy Audit:
Energy Audit Report

James J. Howard Marine Lab

74 Magruder Road

Highlands, NJ 07732

JJH Marine Lab

March 26, 2019

Final Report by:

TRC Energy Services

Disclaimer

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

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

TRC bases estimated installation costs on our experience at similar facilities, pricing from local contractors and vendors, and/or cost estimates from RS Means. We encourage the owner of the facility is encouraged to independently confirm these cost estimates and to obtain multiple estimates when considering measure installations. Actual installation costs can vary widely based on individual measures and conditions. TRC and NJBPU do not guarantee installed cost estimates and shall in no event be held liable should actual installed costs vary from estimates.

The New Jersey Clean Energy Program (NJCEP) incentive values provided in this report are estimates based on program information available at the time of the report. Incentive levels are not guaranteed. The NJBPU reserves the right to extend, modify, or terminate programs without prior notice. Please review all available program incentives and eligibility requirements prior to selecting and installing any energy conservation measures.

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

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1 Executive Summary

The New Jersey Board of Public Utilities (NJBPU) has sponsored this Local Government Energy Audit (LGEA) Report for James J. Howard Marine Lab (JJH Marine Lab).

The goal of an LGEA report is to provide you with information on how your facility uses energy, identify energy conservation measures (ECMs) that can reduce your energy use, and provide information and assistance to help facilities implement ECMs. The LGEA report also contains valuable information on financial incentives from New Jersey's Clean Energy Program (NJCEP) for implementing ECMs.

This study was conducted by TRC Energy Services (TRC), as part of a comprehensive effort to assist New Jersey local governments in controlling energy costs and protecting our environment by offering a wide range of energy management options and advice.

1.1 Facility Summary

JJH Marine Lab is a 40,638 square foot laboratory facility located on the New Jersey shore at Sandy Hook. It is a state-of-the-art marine research facility shared by the National Oceanic and Atmospheric Administration (NOAA) and the State of New Jersey. Federal research at the laboratory is conducted by NOAA's National Marine Fisheries Service (NMFS).

The primary mission of the Howard Laboratory is to conduct research in ecology, leading to a better understanding of both coastal and estuarine organisms and the effects of human activities on nearshore marine populations.

The lab building is three stories and includes several research labs, office spaces, a large aquarium, temperature-controlled rooms and mechanical spaces.

Lighting at JJH Marine Lab consists of aging and inefficient T12 fixtures and HVAC equipment in need of replacement as well. Space cooling is provided by water-cooled chillers and air handling units located in the penthouse. Heating is provided by No. 2 fuel oil hot water boilers. A thorough description of the facility and our observations are located in Section 2.

1.2 Your Cost Reduction Opportunities

Energy Conservation Measures

TRC evaluated 13 measures and recommends 12 measures which together represent an opportunity for JJH Marine Lab to reduce annual energy costs by $112,834 and annual greenhouse gas emissions by 948,738 lbs CO_2e. We estimate that if all measures were implemented as recommended, the project would pay for itself in 5.4 years. The breakdown of existing and potential utility costs after project implementation are illustrated in Figure 1 and Figure 2, respectively. Together these measures represent an opportunity to reduce JJH Marine Lab's annual energy use by 14%.

Figure 1 – Previous 12 Month Utility Costs

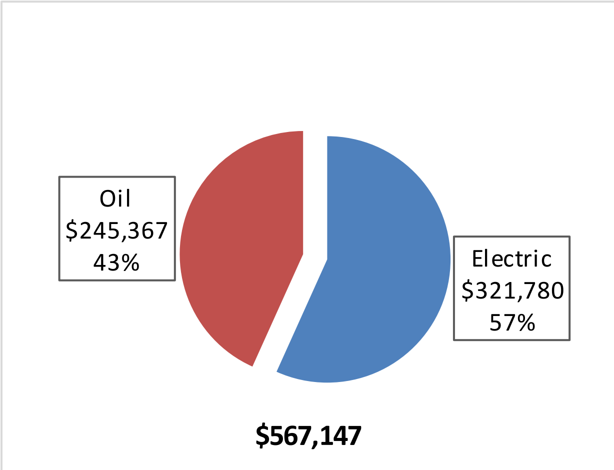
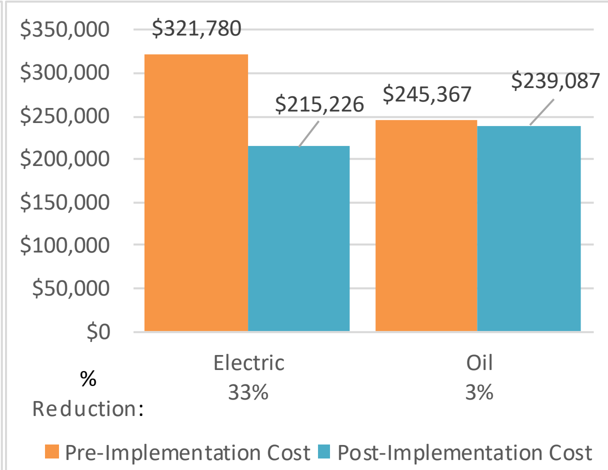


Figure 2 – Potential Post-Implementation Costs



A detailed description of JJH Marine Lab's existing energy use can be found in Section 3.

Estimates of the total cost, energy savings, and financial incentives for the proposed energy efficient upgrades are summarized below in Figure 3. A brief description of each category can be found below and a description of savings opportunities can be found in Section 4.

Figure 3 – Summary of Energy Reduction Opportunities

Energy Conservation Measure		Recommend?	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades			**229,869**	**73.5**	**0.0**	**$27,994.11**	**$139,487.70**	**$14,995.00**	**$124,492.70**	**4.4**	**231,477**
ECM 1	Install LED Fixtures	Yes	24,732	4.1	0.0	$3,011.95	$29,390.08	$1,100.00	$28,290.08	9.4	24,905
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	Yes	168,465	58.8	0.0	$20,516.09	$84,448.74	$12,715.00	$71,733.74	3.5	169,643
ECM 3	Retrofit Fixtures with LED Lamps	Yes	34,515	10.4	0.0	$4,203.27	$24,417.82	$1,180.00	$23,237.82	5.5	34,756
ECM 4	Install LED Exit Signs	Yes	2,158	0.2	0.0	$262.80	$1,231.06	$0.00	$1,231.06	4.7	2,173
Lighting Control Measures			**14,889**	**4.1**	**0.0**	**$1,813.23**	**$18,900.00**	**$2,450.00**	**$16,450.00**	**9.1**	**14,993**
ECM 5	Install Occupancy Sensor Lighting Controls	Yes	14,889	4.1	0.0	$1,813.23	$18,900.00	$2,450.00	$16,450.00	9.1	14,993
Motor Upgrades			**35,344**	**5.9**	**0.0**	**$4,304.29**	**$60,280.94**	**$0.00**	**$60,280.94**	**14.0**	**35,591**
	Premium Efficiency Motors	No	35,344	5.9	0.0	$4,304.29	$60,280.94	$0.00	$60,280.94	14.0	35,591
Variable Frequency Drive (VFD) Measures			**370,722**	**40.5**	**0.0**	**$45,147.48**	**$122,799.03**	**$15,180.00**	**$107,619.03**	**2.4**	**373,314**
ECM 6	Install VFDs on Constant Volume (CV) HVAC	Yes	167,498	24.2	0.0	$20,398.36	$64,113.73	$8,580.00	$55,533.73	2.7	168,669
ECM 7	Install VFDs on Chilled Water Pumps	Yes	132,229	12.7	0.0	$16,103.23	$37,907.50	$4,800.00	$33,107.50	2.1	133,154
ECM 8	Install VFDs on Hot Water Pumps	Yes	35,497	3.6	0.0	$4,322.94	$10,388.90	$0.00	$10,388.90	2.4	35,745
ECM 9	Install VFDs on Cooling Tower Fans	Yes	35,497	0.0	0.0	$4,322.94	$10,388.90	$1,800.00	$8,588.90	2.0	35,745
Electric Chiller Replacement			**259,469**	**52.1**	**0.0**	**$31,598.84**	**$325,874.60**	**$16,535.00**	**$309,339.60**	**9.8**	**261,283**
ECM 10	Install High Efficiency Chillers	Yes	259,469	52.1	0.0	$31,598.84	$325,874.60	$16,535.00	$309,339.60	9.8	261,283
Gas Heating (HVAC/Process) Replacement			**0**	**0.0**	**396.1**	**$6,013.85**	**$59,624.10**	**$5,010.00**	**$54,614.10**	**9.1**	**64,801**
ECM 11	Install High Efficiency Hot Water Boilers	Yes	0	0.0	396.1	$6,013.85	$59,624.10	$5,010.00	$54,614.10	9.1	64,801
Domestic Water Heating Upgrade			**0**	**0.0**	**17.5**	**$266.36**	**$86.04**	**$0.00**	**$86.04**	**0.3**	**2,870**
ECM 12	Install Low-Flow Domestic Hot Water Devices	Yes	0	0.0	17.5	$266.36	$86.04	$0.00	$86.04	0.3	2,870
TOTALS FOR HIGH PRIORITY MEASURES			**874,949**	**170.3**	**413.6**	**$112,833.87**	**$666,771.48**	**$54,170.00**	**$612,601.48**	**5.4**	**948,738**
TOTALS FOR ALL EVALUATED MEASURES			**910,293**	**176.2**	**413.6**	**$117,138.16**	**$727,052.42**	**$54,170.00**	**$672,882.42**	**5.7**	**984,329**

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

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

Lighting Upgrades generally involve the replacement of existing lighting components such as lamps and ballasts (or the entire fixture) with higher efficiency lighting components. These measures save energy by reducing the power used by the lighting components due to improved electrical efficiency.

Lighting Controls measures generally involve the installation of automated controls to turn off lights or reduce light output when not needed. Automated control reduces reliance on occupant behavior for adjusting lights. These measures save energy by reducing the amount of time lights are on.

Motor Upgrades generally involve replacing older standard efficiency motors with high efficiency standard (NEMA Premium®). Motors replacements generally assume the same size motors, just higher efficiency. Although occasionally additional savings can be achieved by downsizing motors to better meet current load requirements. This measure saves energy by reducing the power used by the motors, due to improved electrical efficiency.

Variable Frequency Drives (VFDs) are motor control devices. These measures control the speed of a motor so that the motor spins at peak efficiency during partial load conditions. Sensors adapt the speed to flow, temperature, or pressure settings which is much more efficient that usage a valve or damper to control flow rates, or running the motor at full speed when only partial power is needed. These measures save energy by controlling motor usage more efficiently.

Electric Chiller measures generally involve replacing older inefficient hydronic chillers with modern energy efficient systems. New chillers can provide equivalent cooling compared to older chillers at a reduced energy cost. These measures save energy by reducing chiller energy usage, due to improved electrical and heat transfer efficiency.

Gas Heating (HVAC/Process) measures generally involve replacing older inefficient hydronic heating systems with modern energy efficient systems. Gas heating systems can provide equivalent heating compared to older systems at a reduced energy cost. These measures save energy by reducing the fuel demands for heating, due to improved combustion and heat transfer efficiency.

Domestic Hot Water upgrade measures generally involve replacing older inefficient domestic water heating systems with modern energy efficient systems. New domestic hot water heating systems can provide equivalent, or greater, water heating capacity compared to older systems at a reduced energy cost. These measures save energy by reducing the fuel used for domestic hot water heating due to improved heating efficiency or reducing standby losses.

Energy Efficient Practices

TRC also identified ten low cost (or no cost) energy efficient practices. A facility's energy performance can be significantly improved by employing certain behavioral or operational adjustments and by performing better routine maintenance on building systems. These practices can extend equipment lifetime, improve occupant comfort, provide better health and safety, as well as reduce annual energy and O&M costs. Potential opportunities identified at JJH Marine Lab include:

- Reduce Air Leakage
- Perform Routine Motor Maintenance
- Practice Proper Use of Thermostat Schedules and Temperature Resets
- Assess Chillers & Request Tune-Ups
- Clean and/or Replace HVAC Filters

- Check for and Seal Duct Leakage
- Perform Proper Boiler Maintenance
- Perform Maintenance on Compressed Air Systems
- Install Plug Load Controls
- Water Conservation

For details on these Energy Efficient Practices, please refer to Section 5.

On-Site Generation Measures

TRC evaluated the potential for installing on-site generation for JJH Marine Lab. Based on the configuration of the site and its loads there is a high potential for installing a photovoltaic (PV) array.

Figure 4 – Photovoltaic Potential

Potential	High	
System Potential	268	kW DC STC
Electric Generation	319,287	kWh/yr
Displaced Cost	$27,780	/yr
Installed Cost	$1,045,200	

For details on our evaluation and on-site generation potential, please refer to Section 6.

1.3 Implementation Planning Implementation Planning

To realize the energy savings from the ECMs listed in this report, a project implementation plan must be developed. Available capital must be considered and decisions need to be made whether it is best to pursue individual ECMs separately, groups of ECMs, or a comprehensive approach where all ECMs are implemented together, possibly in conjunction with other facility upgrades or improvements.

Rebates, incentives, and financing are available from NJCEP, as well as other sources, to help reduce the costs associated with the implementation of energy efficiency projects. Prior to implementing any measure, please review the relevant incentive program guidelines before proceeding. This is important because in most cases you will need to submit applications for the incentives prior to purchasing materials or commencing with installation.

The ECMs outlined in this report may qualify under the following program(s):

- SmartStart
- Pay for Performance - Existing Building (P4P)
- SREC (Solar Renewable Energy Certificate) Registration Program (SRP)
- Energy Savings Improvement Program (ESIP)

For facilities wanting to pursue only selected individual measures (or planning to phase implementation of selected measures over multiple years), incentives are available through the SmartStart program. To participate in this program you may utilize internal resources, or an outside firm or contractor, to do the final design of the ECM(s) and do the installation. Program pre-approval is required for some SmartStart incentives, so only after receiving pre-approval should you proceed with ECM installation. The incentive estimates listed above in Figure 3 are based on the SmartStart program. More details on this program and others are available in Section 8.

Larger facilities with an interest in a more comprehensive whole building approach to energy conservation should consider participating in the Pay for Performance (P4P) program. Projects eligible for this project program must meet minimum savings requirements. Final incentives are calculated based on actual measured performance achieved at the end of the project. The application process is more involved, and it requires working with a qualified P4P contractor, but the process may result in greater energy savings overall and more lucrative incentives, up to 50% of project's total cost.

For larger facilities with limited capital availability to implement ECMs, project financing may be available through the Energy Savings Improvement Program (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. An LGEA report (or other approved energy audit) is required for participation in ESIP. Please refer to Section 8.4 for additional information on the ESIP Program.

The Demand Response Energy Aggregator is a (non-NJCEP) program designed to reduce 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. Demand Response (DR) service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability. By enabling grid operators to call upon commercial facilities to reduce their electric usage 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 DR programs. Program participation is voluntary and facilities receive payments whether or not they are called upon to curtail their load during times of peak demand. Refer to Section 7 for additional information on this program.

Additional information on relevant incentive programs is located in Section 8. You may also check the following website for more details: www.njcleanenergy.com/ci.

2 FACILITY INFORMATION AND EXISTING CONDITIONS

2.1 Project Contacts

Figure 5 – Project Contacts

Name	Role	E-Mail	Phone #
Customer			
Amanda Plantamura	Administrative Specialist	amanda.plantamura@noaa.gov	(732) 872-3025
Designated Representative			
Keith Noonan	Operations Supervisor	knoonan@burgosgroup.com	(848) 218-4499
TRC Energy Services			
Vish Nimbalkar	Auditor	vnaiknimbalkar@trcsolutions.com	(732) 855-0033

2.2 General Site Information

On August 15, 2018, TRC performed an energy audit at JJH Marine Lab located in Sandy Hook, New Jersey. TRC's team met with Keith Noonan, Operations Supervisor to review the facility operations and help focus our investigation on specific energy-using systems.

JJH Marine Lab is a 40,638 square foot laboratory facility located on the New Jersey shore at Sandy Hook. The building was constructed in 1970. It is a state-of-the-art marine research facility shared by the National Oceanic and Atmospheric Administration (NOAA) and the State of New Jersey. Federal research at the laboratory is conducted by NOAA's National Marine Fisheries Service (NMFS).

The primary mission of the Howard Laboratory is to conduct research in ecology, leading to a better understanding of both coastal and estuarine organisms and the effects of human activities on nearshore marine populations.

The lab building is three stories and includes several research labs, office spaces, a large aquarium, temperature controlled rooms and mechanical spaces.

Lighting at JJH Marine Lab consists of aging and inefficient T12 fixtures and HVAC equipment in need of replacement. Space cooling is provided by water-cooled chillers and air handling units located in the penthouse. Heating is provided by No. 2 fuel oil hot water boilers.

2.3 Building Occupancy

The lab building is open Monday through Friday all year. There is no operation on the weekends. The process equipment and majority of HVAC run all seven days to maintain the necessary conditions for the marine organisms. The typical schedule is presented in the table below. During a typical day, the facility is occupied by a staff of 12-15 people.

Figure 6 - Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Lab building	Weekday	8:00 AM to 6:00 PM
Lab building	Weekend	Closed

2.4 Building Envelope

The lab building is constructed of concrete block and structural steel with a brick facade. The building has pitched roofs covered with black membrane and asphalt shingles in most areas. The building has double-pane windows which are in fair condition and show little sign of excessive infiltration. The exterior doors are constructed of aluminum and in good condition except that the door seals have worn out in some places which increases the level of outside air infiltration. Overall, the building envelope appears in decent shape given the age of the building.

Image 1: Building Exterior

2.5 On-Site Generation

JJH Marine Lab has a 660 kW diesel electric generator as a back-up power source in case of emergency.

2.6 Energy-Using Systems

Please see Appendix A: Equipment Inventory & Recommendations for an inventory of the facility's equipment.

Lighting System

Lighting at the facility is provided mostly by 32-Watt linear fluorescent T12 lamps with magnetic ballasts as well as some compact fluorescent lamps (CFL). Most of the fixtures are 2-lamp or 3-lamp, 4-foot long troffers with diffusers. There are some T8 lamp fixtures located in the generator room and stairwells.

A small area of the building including some closets and lobby are lit by 13-Watt or 23-Watt CFL lamps in recessed can ceiling fixtures. In addition, there is a large aquarium at the facility that is illuminated by a total of 281, 13-Watt CFL light fixtures. These lights are controlled by a light management control system with only a few on at a time to replicate the sun traversing the sky.

Lighting control in most spaces is provided by wall switches. Stairwells, hallways and main lobby areas do not contain any controls and are on 24 hours per day throughout the year.

The building's exterior lighting is minimal and consists primarily of inefficient high pressure sodium (HPS) fixtures and a few metal halide wall pack fixtures that are controlled by photocells.

Image 2: Indoor and Outdoor Light Fixtures

Chilled Water or Condenser Water System

The facility is served by three Dunham-Busch water-cooled, R-22, screw chillers. One 236 ton chiller (CH2) is used for space cooling while the other two (CH3 and CH4) 64 ton and 89 ton chillers are used for seawater cooling. The seawater cooling is needed to maintain constant water temperature in the aquarium and other seawater labs. The space cooling chiller distributes chilled water to the air handling units located in the penthouse to condition all interior spaces. The chillers are configured in a primary-secondary distribution loop with three constant flow primary pumps (two 25 hp and one 7.5 hp) and four constant flow secondary pumps (1.5 hp, 2 hp, 5 hp, and 15 hp). The chillers are controlled by the central building energy management system (BEMS) which has basic controls such as start/stop and outdoor air temperature lock outs. The space conditioning chiller CH2 is cycled on when outdoor temperature is above 60^{o}F and the four compressors are staged based on the chilled water demand. The process chillers CH3 and CH4 are operated in tandem and turned on when outdoor air temperature is above 32^{o}F which is for the majority of the year which requires these chillers to run longer than CH2.

The condenser water system consists of two, one-cell Thermal Care cooling towers. Water is circulated to both towers. Each tower has a single constant speed 15 hp fan motor. Condenser water is supplied to the chillers by two 40 hp constant flow pumps. The site contact mentioned that these cooling towers are also used to dissipate heat from chillers located in a second office building located across the street from the lab building. All chilled water and condenser water system except the cooling tower are from 1995 and passed their useful life and in need of replacement.

Image 3: (Clockwise) Top 2 – CH4 and CH3 located in the mechanical room, condenser water pumps, cooling tower located on the ground outside.

Hot Water Heating System

The hot water system consists of two, fuel oil-fired, PVI 1,670 kBtu/hr output, non-condensing boilers (BR1 & 2) used for space heating. The boilers have a nominal combustion efficiency of 80%. Each boiler has a 0.5 hp forced draft fan. The boilers are configured in a constant flow primary distribution with two hot water pumps of 15 hp each (HHWP1 & 2). Hot water is supplied at 180°F when the outside air temperature is below 50°F and the setpoint is reset to 155°F when the outside air is above 65°F. The boilers provide hot water to air handlers located in the penthouse. The boilers operate in a lead/lag configuration. Both boilers may be required during cold weather. The boilers are very old and at the end of their useful life.

In addition to the space heating boilers there are two non-condensing, 840 kBtu/hr output hot water process boilers used for seawater heating. These boilers are needed to maintain constant water temperature in the aquarium and other seawater labs. The boilers are relatively new, in good condition and well maintained.

Image 4: (Left) Space Heating PVI Boilers, (Right) Seawater Heating Triad Boilers

Air Handling Units (AHUs)

The building is conditioned by a total of 13 air handling units located in the penthouse mechanical room. There are no dedicated return fans on these air handlers, but air is returned via a number of exhaust fans located throughout the building. All supply fans are constant speed and range in size from 0.3 hp to 20 hp. All AHUs are single zone constant air volume (CAV) systems. Supply air temperature modulates to maintain the zone temperature setpoint of 70°F. One of the air handlers, MA-1L, is decommissioned and not used any more.

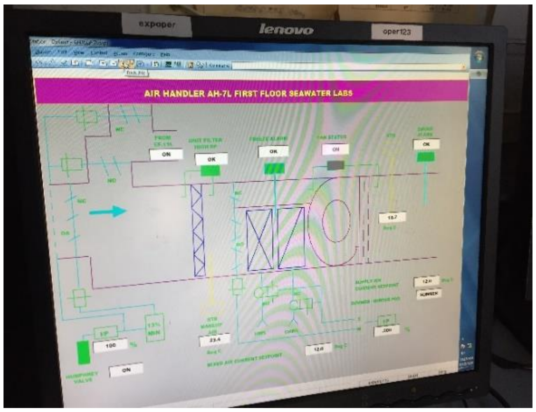
Due to the several labs throughout the building, there are 29 exhaust fans ranging in size from 1/40 hp to 7.5 hp. Many of the fans run continuously to maintain the required air changes per hour. The fans are controlled from the central BEMS and are on a set schedule regardless of occupancy.

Almost all the motors in the AHUs and exhaust fans have passed their useful life and are due for an upgrade.

Image 5: (Left) AHU-7 located in the Penthouse, (Right) Exhaust Fan 9L Motor

Building Energy Management System (BEMS)

The majority of the facility's HVAC, as the seawater pumping system, is controlled with an older generation Honeywell pneumatic building energy management system (BEMS). The system has basic controls such as start/stop, status, and HVAC schedules. The exhaust fan schedules are also set from the BEMS. The system did appear to have minimum trending capabilities for individual control points. The lighting for the large aquarium (500,000 gallon) tank is controlled by a separate control system which follows the sunrise to sunset schedule.



Domestic Hot Water Heating System

The domestic hot water heating system for the facility consists of one fuel oil-fired hot water heater with an input rating of 199 kBtu/hr and a nominal efficiency of 80%. The water heater has a 225 gallon storage tank. Two 1.5 hp and two 1 hp recirculation pumps distribute 120°F water to the entire site. The recirculation pumps operate continuously.

Refrigeration

The facility has three Sure Temp walk-in freezers/temperature control rooms that are used to store lab equipment and biological specimens. Each refrigerator has a single 1.5 ton air-cooled scroll compressor. The walk-in space temperature is maintained at -35°F to -5°F.

Building Plug Load

There are 25 computer work stations throughout the facility. Ninety percent of the computers are assumed to be desktop units with LCD monitors. Additionally, there are copiers, printers and scanners throughout the facility. Some private offices have microwaves and mini fridges as well.

There are also several refrigerators, icemakers, and chest freezers in several labs to store the lab specimens and other material needed for the operation.

2.7 Water-Using Systems

There are six restrooms at this facility. A sampling of restrooms found that the faucets are rated for 2.2 gallons per minute (gpm) or higher, the toilets are rated at 2.5 gallons per flush (gpf) and the urinals are rated at 2 gpf.

3 SITE ENERGY USE AND COSTS

Utility data for electricity and No. 2 fuel oil was analyzed to identify opportunities for savings. In addition, data for electricity and No. 2 fuel oil was evaluated to determine the annual energy performance metrics for the building in energy cost per square foot and energy usage per square foot. These metrics are an estimate of the relative energy efficiency of this building. There are a number of factors that could cause the energy use of this building to vary from the "typical" energy usage profile for facilities with similar characteristics. Local weather conditions, building age and insulation levels, equipment efficiency, daily occupancy hours, changes in occupancy throughout the year, equipment operating hours, and energy efficient behavior of occupants all contribute to benchmarking scores. Please refer to the Benchmarking section within Section 3.4 for additional information.

3.1 Total Cost of Energy

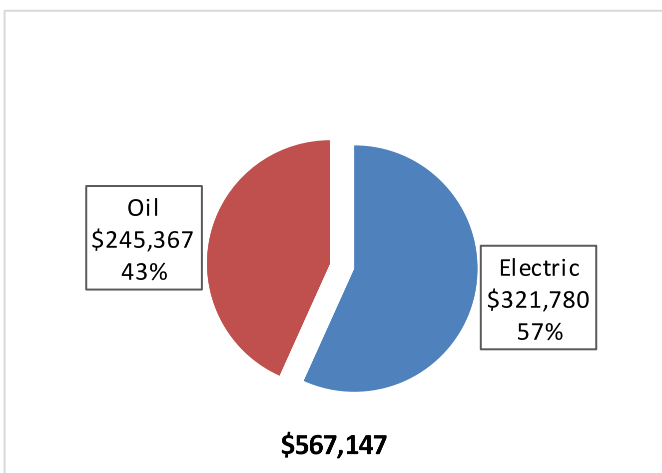
The following energy consumption and cost data is based on the last 12-month period of utility billing data that was provided for each utility. A profile of the annual energy consumption and energy cost of the facility was developed from this information.

Figure 7 - Utility Summary

Utility Summary for James J. Howard Marine Sciences Lab		
Fuel	**Usage**	**Cost**
Electricity	2,642,248 kWh	$321,780
No. 2 Fuel Oil	116,597 Gallons	$245,367
Total		**$567,147**

The current annual energy cost for this facility is $567,147 as shown in the chart below.

Figure 8 - Energy Cost Breakdown



3.2 Electricity Usage

Electricity is provided by JCP&L. The average electric cost over the past 12 months was $0.122/kWh, which is the blended rate that includes energy supply, distribution, and other charges. This rate is used throughout the analyses in this report to assess energy costs and savings. The monthly electricity consumption and peak demand are shown in the chart below.

Figure 9 - Electric Usage & Demand

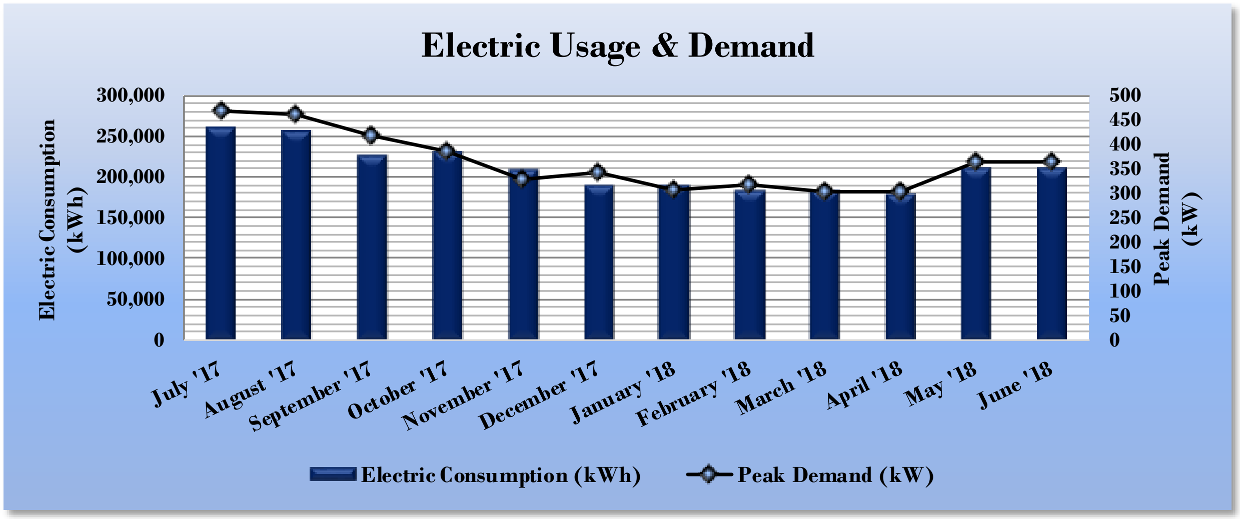


Figure 10 - Electric Usage & Demand

Electric Billing Data for James J. Howard Marine Sciences Lab					
Period Ending	Days in Period	Electric Usage (kWh)	Demand (kW)	Demand Cost	Total Electric Cost
8/4/17	28	262,002	469		$31,929
9/6/17	32	258,380	463		$31,467
10/5/17	28	226,229	419		$27,289
11/6/17	31	230,468	387		$27,431
12/6/17	29	210,074	328		$24,911
1/5/18	29	190,600	344		$23,236
2/5/18	30	191,364	305		$23,195
3/6/18	28	184,558	318		$22,869
4/4/18	28	184,301	304		$23,103
5/3/18	28	179,442	305		$22,434
6/3/18	30	211,742	364		$25,786
7/4/18	30	211,742	364		$25,786
Totals	**351**	**2,540,902**	**469.4**	**$0**	**$309,438**
Annual	**365**	**2,642,248**	**469.4**	**$0**	**$321,780**

3.3 No. 2 Fuel Oil Usage

No. 2 fuel oil is provided by Sprague. The average oil cost for the past 12 months is $2.104/gallon, which is the blended rate used throughout the analyses in this report. The oil consumption is shown in the table below.

Figure 11 – No. 2 Fuel Oil Usage

No. 2 Fuel Oil Billing Data for James J. Howard Marine Sciences Lab			
Period Ending	Days in Period	Oil Usage (Gallons)	Fuel Cost
10/26/17		7,000	$13,932
11/28/17	33	7,000	$13,950
12/21/17	23	7,500	$16,917
1/12/18	22	7,000	$15,335
1/31/18	19	4,000	$8,384
2/7/18	7	7,000	$14,109
3/1/18	22	4,000	$7,796
3/15/18	14	5,000	$10,504
3/31/18	16	6,000	$13,296
4/24/18	24	3,000	$6,779
Totals	**180**	**57,500**	**$121,003**
Annual	**365**	**116,597**	**$245,367**

3.4 Benchmarking

This facility was benchmarked using Portfolio Manager®, an online tool created and managed by the United States Environmental Protection Agency (EPA) through the ENERGY STAR® program. Portfolio Manager® analyzes your building's consumption data, cost information, and operational use details and then compares its performance against a national median for similar buildings of its type. Metrics provided by this analysis are Energy Use Intensity (EUI) and an ENERGY STAR® score for select building types.

The EUI is a measure of a facility's energy consumption per square foot, and it is the standard metric for comparing buildings' energy performance. Comparing the EUI of a building with the national median EUI for that building type illustrates whether that building uses more or less energy than similar buildings of its type on a square foot basis. 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.

Figure 12 - Energy Use Intensity Comparison – Existing Conditions

Energy Use Intensity Comparison - Existing Conditions		
	James J. Howard Marine Sciences Lab	National Median Building Type: Other - Special
Source Energy Use Intensity (kBtu/ft^2)	1098.2	123.1
Site Energy Use Intensity (kBtu/ft^2)	619.5	78.8

Implementation of all recommended measures in this report would improve the building's estimated EUI significantly, as shown in the table below:

Figure 13 - Energy Use Intensity Comparison – Following Installation of Recommended Measures

Energy Use Intensity Comparison - Following Installation of Recommended Measures		
	James J. Howard Marine Sciences Lab	National Median Building Type: Other - Special
Source Energy Use Intensity ($kBtu/ft^2$)	857.3	123.1
Site Energy Use Intensity ($kBtu/ft^2$)	535.9	78.8

Many types of commercial buildings are also eligible to receive an ENERGY STAR® score. This score is a percentile ranking from 1 to 100. It compares your building's energy performance to similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 means your building performs better than 75% of all similar buildings nationwide and may be eligible for ENERGY STAR® certification. Your building is not is one of the building categories that are eligible to receive a score. The large amount of electric consuming equipment in use at the JJH Marine Lab, including the seawater pumps, make this building unique and that Portfolio Manager® doesn't have enough buildings like JJH Marine Lab to make any meaningful comparisons.

A Portfolio Manager® Statement of Energy Performance (SEP) was generated for this facility, see **Appendix B: ENERGY STAR® Statement of Energy Performance**.

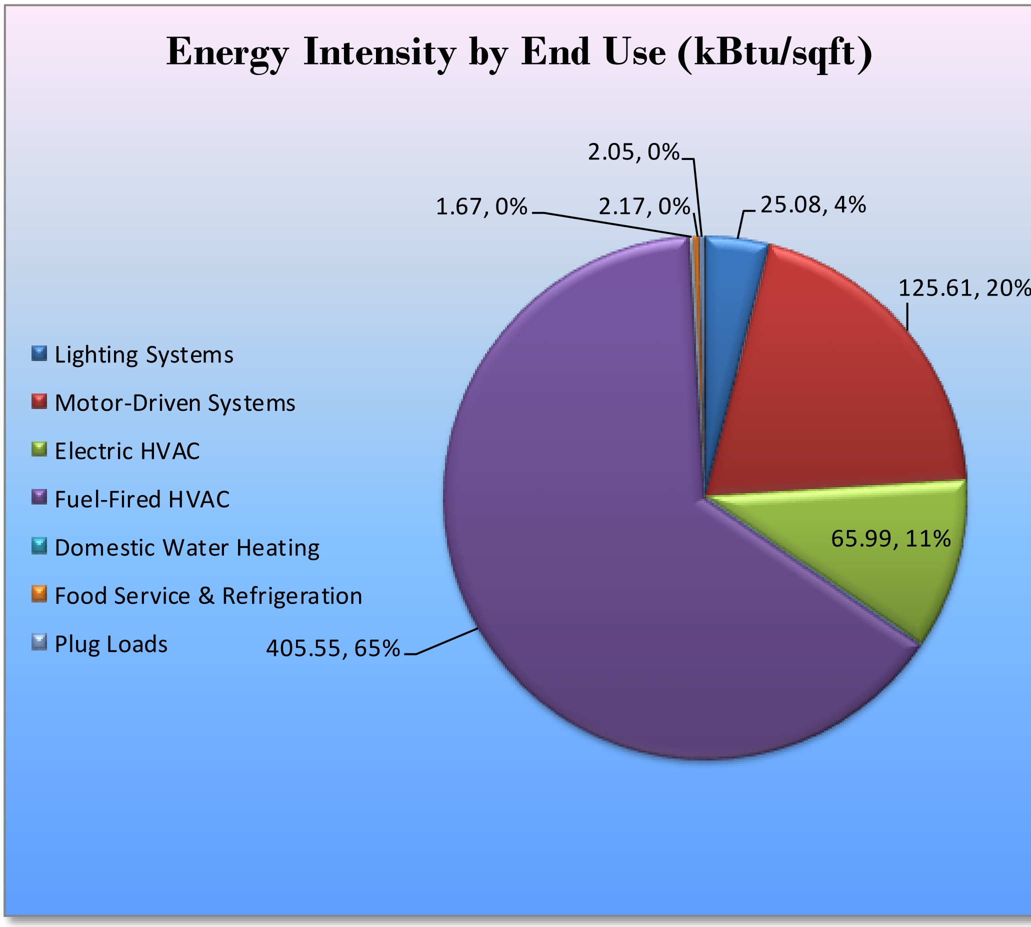
For more information on ENERGY STAR® certification go to: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/earn-recognition/energy-star-certification/how-app-1.

A Portfolio Manager® account has been created online for your facility and you will be provided with the login information for the account. We encourage you to update your utility information in Portfolio Manager® regularly, so that you can keep track of your building's performance. 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.

3.5 Energy End-Use Breakdown

In order to provide a complete overview of energy consumption across building systems, an energy balance was performed at this facility. An energy balance utilizes standard practice engineering methods to evaluate all components of the various electric and fuel-fired systems found in a building to determine their proportional contribution to overall building energy usage. This chart of energy end uses highlights the relative contribution of each equipment category to total energy usage. This can help determine where the greatest benefits might be found from energy efficiency measures.

Figure 14 - Energy Balance (kBtu/SF)



4 ENERGY CONSERVATION MEASURES

The goal of this audit report is to identify potential energy efficiency opportunities, help prioritize specific measures for implementation, and provide information to the JJH Marine Lab regarding financial incentives for which they may qualify to implement the recommended measures. For this audit report, most measures have received only a preliminary analysis of feasibility which identifies expected ranges of savings and costs. This level of analysis is usually considered sufficient to demonstrate project cost-effectiveness and help prioritize energy measures. Savings are based on the New Jersey Clean Energy Program Protocols to Measure Resource Savings dated June 29, 2016, approved by the New Jersey Board of Public Utilities. Further analysis or investigation may be required to calculate more precise savings based on specific circumstances. A higher level of investigation may be necessary to support any custom SmartStart or Pay for Performance, or Direct Install incentive applications. Financial incentives for the ECMs identified in this report have been calculated based the NJCEP prescriptive SmartStart program. Some measures and proposed upgrade projects may be eligible for higher incentives than those shown below through other NJCEP programs as described in Section 8.

The following sections describe the evaluated measures.

4.1 Recommended ECMs

The measures below have been evaluated by the auditor and are recommended for implementation at the facility.

Figure 15 – Summary of Recommended ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		**229,869**	**73.5**	**0.0**	**$27,994.11**	**$139,487.70**	**$14,995.00**	**$124,492.70**	**4.4**	**231,477**
ECM 1	Install LED Fixtures	24,732	4.1	0.0	$3,011.95	$29,390.08	$1,100.00	$28,290.08	9.4	24,905
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	168,465	58.8	0.0	$20,516.09	$84,448.74	$12,715.00	$71,733.74	3.5	169,643
ECM 3	Retrofit Fixtures with LED Lamps	34,515	10.4	0.0	$4,203.27	$24,417.82	$1,180.00	$23,237.82	5.5	34,756
ECM 4	Install LED Exit Signs	2,158	0.2	0.0	$262.80	$1,231.06	$0.00	$1,231.06	4.7	2,173
Lighting Control Measures		**14,889**	**4.1**	**0.0**	**$1,813.23**	**$18,900.00**	**$2,450.00**	**$16,450.00**	**9.1**	**14,993**
ECM 5	Install Occupancy Sensor Lighting Controls	14,889	4.1	0.0	$1,813.23	$18,900.00	$2,450.00	$16,450.00	9.1	14,993
Variable Frequency Drive (VFD) Measures		**370,722**	**40.5**	**0.0**	**$45,147.48**	**$122,799.03**	**$15,180.00**	**$107,619.03**	**2.4**	**373,314**
ECM 6	Install VFDs on Constant Volume (CV) HVAC	167,498	24.2	0.0	$20,398.36	$64,113.73	$8,580.00	$55,533.73	2.7	168,669
ECM 7	Install VFDs on Chilled Water Pumps	132,229	12.7	0.0	$16,103.23	$37,907.50	$4,800.00	$33,107.50	2.1	133,154
ECM 8	Install VFDs on Hot Water Pumps	35,497	3.6	0.0	$4,322.94	$10,388.90	$0.00	$10,388.90	2.4	35,745
ECM 9	Install VFDs on Cooling Tower Fans	35,497	0.0	0.0	$4,322.94	$10,388.90	$1,800.00	$8,588.90	2.0	35,745
Electric Chiller Replacement		**259,469**	**52.1**	**0.0**	**$31,598.84**	**$325,874.60**	**$16,535.00**	**$309,339.60**	**9.8**	**261,283**
ECM 10	Install High Efficiency Chillers	259,469	52.1	0.0	$31,598.84	$325,874.60	$16,535.00	$309,339.60	9.8	261,283
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**396.1**	**$6,013.85**	**$59,624.10**	**$5,010.00**	**$54,614.10**	**9.1**	**64,801**
ECM 11	Install High Efficiency Hot Water Boilers	0	0.0	396.1	$6,013.85	$59,624.10	$5,010.00	$54,614.10	9.1	64,801
Domestic Water Heating Upgrade		**0**	**0.0**	**17.5**	**$266.36**	**$86.04**	**$0.00**	**$86.04**	**0.3**	**2,870**
ECM 12	Install Low-Flow Domestic Hot Water Devices	0	0.0	17.5	$266.36	$86.04	$0.00	$86.04	0.3	2,870
TOTALS		**874,949**	**170.3**	**413.6**	**$112,833.87**	**$666,771.48**	**$54,170.00**	**$612,601.48**	**5.4**	**948,738**

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

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

4.2 Lighting Upgrades

Our recommendations for upgrades to existing lighting fixtures are summarized in Figure 16 below.

Figure 16 – Summary of Lighting Upgrade ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Upgrades		229,869	73.5	0.0	$27,994.11	$139,487.70	$14,995.00	$124,492.70	4.4	231,477
ECM 1	Install LED Fixtures	24,732	4.1	0.0	$3,011.95	$29,390.08	$1,100.00	$28,290.08	9.4	24,905
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	168,465	58.8	0.0	$20,516.09	$84,448.74	$12,715.00	$71,733.74	3.5	169,643
ECM 3	Retrofit Fixtures with LED Lamps	34,515	10.4	0.0	$4,203.27	$24,417.82	$1,180.00	$23,237.82	5.5	34,756
ECM 4	Install LED Exit Signs	2,158	0.2	0.0	$262.80	$1,231.06	$0.00	$1,231.06	4.7	2,173

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 1: Install LED Fixtures

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0
Exterior	24,732	4.1	0.0	$3,011.95	$29,390.08	$1,100.00	$28,290.08	9.4	24,905

Measure Description

We recommend replacing existing fixtures containing high pressure sodium and metal halides with new high-performance LED light fixtures on the exterior of the building. This measure saves energy by installing LEDs which use less power than other technologies with a comparable light output.

ECM 2: Retrofit Fluorescent Fixtures with LED Lamps and Drivers

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	168,465	58.8	0.0	$20,516.09	$84,448.74	$12,715.00	$71,733.74	3.5	169,643
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend retrofitting existing T12 fluorescent fixtures by removing fluorescent tubes and ballasts and replacing them with LEDs and LED drivers (if necessary), which are designed to be used retrofitted fluorescent fixtures. These fixtures are located throughout the facility in hallways, labs, and offices. The measure uses the existing fixture housing but replaces the rest of the components with more efficient lighting technology. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes.

ECM 3: Retrofit Fixtures with LED Lamps

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	34,515	10.4	0.0	$4,203.27	$24,417.82	$1,180.00	$23,237.82	5.5	34,756
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend retrofitting existing incandescent, compact fluorescent, and linear fluorescent T8 lamps with LED lamps. This measure is recommended in the aquarium area, labs on the first floor, and stairwells. Many LED tube lamps are direct replacements for existing fluorescent lamps and can be installed while leaving the fluorescent fixture ballast in place. LED bulbs can be used in existing fixtures as a direct replacement for most other lighting technologies. This measure saves energy by installing LEDs which use less power than other lighting technologies yet provide equivalent lighting output for the space.

Additional savings from lighting maintenance can be anticipated since LEDs have lifetimes which are more than twice that of fluorescent tubes and more than ten times longer than many incandescent lamps.

ECM 4: Install LED Exit Signs

Summary of Measure Economics

Interior/ Exterior	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Interior	2,158	0.2	0.0	$262.80	$1,231.06	$0.00	$1,231.06	4.7	2,173
Exterior	0	0.0	0.0	$0.00	$0.00	$0.00	$0.00	0.0	0

Measure Description

We recommend replacing all incandescent and compact fluorescent exit signs with LED exit signs throughout the facility. LED exit signs require virtually no maintenance and have a life expectancy of at least 20 years. This measure saves energy by installing LED fixtures, which use less power than other technologies with an equivalent lighting output.

4.3 Lighting Control Measures

Our recommendation for upgrades to existing lighting fixtures is summarized in Figure 17 below.

Figure 17 – Summary of Lighting Control ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Lighting Control Measures		**14,889**	**4.1**	**0.0**	**$1,813.23**	**$18,900.00**	**$2,450.00**	**$16,450.00**	**9.1**	**14,993**
ECM 5	Install Occupancy Sensor Lighting Controls	14,889	4.1	0.0	$1,813.23	$18,900.00	$2,450.00	$16,450.00	9.1	14,993

During lighting upgrade planning and design, we recommend a comprehensive approach that considers both the efficiency of the lighting fixtures and how they are controlled.

ECM 5: Install Occupancy Sensor Lighting Controls

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
14,889	4.1	0.0	$1,813.23	$18,900.00	$2,450.00	$16,450.00	9.1	14,993

Measure Description

We recommend installing occupancy sensors to control lighting fixtures that are currently controlled by manual switches in all labs, offices, mechanical rooms, and restrooms. Lighting sensors detect occupancy using ultrasonic and/or infrared sensors. For most spaces, we recommend lighting controls use dual technology sensors, which can eliminate the possibility of any lights turning off unexpectedly. Lighting systems are enabled when an occupant is detected. Fixtures are automatically turned off after an area has been vacant for a preset period. Some controls also provide dimming options and all modern occupancy controls can be easily over-ridden by room occupants to allow them to manually turn fixtures on or off, as desired. Energy savings results from only operating lighting systems when they are required.

Occupancy sensors may be mounted on the wall at existing switch locations, mounted on the ceiling, or in remote locations. In general, wall switch replacement sensors are recommended for single occupant offices and other small rooms. Ceiling-mounted or remote mounted sensors are used in locations without local switching or where wall switches are not in the line-of-sight of the main work area and in large spaces. We recommend a comprehensive approach to lighting design that upgrades both the lighting fixtures and the controls together for maximum energy savings and improved lighting for occupants.

4.4 Variable Frequency Drive Measures

Our recommendations for variable frequency drive (VFD) measures are summarized in Figure 18 below.

Figure 18 – Summary of Variable Frequency Drive ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Variable Frequency Drive (VFD) Measures		**370,722**	**40.5**	**0.0**	**$45,147.48**	**$122,799.03**	**$15,180.00**	**$107,619.03**	**2.4**	**373,314**
ECM 6	Install VFDs on Constant Volume (CV) HVAC	167,498	24.2	0.0	$20,398.36	$64,113.73	$8,580.00	$55,533.73	2.7	168,669
ECM 7	Install VFDs on Chilled Water Pumps	132,229	12.7	0.0	$16,103.23	$37,907.50	$4,800.00	$33,107.50	2.1	133,154
ECM 8	Install VFDs on Hot Water Pumps	35,497	3.6	0.0	$4,322.94	$10,388.90	$0.00	$10,388.90	2.4	35,745
ECM 9	Install VFDs on Cooling Tower Fans	35,497	0.0	0.0	$4,322.94	$10,388.90	$1,800.00	$8,588.90	2.0	35,745

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

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
167,498	24.2	0.0	$20,398.36	$64,113.73	$8,580.00	$55,533.73	2.7	168,669

Measure Description

We recommend installing variable frequency drives (VFDs) to control supply fan motor speeds on all air handling units, heating ventilating units, and exhaust fans to convert 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 will cause the VFD to modulate fan speed to maintain the appropriate temperature in the zone, while maintaining a constant supply air temperature. Energy savings results from reducing fan speed (and power) when there is a reduced load required for the zone. The magnitude of energy savings is based on the estimated amount of time that fan motors operate at partial load.

VAV systems should not be controlled such that the supply air temperature is raised at the expense of the fan power. A common mistake is to reset the supply air temperature to achieve chiller energy savings, which can lead to additional air flow requirements. Supply air temperature should be kept low, e.g., 55°F, until the minimum fan speed (typically about 50%) is met. At this point, it is efficient to raise the supply air temperature as the load decreases, but not such that additional air flow and thus fan energy is required.

ECM 7: Install VFDs on Chilled Water Pumps

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
132,229	12.7	0.0	$16,103.23	$37,907.50	$4,800.00	$33,107.50	2.1	133,154

Measure Description

We recommend installing a variable frequency drives (VFD) to control two 25 hp and one 7.5 hp chilled water pumps. This measure requires that chilled water coils be served by a two-way valve and that a differential pressure sensor be installed in the chilled water loop. As the chilled water valves close, the differential pressure increases. The VFD modulates pump speed to maintain a differential pressure setpoint. Energy savings results from reducing pump motor speed (and power) as chilled water valves close. The magnitude of energy savings is based on the estimated amount of time that the system operates at reduced loads.

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

ECM 8: Install VFDs on Hot Water Pumps

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
35,497	3.6	0.0	$4,322.94	$10,388.90	$0.00	$10,388.90	2.4	35,745

Measure Description

We recommend installing a variable frequency drives (VFD) to control the two 15 hp hot water pumps. This measure requires that a majority of the hot water coils be served by two-way valves and that a differential pressure sensor is installed in the hot water loop. As the hot water valves close, the differential pressure increases. The VFD modulates pump speed to maintain a differential pressure setpoint. Energy savings results from reducing pump motor speed (and power) as hot water valves close. The magnitude of energy savings is based on the estimated amount of time that the system will operate at reduced load.

ECM 9: Install VFDs on Cooling Tower Fans

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
35,497	0.0	0.0	$4,322.94	$10,388.90	$1,800.00	$8,588.90	2.0	35,745

Measure Description

We recommend installing a variable frequency drives (VFD) to control both 15 hp cooling tower fan motors. The VFDs 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 results 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.

4.5 Electric Chiller Replacement

Our recommendation for electric chiller replacement is summarized in Figure 19 below.

Figure 19 – Summary of Electric Chiller ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Electric Chiller Replacement		**259,469**	**52.1**	**0.0**	**$31,598.84**	**$325,874.60**	**$16,535.00**	**$309,339.60**	**9.8**	**261,283**
ECM 10	Install High Efficiency Chillers	259,469	52.1	0.0	$31,598.84	$325,874.60	$16,535.00	$309,339.60	9.8	261,283

ECM 10: Install High Efficiency Chillers

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
259,469	52.1	0.0	$31,598.84	$325,874.60	$16,535.00	$309,339.60	9.8	261,283

Measure Description

We recommend replacing all three existing electric chillers with new high efficiency chillers. The type of chiller to be installed depends on the magnitude of the cooling load and variability of the cooling load profile. Positive displacement chillers are usually under 600 tons of cooling capacity and centrifugal chillers generally start at 150 tons of cooling capacity. Constant speed chillers should be used to meet cooling loads with little or no variation while variable speed chillers are more efficient for variable cooling load profiles. Water cooled chillers are more efficient than air cooled chillers but require cooling towers and additional pumps to circulate the cooling water. In any given size range variable speed chillers tend to have better partial load efficiency, but worse full load efficiency, than constant speed chillers.

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

4.6 Gas-Fired Heating System Replacements

Our recommendation for gas-fired heating system replacements is summarized in Figure 20 below.

Figure 20 - Summary of Gas-Fired Heating Replacement ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Gas Heating (HVAC/Process) Replacement		**0**	**0.0**	**396.1**	**$6,013.85**	**$59,624.10**	**$5,010.00**	**$54,614.10**	**9.1**	**64,801**
ECM 11	Install High Efficiency Hot Water Boilers	0	0.0	396.1	$6,013.85	$59,624.10	$5,010.00	$54,614.10	9.1	64,801

ECM 11: Install High Efficiency Hot Water Boilers

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	396.1	$6,013.85	$59,624.10	$5,010.00	$54,614.10	9.1	64,801

Measure Description

We recommend replacing both older inefficient hot water boilers with high efficiency hot water boilers. Significant improvements have been made in combustion technology resulting in increased overall boiler efficiency. Energy savings results from improved combustion efficiency and reduced standby losses at low loads.

The most notable efficiency improvement is condensing hydronic boilers that can achieve over 90% efficiency under the proper conditions. Condensing hydronic boilers typically operate at efficiencies of approximately 85% and 87% (comparable to other high efficiency boilers) when the return water temperature is above 130°F. If the return water temperature drops below 130°F, the unit will enter “condensing mode” providing more efficient operation. Condensing hydronic boilers were only recommended when it could be confirmed that the return water temperature is less than 130°F during most of the operating hours. Please be aware that condensing boilers are typically 10%-15% more expensive than standard high efficiency boilers and should only be selected if the design conditions support “condensing mode” operation.

In addition to determining the appropriate type of new high efficiency boiler, we recommend consideration be made regarding the new unit size(s) and where appropriate, implementation of multiple (modular) boilers versus larger capacity units. We recommend that the site staff work with the design team to evaluate the heating load for the facility prior to replacing the boilers. The new boilers should be sized to meet the current heating requirements rather than simply installing boilers with the same capacity as the existing boilers. The capital cost of the project can generally be reduced if the overall boiler plant capacity can be reduced. In addition, we recommend that the design team consider designing the plant using several lower capacity modular boilers. Configuring a boiler plant with several modular boilers, rather than one or two high capacity boilers, results in a plant that can more efficiently match and serve the load, provides a high level of redundancy, reduces standby losses, and is more flexible to expand if the heating load increases in the future. Finally, we recommend working with the design team to determine if the updated boiler plant can be operated such that the return water temperature is generally lower than 130°F so that condensing boilers could be used.

4.7 Domestic Hot Water Heating System Upgrades

Our recommendation for domestic water heating system improvements is summarized in Figure 21 below.

Figure 21 - Summary of Domestic Hot Water Heating ECMs

Energy Conservation Measure		Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
Domestic Water Heating Upgrade		**0**	**0.0**	**17.5**	**$266.36**	**$86.04**	**$0.00**	**$86.04**	**0.3**	**2,870**
ECM 12	Install Low-Flow Domestic Hot Water Devices	0	0.0	17.5	$266.36	$86.04	$0.00	$86.04	0.3	2,870

ECM 12: Install Low-Flow DHW Devices

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
0	0.0	17.5	$266.36	$86.04	$0.00	$86.04	0.3	2,870

Measure Description

We recommend installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators and low-flow showerheads can reduce hot water usage, relative to standard showerheads and aerators, which saves energy.

Low-flow devices reduce the overall water flow from the fixture, while still providing adequate pressure for washing. This reduces the amount of water used per day resulting in energy and water savings.

4.8 ECM Evaluated but Not Recommended

The measure below has been evaluated by the auditor but are not recommended for implementation at the facility. Reasons for exclusion can be found in the measure description section.

Figure 22 – Summary of Measure Evaluated, But Not Recommended

Energy Conservation Measure	Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)*	Estimated Net Cost ($)	Simple Payback Period (yrs)**	CO_2e Emissions Reduction (lbs)
Motor Upgrades	**35,344**	**5.9**	**0.0**	**$4,304.29**	**$60,280.94**	**$0.00**	**$60,280.94**	**14.0**	**35,591**
Premium Efficiency Motors	35,344	5.9	0.0	$4,304.29	$60,280.94	$0.00	$60,280.94	14.0	35,591

Premium Efficiency Motors

Summary of Measure Economics

Annual Electric Savings (kWh)	Peak Demand Savings (kW)	Annual Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Estimated Install Cost ($)	Estimated Incentive ($)	Estimated Net Cost ($)	Simple Payback Period (yrs)	CO_2e Emissions Reduction (lbs)
35,344	5.9	0.0	$4,304.29	$60,280.94	$0.00	$60,280.94	14.0	35,591

Measure Description

We recommend replacing standard efficiency motors with NEMA Premium® efficiency motors. Our evaluation assumes that existing motors will be replaced with motors of equivalent size and type. Although occasionally additional savings can be achieved by downsizing motors to better meet the motor's current load requirements. The base case motor efficiencies are estimated from nameplate information and our best estimates of motor run hours. Efficiencies of proposed motor upgrades are obtained from the *New Jersey's Clean Energy Program Protocols to Measure Resource Savings (2016)*. Savings are based on the difference between baseline and proposed efficiencies and the assumed annual operating hours.

Reasons for not Recommending

Due to the simple payback of the measure being longer than the two-thirds of the useful life of a new motor this measure is not recommend for implementation. However, if the facility can account for additional operational and maintenance savings the payback could be shortened with measure becoming more cost effective.

5 Energy Efficient Practices

In addition to the quantifiable savings estimated in Section 4, a facility's energy performance can also be improved through application of many low cost or no-cost energy efficiency strategies. By employing certain behavioral and operational changes and performing routine maintenance on building systems, equipment lifetime can be extended; occupant comfort, health and safety can be improved; and energy and O&M costs can be reduced. The recommendations below are provided as a framework for developing a whole building maintenance plan that is customized to your facility. Consult with qualified equipment specialists for details on proper maintenance and system operation.

Reduce Air Leakage

Air leakage, or infiltration, occurs when outside air enters a building uncontrollably through cracks and openings. Properly sealing such cracks and openings can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. This includes caulking or installing weather stripping around leaky doors and windows allowing for better control of indoor air quality through controlled ventilation.

Perform Routine Motor Maintenance

Motors consist of many moving parts whose collective degradation can contribute to a significant loss of motor efficiency. In order to prevent damage to motor components, routine maintenance should be performed. This maintenance consists of 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.

Practice Proper Use of Thermostat Schedules and Temperature Resets

Ensure thermostats are correctly set back. By employing proper set back temperatures and schedules, facility heating and cooling costs can be reduced dramatically during periods of low or no occupancy. As such, 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 further 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.

Assess Chillers & Request Tune-Ups

Chillers are responsible for a substantial portion of a commercial building's overall energy usage. When components of a chiller are not optimized, this can quickly result in a noticeable increase in energy bills. Chiller diagnostics can produce a 5% to 10% cost avoidance potential from discovery and implementation of low/no cost optimization strategies.

Clean and/or Replace HVAC Filters

Air filters work to reduce the amount of indoor air pollution and increase occupant comfort. Over time, filters become less and less effective as particulate buildup increases. In addition to health concerns related to clogged filters, filters that have reached saturation also restrict air flow through the facility's air conditioning or heat pump system, increasing the load on the distribution fans and decreasing occupant comfort levels. Filters should be checked monthly and cleaned or replaced when appropriate.

Check for and Seal Duct Leakage

Duct leakage in commercial buildings typically accounts for 5% to 25% of the supply airflow. In the case of rooftop air handlers, duct leakage can occur to the outside of the building, significantly increasing cooling and heating costs. By sealing sources of leakage, cooling, heating, and ventilation energy use can be reduced significantly, depending on the severity of air leakage.

Perform Proper Boiler Maintenance

Many boiler problems develop slowly over time, so regular inspection and maintenance is essential to retain proper functionality and efficiency of the heating system. Fuel burning equipment should undergo yearly tune-ups to ensure they are operating as safely and efficiently as possible from a combustion standpoint. A tune-up should include a combustion analysis to analyze the exhaust from the boilers and to ensure the boiler is operating safely. Buildup of dirt, dust, or deposits on the internal surfaces of a boiler can greatly affect its heat transfer efficiency. These deposits can accumulate on the water side or fire side of the boiler. Boilers should be cleaned regularly according to the manufacturer's instructions to remove this build up in order to sustain efficiency and equipment life.

Perform Maintenance on Compressed Air Systems

Like all electro-mechanical equipment, compressed air systems require periodic maintenance to operate at peak efficiency. A maintenance plan should be developed for process related compressed air systems to include inspection, cleaning, and replacement of inlet filter cartridges, cleaning of drain traps, daily inspection of lubricant levels to reduce unwanted friction, inspection of belt condition and tension, checking for system leaks and adjustment of loose connections, and overall system cleaning. Contact a qualified technician for help with setting up periodic maintenance schedule.

Plug Load Controls

There are a variety of ways to limit the energy use of plug loads including increasing occupant awareness, removing under-utilized equipment, installing hardware controls, and using software controls. Some control steps to take are to enable the most aggressive power settings on existing devices or install load sensing or occupancy sensing (advanced) power strips. For additional information refer to "Plug Load Best Practices Guide" http://www.advancedbuildings.net/plug-load-best-practices-guide-offices.

Water Conservation

Installing low-flow faucets or faucet aerators, low-flow showerheads, and kitchen sink pre-rinse spray valves saves both energy and water. These devices save energy by reducing the overall amount of hot water used hence reducing the energy used to heat the water. The flow ratings for EPA WaterSense™ (http://www3.epa.gov/watersense/products) labeled devices are 1.5 gpm for bathroom faucets, 2.0 gpm for showerheads, and 1.28 gpm for pre-rinse spray valves.

Installing dual flush or low-flow toilets and low-flow or waterless urinals are additional ways to reduce the sites water use, however, these devices do not provide energy savings at the site level. 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. The EPA WaterSense™ ratings for urinals is 0.5 gpf and toilets that use as little as 1.28 gpf (this is lower than the current 1.6 gpf federal standard).

Refer to Section 4.1.7 for any low-flow ECM recommendations.

6 On-Site Generation Measures

On-site generation measure options include both renewable (e.g., solar, wind) and non-renewable (e.g., fuel cells) on-site technologies that generate power to meet all or a portion of the electric energy needs of a facility, often repurposing any waste heat where applicable. Also referred to as distributed generation, these systems contribute to Greenhouse Gas (GHG) emission reductions, demand reductions and reduced customer electricity purchases, resulting in the electric system reliability through improved transmission and distribution system utilization.

The State of New Jersey's Energy Master Plan (EMP) encourages new distributed generation of all forms and specifically focuses on expanding use of combined heat and power (CHP) by reducing financial, regulatory and technical barriers and identifying opportunities for new entries. The EMP also outlines a goal of 70% of the State's electrical needs to be met by renewable sources by 2050.

Preliminary screenings were performed to determine the potential that a generation project could provide a cost-effective solution for your facility. Before making a decision to implement, a feasibility study should be conducted that would take a detailed look at 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.

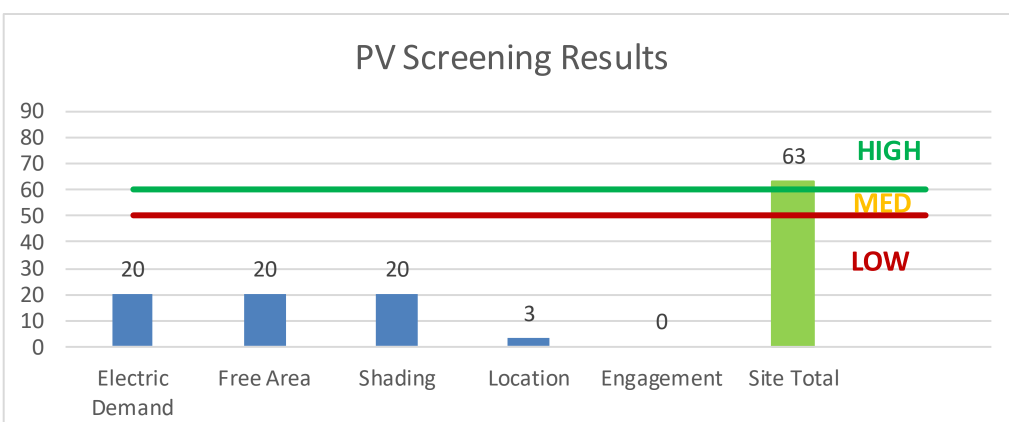
6.1 Photovoltaic

Sunlight can be converted into electricity using photovoltaics (PV) modules. Modules are racked together into an array that produces direct current (DC) electricity. The DC current is converted to alternating current (AC) through an inverter. The inverter is interconnected to the facility's electrical distribution system. The amount of unobstructed area available determines how large of a solar array can be installed. The size of the array combined with the orientation, tilt, and shading elements determines the energy produced.

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

The amount of free area, ease of installation (location), and the lack of shading elements contribute to the high potential for PV at the site. A PV array located on the roof of the main building/ground next to the building/over the main parking lot may be feasible. If JJH Marine Lab is interested in pursuing the installation of PV, we recommended a full feasibility study be conducted.

Figure 23 - Photovoltaic Screening



Potential	High	
System Potential	268	kW DC STC
Electric Generation	319,287	kWh/yr
Displaced Cost	$27,780	/yr
Installed Cost	$1,045,200	

Solar projects must register their projects in the SREC (Solar Renewable Energy Certificate) Registration Program prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about developed new solar projects and insight into future SREC pricing. Refer to Section 8.3 for additional information.

For more information on solar PV technology and commercial solar markets in New Jersey, or to find a qualified solar installer, who can provide a more detailed assessment of the specific costs and benefits of solar develop of the site, please visit the following links below:

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

6.2 Combined Heat and Power

Combined heat and power (CHP) is the on-site generation of electricity along with the recovery of heat energy, which is put to beneficial use. Common technologies for CHP include reciprocating engines, microturbines, fuel cells, backpressure steam turbines, and (at large facilities) gas turbines. Electric generation from a CHP system is typically interconnected to local power distribution systems. Heat is recovered from exhaust and ancillary cooling systems and interconnected to the existing hot water (or steam) distribution systems.

CHP systems are typically used to produce a portion of the electric power used onsite by a facility, with the balance of electric power needs supplied by grid purchases. The heat is used to supplement (or supplant) existing boilers for the purpose of space heating and/or domestic hot water heating. Waste heat can also be routed through absorption chillers for the purpose of space cooling. The key criteria used for screening, however, is the amount of time the system operates at full load and the facility's ability to use the recovered heat. Facilities with continuous use 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 a **Low** potential for installing a cost-effective CHP system.

Infrequent thermal load, and lack of space near the existing boilers are the most significant factors contributing to the low potential for CHP at the site. In our opinion, the facility does not appear to meet the minimum requirements for a cost-effective CHP installation.

For a list of qualified firms in New Jersey specializing in commercial CHP cost assessment and installation, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/tools-and-resources/tradeally/approved_vendorsearch/.

7 Demand Response

Demand Response (DR) is a program designed to reduce the electric load of commercial facilities when electric wholesale prices are high or when the reliability of the electric grid is threatened due to peak demand. Demand Response service providers (a.k.a. Curtailment Service Providers) are registered with PJM, the independent system operator (ISO) for mid-Atlantic state region that is charged with maintaining electric grid reliability.

By enabling grid operators to call upon Curtailment Service Providers and commercial facilities to reduce electric usage 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 DR programs. Program participation is voluntary and participants receive payments whether or not their facility is called upon to curtail their electric usage.

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

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

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

The first step toward participation in a DR program is to contact a Curtailment Service Provider. A list of these providers is available on PJM's website and it includes contact information for each company, as well as the states where they have active business (http://www.pjm.com/markets-and-operations/demand-response/csps.aspx). PJM also posts training materials that are developed for program members interested in specific rules and requirements regarding DR activity (http://www.pjm.com/training/training%20material.aspx), along with a variety of other DR program information.

Curtailment Service Providers typically offer free assessments to determine a facility's eligibility to participate in a DR program. They will provide details regarding program rules and requirements for metering and controls, assess a facility's ability to temporarily reduce electric load, and provide details on payments to be expected for participation in the program. Providers usually offer multiple options for DR to larger facilities and may also install controls or remote monitoring equipment of their own to help ensure compliance with all terms and conditions of a DR contract. Due to the critical lab and HVAC equipment needed to run during summer peak times this facility may not be a good candidate for DR program.

8 PROJECT FUNDING / INCENTIVES

The NJCEP is able to provide the incentive programs described below, and other benefits to ratepayers, because of the Societal Benefits Charge (SBC) Fund. The SBC was created by the State of New Jersey's Electricity Restructuring Law (1999), which requires all customers of investor-owned electric and gas utilities to pay a surcharge on their monthly energy bills. As a customer of a state-regulated electric or gas utility and therefore a contributor to the fund, your organization is eligible to participate in the LGEA program and also eligible to receive incentive payment for qualifying energy efficiency measures. Also available through the NJBPU are some alternative financing programs described later in this section. Please refer to Figure 24 for a list of the eligible programs identified for each recommended ECM.

Figure 24 - ECM Incentive Program Eligibility

Energy Conservation Measure		SmartStart Prescriptive	SmartStart Custom	Direct Install	Pay For Performance Existing Buildings	Large Energy Users Program	Combined Heat & Power and Fuel Cell
ECM 1	Install LED Fixtures	X			X		
ECM 2	Retrofit Fluorescent Fixtures with LED Lamps and Drivers	X			X		
ECM 3	Retrofit Fixtures with LED Lamps	X			X		
ECM 4	Install LED Exit Signs				X		
ECM 5	Install Occupancy Sensor Lighting Controls	X			X		
ECM 6	Install VFDs on Constant Volume (CV) HVAC	X			X		
ECM 7	Install VFDs on Chilled Water Pumps	X			X		
ECM 8	Install VFDs on Hot Water Pumps	X			X		
ECM 9	Install VFDs on Cooling Tower Fans	X			X		
ECM 10	Install High Efficiency Chillers	X			X		
ECM 11	Install High Efficiency Hot Water Boilers	X			X		
ECM 12	Install Low-Flow Domestic Hot Water Devices				X		

SmartStart is generally well-suited for implementation of individual measures or small group of measures. It provides flexibility to install measures at your own pace using in-house staff or a preferred contractor. Direct Install caters to small to mid-size facilities that can bundle multiple ECMs together. This can greatly simplify participation and may lead to higher incentive amounts, but requires the use of pre-approved contractors. The Pay for Performance (P4P) program is a "whole-building" energy improvement program designed for larger facilities. It requires implementation of multiple measures meeting minimum savings thresholds, as well as use of pre-approved consultants. The Large Energy Users Program (LEUP) is available to New Jersey's largest energy users giving them flexibility to install as little or as many measures, in a single facility or several facilities, with incentives capped based on the entity's annual energy consumption. LEUP applicants can use in-house staff or a preferred contractor.

Generally, the incentive values provided throughout the report assume the SmartStart program is utilized because it provides a consistent basis for comparison of available incentives for various measures, though in many cases incentive amounts may be higher through participation in other programs.

Brief descriptions of all relevant financing and incentive programs are located in the sections below. Further information, including most current program availability, requirements, and incentive levels can be found at: www.njcleanenergy.com/ci.

8.1 SmartStart

Overview

The SmartStart program offers incentives for installing prescriptive and custom energy efficiency measures at your facility. Routinely the program adds, removes or modifies incentives from year to year for various energy efficiency equipment based on market trends and new technologies.

<u>Equipment with Prescriptive Incentives Currently Available</u>:

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

Most equipment sizes and types are served by this program. This program provides an effective mechanism for securing incentives for energy efficiency measures installed individually or as part of a package of energy upgrades.

Incentives

The SmartStart prescriptive incentive program provides fixed incentives for specific energy efficiency measures, whereas the custom SmartStart program provides incentives for more unique or specialized technologies or systems that are not addressed through prescriptive incentive offerings for specific devices.

Since your facility is an existing building, only the retrofit incentives have been applied in this report. Custom measure incentives are calculated at $0.16/kWh and $1.60/therm based on estimated annual savings, capped at 50% of the total installed incremental project cost, or a project cost buy down to a one year payback (whichever is less). Program incentives are capped at $500,000 per electric account and $500,000 per natural gas account, per fiscal year.

How to Participate

To participate in the SmartStart program you will need to submit an application for the specific equipment to be installed. Many applications are designed as rebates, although others require application approval prior to installation. Applicants may work with a contractor of their choosing and can also utilize internal personnel, which provides added flexibility to the program. Using internal personnel also helps improve the economics of the ECM by reducing the labor cost that is included in the tables in this report.

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

8.2 Pay for Performance – Existing Buildings

Overview

The Pay for Performance – Existing Buildings (P4P EB) program is designed for larger customers with a peak demand over 200 kW in any of the preceding 12 months. Under this program the minimum installed scope of work must include at least two unique measures resulting in at least 15% energy savings, where lighting cannot make up the majority of the savings. P4P is a generally a good option for medium to large sized facilities looking to implement as many measures as possible under a single project in order to achieve deep energy savings. This program has an added benefit of evaluating a broad spectrum of measures that may not otherwise qualify under other programs. Many facilities pursuing an Energy Savings Improvement Program (ESIP) loan also utilize the P4P program.

Incentives

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

How to Participate

To participate in the P4B EB program you will need to contact one of the pre-approved consultants and contractors ("Partners"). Under direct contract to you, the Partner will help further evaluate the measures identified in this report through development of the Energy Reduction Plan (ERP), assist you in implementing selected measures, and verify actual savings one year after the installation. At each of these three milestones your Partner will also facilitate securing program incentives.

Approval of the final scope of work is required by the program prior to installation completion. Although installation can be accomplished by a contractor of your choice (some P4P Partners are also contractors) or by internal personnel, the Partner must remain involved to ensure compliance with the program guidelines and requirements.

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

8.3 SREC Registration Program

The SREC (Solar Renewable Energy Certificate) Registration Program (SRP) is used to register the intent to install solar projects in New Jersey. Rebates are not available for solar projects, but owners of solar projects MUST register their projects in the SRP prior to the start of construction in order to establish the project's eligibility to earn SRECs. Registration of the intent to participate in New Jersey's solar marketplace provides market participants with information about the pipeline of anticipated new solar capacity and insight into future SREC pricing.

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

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

Electricity suppliers, the primary purchasers of SRECs, are required to pay a Solar Alternative Compliance Payment (SACP) if they do not meet the requirements of New Jersey's Solar RPS. One way they can meet the RPS requirements is by purchasing SRECs. As SRECs are traded in a competitive market, the price may vary significantly. The actual price of an SREC during a trading period can and will fluctuate depending on supply and demand.

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

8.4 Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) is an alternate method for New Jersey's government agencies to finance the implementation of energy conservation measures. An ESIP is a type of "performance contract," whereby school districts, counties, municipalities, housing authorities and other public and state entities enter in to contracts to help finance building energy upgrades. This is done in a manner that ensures that annual payments are lower than the savings projected from the ECMs, ensuring that ESIP projects are cash flow positive in year one, and every year thereafter. 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 can be leveraged to help further reduce the total project cost of eligible measures.

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 utilized for some services and independent engineers, or other specialists or qualified staff, are used to deliver other requirements of the program.

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

The ESIP approach may not be appropriate for all energy conservation and energy efficiency improvements. Entities should carefully consider all alternatives to develop an approach that best meets their needs. A detailed program description and application can be found at: www.njcleanenergy.com/ESIP.

Please note that ESIP is a program delivered directly by the NJBPU and is not an NJCEP incentive program. As mentioned above, you may utilize NJCEP incentive programs to help further reduce costs when developing the ESP. You should refer to the ESIP guidelines at the link above for further information and guidance on next steps.

9 Energy Purchasing and Procurement Strategies

9.1 Retail Electric Supply Options

In 1999, New Jersey State Legislature passed the Electric Discount & Energy Competition Act (EDECA) to restructure the electric power industry in New Jersey. This law deregulated the retail electric markets, allowing all consumers to shop for service from competitive electric suppliers. The intent was to create a more competitive market for electric power supply in New Jersey. As a result, utilities were allowed to charge Cost of Service and customers were given the ability to choose a third-party (i.e., non-utility) energy supplier.

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

If your facility is not purchasing electricity from a third-party supplier, consider shopping for a reduced rate from third party electric suppliers. If your facility is purchasing electricity from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party electric suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: www.state.nj.us/bpu/commercial/shopping.html.

9.2 Retail Natural Gas Supply Options

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

A customer's decision about whether to buy natural gas from a retail supplier is typically dependent upon whether a customer seeks 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 is not purchasing natural gas from a third-party supplier, consider shopping for a reduced rate from third-party natural gas suppliers. If your facility is purchasing natural gas from a third-party supplier, review and compare prices at the end of the current contract or every couple years.

A list of third-party natural gas suppliers, who are licensed by the state to provide service in New Jersey, can be found online at: 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	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Penthouse mechanical room	29	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	Yes	29	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	1.60	5,768	0.0	$702.46	$2,534.40	$360.00	3.10
Generator room	6	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.16	582	0.0	$70.84	$219.09	$60.00	2.25
Condenser pump room	1	Compact Fluorescent: 23W Screw-In	Wall Switch	23	2,600	Relamp	No	1	LED - Fixtures: Ceiling Mount	Wall Switch	10	2,600	0.01	38	0.0	$4.65	$20.00	$0.00	4.30
1st Floor boiler room	12	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	12	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.58	2,080	0.0	$253.32	$825.27	$120.00	2.78
Chiller room	36	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	36	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	1.73	6,240	0.0	$759.96	$2,475.81	$360.00	2.78
Office 107	3	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.24	851	0.0	$103.64	$562.55	$80.00	4.66
Office 106	3	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.24	851	0.0	$103.64	$562.55	$80.00	4.66
Office 105	2	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	2,600	Relamp & Reballast	Yes	2	LED - Linear Tubes: (4) 4' Lamps	Occupancy Sensor	58	1,820	0.22	796	0.0	$96.89	$506.73	$75.00	4.46
Office 104	6	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	6	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.47	1,702	0.0	$207.27	$855.11	$125.00	3.52
Office 103	5	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	Yes	5	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.28	995	0.0	$121.11	$613.86	$85.00	4.37
Office 103	1	U-Bend Fluorescent - T12: U T12 (34W) - 2L	Wall Switch	72	2,600	Relamp & Reballast	Yes	1	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,820	0.05	177	0.0	$21.50	$334.77	$45.00	13.48
Acquarium 102	281	Compact Fluorescent: 13W 4-Pin	Wall Switch	13	657	Relamp	No	281	LED - Fixtures: Ceiling Mount	Wall Switch	10	657	0.69	626	0.0	$76.22	$14,050.00	$0.00	184.34
Acquarium 102	240	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	657	Relamp & Reballast	No	240	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	657	16.30	14,878	0.0	$1,811.87	$23,404.32	$3,600.00	10.93
Acquarium 102	12	Incandescent: 60W Incandascent	Wall Switch	60	657	Relamp	No	12	LED Screw-In Lamps: 10W screw-in	Wall Switch	10	657	0.49	445	0.0	$54.25	$206.70	$60.00	2.70
Hallway	19	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,600	Relamp & Reballast	No	19	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.49	1,758	0.0	$214.14	$959.79	$95.00	4.04
Hallway	4	Linear Fluorescent - T12: 3' T12 (30W) - 1L	Wall Switch	46	2,600	Relamp & Reballast	No	4	LED - Linear Tubes: (1) 3' Lamp	Wall Switch	11	2,600	0.12	417	0.0	$50.81	$202.06	$0.00	3.98
Exit	4	Exit Signs: Fluorescent	None	16	8,760	Fixture Replacement	No	4	LED Exit Signs: 2 W Lamp	None	6	8,760	0.03	396	0.0	$48.22	$289.66	$0.00	6.01
Lab 124	29	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	29	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	2.28	8,226	0.0	$1,001.82	$3,368.02	$505.00	2.86
Lab 124	31	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	31	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	1.34	4,827	0.0	$587.86	$1,073.98	$225.00	1.44
Lab 122	40	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	40	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	3.14	11,347	0.0	$1,381.81	$4,440.72	$670.00	2.73
Lab 122	4	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	796	0.0	$96.89	$545.09	$75.00	4.85
Lab 122	26	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	26	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	1.12	4,049	0.0	$493.04	$987.85	$200.00	1.60
Lab 125	14	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	1.10	3,971	0.0	$483.63	$1,905.25	$280.00	3.36
Lab 125	4	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	796	0.0	$96.89	$545.09	$75.00	4.85
Lab 125	10	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	10	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	0.43	1,557	0.0	$189.63	$712.25	$120.00	3.12

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Closet	3	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.14	520	0.0	$63.33	$206.32	$30.00	2.78
Lab 123	14	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	1.10	3,971	0.0	$483.63	$1,905.25	$280.00	3.36
Lab 123	4	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	796	0.0	$96.89	$545.09	$75.00	4.85
Lab 123	10	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	10	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	0.43	1,557	0.0	$189.63	$712.25	$120.00	3.12
Lab 121	14	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	1.10	3,971	0.0	$483.63	$1,905.25	$280.00	3.36
Lab 121	4	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	796	0.0	$96.89	$545.09	$75.00	4.85
Lab 121	10	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	10	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	0.43	1,557	0.0	$189.63	$712.25	$120.00	3.12
Lab 119	14	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	1.10	3,971	0.0	$483.63	$1,905.25	$280.00	3.36
Lab 119	4	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	Yes	4	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.22	796	0.0	$96.89	$545.09	$75.00	4.85
Lab 119	10	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	10	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	0.43	1,557	0.0	$189.63	$712.25	$120.00	3.12
Lab 117	14	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	1.10	3,971	0.0	$483.63	$1,905.25	$280.00	3.36
Lab 117	16	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	16	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	0.69	2,491	0.0	$303.41	$815.60	$150.00	2.19
Lab 115	14	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	14	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	1.10	3,971	0.0	$483.63	$1,905.25	$280.00	3.36
Lab 115	16	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	16	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	0.69	2,491	0.0	$303.41	$815.60	$150.00	2.19
Lab 120	32	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	32	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	2.51	9,077	0.0	$1,105.45	$3,660.58	$550.00	2.81
Lab 120	23	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	23	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	0.99	3,581	0.0	$436.16	$936.18	$185.00	1.72
Lab 120	3	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.24	851	0.0	$103.64	$562.55	$80.00	4.66
Closet	3	Compact Fluorescent: 13W 4-Pin	Wall Switch	13	2,600	Relamp	No	3	LED - Fixtures: Ceiling Mount	Wall Switch	10	2,600	0.01	26	0.0	$3.22	$300.00	$0.00	93.16
Lab 118	39	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	39	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	3.06	11,063	0.0	$1,347.27	$4,343.20	$655.00	2.74
Lab 118	2	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.11	398	0.0	$48.45	$407.55	$55.00	7.28
Lab 118	13	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	13	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	0.56	2,024	0.0	$246.52	$763.93	$135.00	2.55
Lab 116	40	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	40	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	3.14	11,347	0.0	$1,381.81	$4,440.72	$670.00	2.73
Lab 116	26	Incandescent: 60W Incandascent	Wall Switch	60	2,600	Relamp	Yes	26	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	1.12	4,049	0.0	$493.04	$987.85	$200.00	1.60
Hallway	26	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,600	Relamp & Reballast	No	26	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.67	2,406	0.0	$293.04	$1,313.39	$130.00	4.04
Hallway	2	Linear Fluorescent - T12: 3' T12 (30W) - 1L	Wall Switch	46	2,600	Relamp & Reballast	No	2	LED - Linear Tubes: (1) 3' Lamp	Wall Switch	11	2,600	0.06	209	0.0	$25.40	$101.03	$0.00	3.98

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Hallway	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	1	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Stairwell	5	Linear Fluorescent - T8: 4' T8 (32W) - 2L	Wall Switch	62	2,600	Relamp	No	5	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.13	485	0.0	$59.04	$182.58	$50.00	2.25
Stairwell	1	Exit Signs: Fluorescent	None	16	8,760	Fixture Replacement	No	1	LED Exit Signs: 2 W Lamp	None	6	8,760	0.01	99	0.0	$12.06	$72.42	$0.00	6.01
Hallway	12	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,600	Relamp & Reballast	No	12	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.31	1,111	0.0	$135.25	$606.18	$60.00	4.04
Hallway	1	Linear Fluorescent - T12: 3' T12 (30W) - 1L	Wall Switch	46	2,600	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 3' Lamp	Wall Switch	11	2,600	0.03	104	0.0	$12.70	$50.52	$0.00	3.98
114 Field prep	19	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	19	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.91	3,293	0.0	$401.09	$1,306.68	$190.00	2.78
Freezer	4	Compact Fluorescent: Pin based	Wall Switch	13	2,600	Relamp	No	4	LED - Fixtures: Downlight Pendant	Wall Switch	10	2,600	0.01	35	0.0	$4.29	$400.00	$0.00	93.16
Room 113	14	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	14	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.67	2,427	0.0	$295.54	$962.82	$140.00	2.78
Office 110	2	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	2,600	Relamp & Reballast	No	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,600	0.19	693	0.0	$84.44	$236.73	$40.00	2.33
Restroom (M)	3	U-Bend Fluorescent - T12: U T12 (34W) - 2L	Wall Switch	72	2,600	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,820	0.15	530	0.0	$64.51	$464.32	$65.00	6.19
Restroom (M)	1	Incandescent: 60W Incandescent	Wall Switch	60	2,600	Relamp	Yes	1	LED Screw-In Lamps: 10W screw-in	Occupancy Sensor	10	1,820	0.04	156	0.0	$18.96	$287.23	$40.00	13.04
Restroom (W)	3	U-Bend Fluorescent - T12: U T12 (34W) - 2L	Wall Switch	72	2,600	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,820	0.15	530	0.0	$64.51	$464.32	$65.00	6.19
Office 109	3	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.24	851	0.0	$103.64	$562.55	$80.00	4.66
Office 108	3	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	3	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.24	851	0.0	$103.64	$562.55	$80.00	4.66
Lobby	18	Compact Fluorescent: Pin based	Wall Switch	13	2,600	Relamp	No	18	LED - Fixtures: Downlight Pendant	Wall Switch	10	2,600	0.04	159	0.0	$19.32	$1,800.00	$0.00	93.16
Lobby	31	Compact Fluorescent: Pin based	Wall Switch	23	2,600	Relamp	No	31	LED - Fixtures: Downlight Pendant	Wall Switch	10	2,600	0.33	1,184	0.0	$144.19	$3,100.00	$0.00	21.50
Exit	3	Exit Signs: Fluorescent	None	20	8,760	Fixture Replacement	No	3	LED Exit Signs: 2 W Lamp	None	6	8,760	0.03	416	0.0	$50.63	$217.25	$0.00	4.29
2nd Floor - 206 A to E	10	Incandescent: 60W Incandescent	Wall Switch	60	2,600	Relamp	No	10	LED Screw-In Lamps: 10W screw-in	Wall Switch	10	2,600	0.41	1,469	0.0	$178.90	$172.25	$50.00	0.68
3rd Floor - 206 A to E	18	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	2,600	Relamp & Reballast	No	18	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,600	1.73	6,240	0.0	$759.96	$2,130.53	$360.00	2.33
Office 207	3	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	3	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.20	736	0.0	$89.63	$292.55	$45.00	2.76
Office 204	3	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	2,600	Relamp & Reballast	No	3	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,600	0.29	1,040	0.0	$126.66	$355.09	$60.00	2.33
Office 205	3	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	3	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.20	736	0.0	$89.63	$292.55	$45.00	2.76
Office 203	2	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.14	491	0.0	$59.75	$195.04	$30.00	2.76
201/202 Lab	2	U-Bend Fluorescent - T12: U T12 (34W) - 2L	Wall Switch	72	2,600	Relamp & Reballast	Yes	2	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,820	0.10	353	0.0	$43.01	$399.55	$55.00	8.01
201/202 Lab	14	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	Yes	14	LED - Linear Tubes: (2) 4' Lamps	Occupancy Sensor	29	1,820	0.77	2,785	0.0	$339.12	$1,502.82	$210.00	3.81

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
201/202 Lab	4	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	Yes	4	LED - Linear Tubes: (3) 4' Lamps	Occupancy Sensor	44	1,820	0.31	1,135	0.0	$138.18	$660.07	$95.00	4.09
Restroom (M)	3	U-Bend Fluorescent - T12: U T12 (34W) - 2L	Wall Switch	72	2,600	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,820	0.15	530	0.0	$64.51	$464.32	$65.00	6.19
Restroom (W)	3	U-Bend Fluorescent - T12: U T12 (34W) - 2L	Wall Switch	72	2,600	Relamp & Reballast	Yes	3	LED - Linear Tubes: (2) 2' Lamps	Occupancy Sensor	17	1,820	0.15	530	0.0	$64.51	$464.32	$65.00	6.19
Room 227	26	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	26	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	1.25	4,507	0.0	$548.86	$1,788.09	$260.00	2.78
Exit	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	None	No	2	Exit Signs: LED - 2 W Lamp	None	6	8,760	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Office 224	11	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	11	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.75	2,699	0.0	$328.64	$1,072.70	$165.00	2.76
Office 22 A-D	7	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	7	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.48	1,717	0.0	$209.13	$682.63	$105.00	2.76
Office 22 A-D	6	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	2,600	Relamp & Reballast	No	6	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,600	0.58	2,080	0.0	$253.32	$710.18	$120.00	2.33
Office 22 A-D	1	Linear Fluorescent - T12: 4' T12 (40W) - 1L	Wall Switch	46	2,600	Relamp & Reballast	No	1	LED - Linear Tubes: (1) 4' Lamp	Wall Switch	15	2,600	0.03	93	0.0	$11.27	$50.52	$5.00	4.04
Office 220 A-B	4	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	4	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.27	981	0.0	$119.50	$390.07	$60.00	2.76
218 Temp Control	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.05	173	0.0	$21.11	$68.77	$10.00	2.78
216 Temp Control	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.05	173	0.0	$21.11	$68.77	$10.00	2.78
214 Temp Control	1	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	1	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.05	173	0.0	$21.11	$68.77	$10.00	2.78
Room 225 A/B	26	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	26	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	1.25	4,507	0.0	$548.86	$1,788.09	$260.00	2.78
Room 225 A/B	2	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	2,600	Relamp & Reballast	No	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,600	0.19	693	0.0	$84.44	$236.73	$40.00	2.33
Room 221	2	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	2,600	Relamp & Reballast	No	2	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,600	0.19	693	0.0	$84.44	$236.73	$40.00	2.33
Room 219 A-D	10	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	10	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.68	2,453	0.0	$298.76	$975.18	$150.00	2.76
Room 219 A-D	3	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	3	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.14	520	0.0	$63.33	$206.32	$30.00	2.78
Room 219 A-D	23	LED - Fixtures: Ambient - 4' - Indirect Fixture	Wall Switch	13	2,600	None	No	23	LED - Fixtures: Ambient - 4' - Indirect Fixture	Wall Switch	13	2,600	0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Room 219 A-D	14	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	14	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.67	2,427	0.0	$295.54	$962.82	$140.00	2.78
Room 219 A-D	6	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	6	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.41	1,472	0.0	$179.26	$585.11	$90.00	2.76
Room 215	2	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.14	491	0.0	$59.75	$195.04	$30.00	2.76
Room 213	2	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.14	491	0.0	$59.75	$195.04	$30.00	2.76
Room 212	6	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	6	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.29	1,040	0.0	$126.66	$412.64	$60.00	2.78
Room 211	2	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.14	491	0.0	$59.75	$195.04	$30.00	2.76

	Existing Conditions					Proposed Conditions							Energy Impact & Financial Analysis						
Location	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Fixture Recommendation	Add Controls?	Fixture Quantity	Fixture Description	Control System	Watts per Fixture	Annual Operating Hours	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Room 210	10	Linear Fluorescent - T12: 4' T12 (40W) - 2L	Wall Switch	88	2,600	Relamp & Reballast	No	10	LED - Linear Tubes: (2) 4' Lamps	Wall Switch	29	2,600	0.48	1,733	0.0	$211.10	$687.73	$100.00	2.78
Room 209	2	Linear Fluorescent - T12: 4' T12 (40W) - 3L	Wall Switch	127	2,600	Relamp & Reballast	No	2	LED - Linear Tubes: (3) 4' Lamps	Wall Switch	44	2,600	0.14	491	0.0	$59.75	$195.04	$30.00	2.76
Room 208 A-B	9	Linear Fluorescent - T12: 4' T12 (40W) - 4L	Wall Switch	176	2,600	Relamp & Reballast	No	9	LED - Linear Tubes: (4) 4' Lamps	Wall Switch	58	2,600	0.86	3,120	0.0	$379.98	$1,065.27	$180.00	2.33
Lobby	33	Compact Fluorescent: 23W Screw-In	Wall Switch	23	2,600	Relamp	No	33	LED - Fixtures: Ceiling Mount	Wall Switch	10	2,600	0.35	1,260	0.0	$153.50	$660.00	$0.00	4.30
Hallway	23	U-Bend Fluorescent - T12: U T12 (34W) - 2L	Wall Switch	72	2,600	Relamp & Reballast	No	23	LED - Linear Tubes: (2) 2' Lamps	Wall Switch	17	2,600	1.03	3,717	0.0	$452.61	$1,489.77	$230.00	2.78
Exit	9	Exit Signs: Fluorescent	None	20	8,760	Fixture Replacement	No	9	LED Exit Signs: 2 W Lamp	None	6	8,760	0.10	1,247	0.0	$151.89	$651.74	$0.00	4.29
Exterior	11	High-Pressure Sodium: (1) 70W Lamp	Daylight Dimming	95	4,380	Fixture Replacement	No	11	LED - Fixtures: Outdoor Wall-Mounted Area Fixture	Daylight Dimming	28	4,380	0.60	3,648	0.0	$444.23	$5,500.00	$1,100.00	9.90
Exterior	20	Metal Halide: (1) 250W Lamp	Daylight Dimming	295	4,380	Fixture Replacement	No	20	LED - Fixtures: Large Pole/Arm-Mounted Area/Roadway Fixture	Daylight Dimming	82	4,380	3.47	21,084	0.0	$2,567.72	$23,890.08	$0.00	9.30

Motor Inventory & Recommendations

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Attic mechanical room	Lab building	1	Supply Fan	0.5	65.0%	No	5,256	Yes	78.2%	No		0.05	382	0.0	$46.50	$352.26	$0.00	7.58
Attic mechanical room	Lab building	1	Supply Fan	0.8	65.0%	No	5,256	Yes	81.1%	No		0.09	674	0.0	$82.03	$413.05	$0.00	5.04
Attic mechanical room	Lab building	1	Supply Fan	1.0	82.5%	No	5,256	Yes	85.5%	Yes	1	0.31	1,746	0.0	$212.67	$3,010.13	$80.00	13.78
Attic mechanical room	Organic Chemistry	1	Supply Fan	0.5	65.0%	No	5,256	Yes	78.2%	Yes	1	0.21	1,237	0.0	$150.62	$2,695.54	$40.00	17.63
Attic mechanical room	Microbiology	1	Supply Fan	1.0	82.5%	No	5,256	Yes	85.5%	Yes	1	0.31	1,746	0.0	$212.67	$3,010.13	$80.00	13.78
Attic mechanical room	Lab building	1	Supply Fan	0.3	65.0%	No	5,256	Yes	69.5%	Yes	1	0.10	568	0.0	$69.22	$2,742.92	$20.00	39.34
Attic mechanical room	Lab building	1	Supply Fan	5.0	87.5%	No	5,256	Yes	89.5%	Yes	1	1.45	8,142	0.0	$991.50	$4,076.22	$400.00	3.71
Attic mechanical room	Lab building	1	Supply Fan	5.0	87.5%	No	5,256	Yes	89.5%	Yes	1	1.45	8,142	0.0	$991.50	$4,076.22	$400.00	3.71
Attic mechanical room	Lab building	1	Supply Fan	3.0	86.5%	No	5,256	Yes	89.5%	Yes	1	0.88	4,990	0.0	$607.68	$3,884.01	$240.00	6.00
Attic mechanical room	2nd floor lab spaces	1	Supply Fan	10.0	89.5%	No	5,256	Yes	91.7%	Yes	1	2.83	15,942	0.0	$1,941.49	$5,151.50	$800.00	2.24
Attic mechanical room	1st and 2nd floor offices + acquarium	1	Supply Fan	20.0	91.0%	No	5,256	Yes	93.0%	Yes	1	5.57	31,291	0.0	$3,810.66	$8,582.03	$1,600.00	1.83
Attic mechanical room	1st floor seawater labs	1	Supply Fan	10.0	89.5%	No	5,256	Yes	91.7%	Yes	1	2.83	15,942	0.0	$1,941.49	$5,151.50	$800.00	2.24
Attic mechanical room	Lab building	1	Supply Fan	20.0	91.0%	No	0	Yes	93.0%	Yes	1	0.00	0	0.0	$0.00	$8,582.03	$1,600.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.1	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.3	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.1	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.1	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.1	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.1	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.1	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Attic mechanical room	Lab building	1	Exhaust Fan	0.1	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.2	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.2	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.3	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.4	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.3	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.3	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	2.0	84.0%	No	8,760	Yes	86.5%	Yes	1	0.61	5,686	0.0	$692.50	$3,261.02	$160.00	4.48
Attic mechanical room	Lab building	1	Exhaust Fan	5.0	87.5%	No	8,760	Yes	89.5%	Yes	1	1.45	13,569	0.0	$1,652.51	$4,076.22	$400.00	2.22
Attic mechanical room	Lab building	1	Exhaust Fan	5.0	87.5%	No	8,760	Yes	89.5%	Yes	1	1.45	13,569	0.0	$1,652.51	$4,076.22	$400.00	2.22
Attic mechanical room	Lab building	1	Exhaust Fan	5.0	87.5%	No	8,760	Yes	89.5%	Yes	1	1.45	13,569	0.0	$1,652.51	$4,076.22	$400.00	2.22
Attic mechanical room	Lab building	1	Exhaust Fan	7.5	87.5%	No	8,760	Yes	91.0%	Yes	1	2.19	20,642	0.0	$2,513.80	$4,738.24	$600.00	1.65
Attic mechanical room	Lab building	1	Exhaust Fan	5.0	87.5%	No	8,760	Yes	89.5%	Yes	1	1.45	13,569	0.0	$1,652.51	$4,076.22	$400.00	2.22
Attic mechanical room	Lab building	1	Exhaust Fan	1.0	82.5%	No	8,760	Yes	85.5%	Yes	1	0.31	2,911	0.0	$354.45	$3,010.13	$80.00	8.27
Attic mechanical room	Lab building	1	Exhaust Fan	1.0	82.5%	No	8,760	Yes	85.5%	Yes	1	0.31	2,911	0.0	$354.45	$3,010.13	$80.00	8.27
Attic mechanical room	Lab building	1	Exhaust Fan	0.0	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.0	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.0	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.0	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.2	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Attic mechanical room	Lab building	1	Exhaust Fan	0.4	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Attic mechanical room	Lab building	1	Exhaust Fan	0.3	65.0%	No	2,745	No	65.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Exterior	Lab building	1	Cooling Tower Fan	15.0	90.0%	No	3,391	Yes	93.0%	Yes	1	0.20	18,667	0.0	$2,273.27	$7,041.17	$900.00	2.70
Exterior	Lab building	1	Cooling Tower Fan	15.0	90.0%	No	3,391	Yes	93.0%	Yes	1	0.20	18,667	0.0	$2,273.27	$7,041.17	$900.00	2.70
Chiller room	Lab building	1	Condenser Water Pump	40.0	93.0%	No	8,760	Yes	94.1%	No		0.21	2,464	0.0	$300.10	$4,005.75	$0.00	13.35
Chiller room	Lab building	1	Condenser Water Pump	40.0	93.0%	No	8,760	Yes	94.1%	No		0.21	2,464	0.0	$300.10	$4,005.75	$0.00	13.35
Boiler room	Lab building	1	Heating Hot Water Pump	15.0	90.0%	No	3,391	Yes	93.0%	Yes	1	2.01	18,667	0.0	$2,273.27	$7,041.17	$0.00	3.10
Boiler room	Lab building	1	Heating Hot Water Pump	15.0	90.0%	No	3,391	Yes	93.0%	Yes	1	2.01	18,667	0.0	$2,273.27	$7,041.17	$0.00	3.10
Chiller room	Lab building	1	Chilled Water Pump	25.0	88.5%	No	4,067	Yes	93.6%	Yes	1	3.58	38,403	0.0	$4,676.79	$10,845.23	$1,500.00	2.00
Chiller room	Lab building	1	Chilled Water Pump	25.0	88.5%	No	4,067	Yes	93.6%	Yes	1	3.58	38,403	0.0	$4,676.79	$10,845.23	$1,500.00	2.00
Chiller room	Lab building	1	Chilled Water Pump	7.5	87.5%	No	3,391	Yes	91.0%	Yes	1	1.05	9,632	0.0	$1,173.04	$4,738.24	$0.00	4.04
Chiller room	Lab building	2	Chilled Water Pump	15.0	90.0%	No	3,391	Yes	93.0%	Yes	1	4.03	37,333	0.0	$4,546.55	$12,165.49	$1,800.00	2.28
Chiller room	Lab building	2	Chilled Water Pump	5.0	87.5%	No	2,745	Yes	89.5%	Yes	1	1.35	10,306	0.0	$1,255.07	$5,408.69	$0.00	4.31
Chiller room	Lab building	2	Chilled Water Pump	1.5	84.0%	No	2,745	Yes	86.5%	Yes	1	0.43	3,232	0.0	$393.61	$4,523.94	$0.00	11.49
Chiller room	Lab building	2	Chilled Water Pump	2.0	84.0%	No	2,745	Yes	86.5%	Yes	1	0.57	4,309	0.0	$524.82	$4,071.99	$0.00	7.76
Boiler room	Lab building	2	Heating Hot Water Pump	1.0	82.5%	No	2,745	Yes	85.5%	No		0.04	131	0.0	$15.91	$948.12	$0.00	59.59
Boiler room	Lab building	2	Heating Hot Water Pump	1.5	84.0%	No	2,745	Yes	86.5%	No		0.04	159	0.0	$19.31	$1,516.29	$0.00	78.54
Boiler room	Lab building	1	Other	10.0	89.5%	No	3,391	No	89.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chiller room	Lab building	1	Air Compressor	40.0	93.0%	Yes	4,957	No	93.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Chiller room	Lab building	1	Air Compressor	10.0	89.5%	No	4,957	No	89.5%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00

		Existing Conditions						Proposed Conditions				Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency	VFD Control?	Annual Operating Hours	Install High Efficiency Motors?	Full Load Efficiency	Install VFDs?	Number of VFDs	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Seawater pump house	Vacuum pump	2	Process Pump	5.0	87.5%	No	2,745	Yes	89.5%	No		0.11	392	0.0	$47.77	$1,600.74	$0.00	33.51
Seawater pump house	#1 Main Sea Water Pump	1	Process Pump	7.5	91.0%	No	3,391	No	91.0%	No		0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Seawater pump house	#2 Main Sea Water Pump	1	Process Pump	7.5	86.5%	No	3,391	Yes	91.0%	No		0.18	813	0.0	$99.07	$1,131.44	$0.00	11.42
Seawater pump house	First Stage Booster	1	Process Pump	15.0	87.5%	No	3,391	Yes	93.0%	No		0.42	1,923	0.0	$234.25	$1,846.72	$0.00	7.88
Seawater pump house	Iron Flock	1	Process Pump	1.5	84.0%	No	2,745	Yes	86.5%	No		0.02	79	0.0	$9.65	$758.15	$0.00	78.54
Seawater pump house	Iron Removal	1	Process Pump	1.5	78.5%	No	2,745	Yes	86.5%	No		0.07	271	0.0	$33.05	$758.15	$0.00	22.94
Seawater pump house	Backwash	1	Process Pump	15.0	86.5%	No	3,391	Yes	93.0%	No		0.50	2,300	0.0	$280.04	$1,846.72	$0.00	6.59
Seawater pump house	Booster Pumps to Lab	1	Process Pump	15.0	88.5%	No	3,391	Yes	93.0%	No		0.34	1,556	0.0	$189.49	$1,846.72	$0.00	9.75

Electric Chiller Inventory & Recommendations

		Existing Conditions			Proposed Conditions							Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	Chiller Quantity	System Type	Cooling Capacity per Unit (Tons)	Install High Efficiency Chillers?	Chiller Quantity	System Type	Constant/ Variable Speed	Cooling Capacity (Tons)	Full Load Efficiency (kW/Ton)	IPLV Efficiency (kW/Ton)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
1st Floor Chiller Room	Lab Building	1	Water-Cooled Screw Chiller	236.00	Yes	1	Water-Cooled Screw Chiller	Variable	236.00	0.68	0.43	20.29	67,836	0.0	$8,261.27	$171,331.28	$10,148.00	19.51
1st Floor Chiller Room	Lab Building	1	Water-Cooled Screw Chiller	64.00	Yes	1	Water-Cooled Screw Chiller	Variable	64.00	0.78	0.49	27.67	166,522	0.0	$20,279.45	$64,645.57	$2,560.00	3.06
1st Floor Chiller Room	Lab Building	1	Water-Cooled Screw Chiller	89.00	Yes	1	Water-Cooled Screw Chiller	Variable	89.00	0.75	0.48	4.17	25,111	0.0	$3,058.12	$89,897.75	$3,827.00	28.14

Fuel Heating Inventory & Recommendations

		Existing Conditions			Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Output Capacity per Unit (MBh)	Install High Efficiency System?	System Quantity	System Type	Output Capacity per Unit (MBh)	Heating Efficiency	Heating Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler Room	Lab Building	1	Non-Condensing Hot Water Boiler	1,670.00	Yes	1	Non-Condensing Hot Water Boiler	1,670.00	85.00%	Et	0.00	0	198.0	$3,006.93	$29,812.05	$2,505.00	9.08
Boiler Room	Lab Building	1	Non-Condensing Hot Water Boiler	1,670.00	Yes	1	Non-Condensing Hot Water Boiler	1,670.00	85.00%	Et	0.00	0	198.0	$3,006.93	$29,812.05	$2,505.00	9.08
Boiler Room	Seawater heating	1	Non-Condensing Hot Water Boiler	840.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00
Boiler Room	Seawater heating	1	Non-Condensing Hot Water Boiler	840.00	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

DHW Inventory & Recommendations

		Existing Conditions		Proposed Conditions						Energy Impact & Financial Analysis						
Location	Area(s)/System(s) Served	System Quantity	System Type	Replace?	System Quantity	System Type	Fuel Type	System Efficiency	Efficiency Units	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Boiler room	Lab building	1	Storage Tank Water Heater (> 50 Gal)	No						0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Low-Flow Device Recommendations

	Recommedation Inputs				Energy Impact & Financial Analysis						
Location	Device Quantity	Device Type	Existing Flow Rate (gpm)	Proposed Flow Rate (gpm)	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
Restrooms	12	Faucet Aerator (Lavatory)	2.20	1.00	0.00	0	17.5	$266.36	$86.04	$0.00	0.32

Walk-In Cooler/Freezer Inventory & Recommendations

	Existing Conditions		Proposed Conditions			Energy Impact & Financial Analysis						
Location	Cooler/ Freezer Quantity	Case Type/Temperature	Install EC Evaporator Fan Motors?	Install Electric Defrost Control?	Install Evaporator Fan Control?	Total Peak kW Savings	Total Annual kWh Savings	Total Annual MMBtu Savings	Total Annual Energy Cost Savings	Total Installation Cost	Total Incentives	Simple Payback w/ Incentives in Years
1st Floor	2	Low Temp Freezer (-35F to -5F)	No	No	No	0.00	0	0.0	$0.00	$0.00	$0.00	0.00

Plug Load Inventory

	Existing Conditions			
Location	Quantity	Equipment Description	Energy Rate (W)	ENERGY STAR Qualified?
Offices	25	Desktop Computer	75.0	No
Lobby	2	46" T.V.	150.0	No
Offices	3	Mini fridge	50.0	No
Kitchen	2	Microwave	1,000.0	No
Offices	3	Printer (medium)	300.0	No
Offices	1	Printer (large)	515.0	No
Labs	3	Ice maker	960.0	Yes
Labs	4	Chest freezer	650.0	No

Appendix B: ENERGY STAR® Statement of Energy Performance

ENERGY STAR® Statement of Energy Performance

LEARN MORE AT energystar.gov

N/A

ENERGY STAR® Score[1]

James J Howard Marine Sciences Lab

Primary Property Type: Laboratory
Gross Floor Area (ft²): 40,638
Built: 1994

For Year Ending: May 31, 2018
Date Generated: November 30, 2018

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
James J Howard Marine Sciences Lab 74-A Magruder Road Highlands, New Jersey 07732-0428	_______________ , (___)___-_____	____ _______ , (___)___-_____ _______________

Property ID: 6629714

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
411.5 kBtu/ft²

Annual Energy by Fuel

Electric - Grid (kBtu)	8,785,996 (52%)	
Fuel Oil (No. 2) (kBtu)	7,935,138 (48%)	

Source EUI
802.6 kBtu/ft²

National Median Comparison

National Median Site EUI (kBtu/ft²)	183.1
National Median Source EUI (kBtu/ft²)	318.2
% Diff from National Median Source EUI	152%

Annual Emissions

Greenhouse Gas Emissions (Metric Tons CO2e/year)	1,479

Signature & Stamp of Verifying Professional

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

Signature: ____________________Date: __________

Licensed Professional

____ _______
,
(___)___-_____
____

Professional Engineer Stamp
(if applicable)