Township of Piscataway

Energy Savings Plan

December 7, 2023

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1.0 Executive Summary

1.1 Overview of the Energy Savings Improvement Program

The Energy Savings Improvement Program (ESIP) was created in 2009 by the NJ legislature to reduce energy & operational costs, reinvest in infrastructure, and support the individual goals of public entities across the state. ESIP is a design-build financing mechanism that is regulated by the NJ Board of Public Utilities (BPU). Township of Piscataway will implement a comprehensive ESIP that addresses building energy and infrastructure needs.

Schneider Electric has hired by the Township of Piscataway on January 24, 2023 via a national cooperative contract under 1GPA. This project is done under the ESCO model with no architect/engineer of record. The Township hired T&M associates as the 3rd party reviewer on September 20, 2023. The Township's bond counsel is McManimon, Scotland, and Baumann, LLC and financial advisor is NW Financial.

The energy conservation measures (ECMs) included in the ESIP were developed in partnership with the Township's staff to meet the following project goals:

1. Reduce energy and operational expenses
2. Generate renewable energy onsite
3. Improve indoor air quality and comfort inside the facilities
4. Provide public EV vehicle chargers across the Township
5. Replace failing HVAC that is beyond useful life
6. Provide resiliency for operations when power is out

The ECMs in the Energy Savings Plan include HVAC upgrades, Building Automation System (BAS) upgrades, solar PV systems, building envelope improvements, air quality enhancements, LED lighting, and EV chargers. The following chart provides an overview of the ECMs included at each facility.

Solution Matrix	Town Hall	Public Safety	DPW	DPW Garage	JFK	Sr. Ctr	YMCA	Westergard	Sterling Village	Little League	Columbus Park	Riverside Park
Sustainability												
Solar PV	X	X	X		X	X	X	X	X			
EV Chargers		X			X		X	X	X			
Battery Energy Storage	X	X										
Efficiency												
LED Lighting - Interior	X	X	X	X	X	X		X	X			
LED Lighting - Exterior	X		X	X	X			X				
Building Envelope & Weatherization	X	X	X		X	X	X	X	X			
HW Pipe Insulation							X	X	X			
Comfort & Indoor Air Quality												
Control Attic Relief/Exhaust Fans		X										
Replace RTU/AHU						X		X				
Bi-Polar Ionization - Advanced Air Purification	X	X	X			X	X		X			
Replace Chiller	X				X							
Add Suction Diffusers to Boiler Circ Pumps			X									
Replace Boilers					N							
Building Automation Systems												
Install New ALC Controls						X		X				
Setpoints & Schedules	X	X	X	X	X	X	X	X	X			
Demand Controlled Ventilation	X				X		X	X				
Replace Freeze-stats		X										
HW/CHW Temp Reset on Boilers/Chillers	X	X			X		X					
Re-Commission BAS & Sequences							X					
Infrastructure												
Micro CHP Boiler								X				

Legend	
Possible ECMs	X
Non-ESIP Project - Energy Savings	N

2.0 Financial Analysis

2.1 Scope Summary

The intent of this project is to maximize savings for the Township, provide renewable solar power, improve indoor air conditions, reduce maintenance costs, provide EV chargers for the public, and make the Township's operations more resilient in the future. The following energy conservation measures have been reviewed with the Township of Piscataway.

FORM II

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ENERGY CONSERVATION MEASURES (ECMs) SUMMARY FORM
TOWNSHIP OF PISCATAWAY
ENERGY SAVINGS IMPROVEMENT PROGRAM

ESCO Name: Schneider Electric

	Proposed Preliminary Energy Savings Plan: ECMs	Estimated Turn-key Costs ($)	Incentives	Estimated Annual Savings ($)
Sustainability				
1	Solar PV	$14,911,627	$3,802,465	$500,953
2	Microgrid & Battery Energy Storage	$4,975,622	$1,263,104	$3,210
Efficiency				
3	LED Lighting	$0	$0	$46,447
4	Building Envelope & Insulation	$229,592	$0	$4,277
HVAC & Indoor Air Quality				
5	RTU / AHU Replacements	$228,873	$0	$3,513
6	Advanced Air Purification	$410,018	$0	$13,580
7	Replace Chillers & Boilers	$187,754	$0	$10,126
Building Automation System				
8	New Building Controls & Optimize Existing BAS	$885,068	$0	$131,515
Infrastructure				
9	Micro CHP	$245,503	$0	$563

	Energy Related Capital Improvements	Estimated Turn-key Costs ($)	Incentives	Estimated Annual Savings ($)
Sustainability				
10	EV Chargers	$946,009	$135,000	$0
	Project Summary:	$23,020,066	$5,200,568	$714,184

2.2 Financial Summary

The table below represents the total turnkey cost of the ESIP based on the scope of work listed in Form II and the ECM Matrix. Schneider Electric will serve as the primary contractor for the scopes of work contained within the ESIP project.

FORM V

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCOs PROPOSED FINAL PROJECT COST FORM FOR BASE CASE PROJECT
TOWNSHIP OF PISCATAWAY
ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: Schneider Electric

PROPOSED CONSTRUCTION FEES

Fee Category	Fees [1] Dollar ($) Value	Percentage of Hard Costs
Estimated Value of Hard Costs [2]:	$ 18,126,036	
Project Service Fees		
Investment Grade Energy Audit	$ 362,521	2.00%
Design Engineering Fees	$ 906,302	5.00%
Construction Management & Project Administration	$ 1,268,823	7.00%
System Commissioning	$ 362,521	2.00%
Equipment Initial Training Fees	$ 181,260	1.00%
ESCO Overhead	$ 906,302	5.00%
ESCO Profit	$ 906,302	5.00%
ESCO Termination Fee [*]	$ -	0.00%
Project Service Fees Sub Total	$ 3,081,426	17.00%
TOTAL FINANCED PROJECT COSTS:	$ 23,020,066	27.00%

PROPOSED ANNUAL SERVICE FEES

First Year Annual Service Fees	Fees [1] Dollar ($) Value	Percentage of Hard Costs
SAVINGS GUARANTEE *(OPTION)*	$ 46,140	
Measurement and Verification *(Associated w/ Savings Guarantee Option)*	included	
ENERGY STAR™ Services *(optional)*	included	
Post Construction Services *(if applicable)*		
Performance Monitoring	included	
On-going Training Services	included	
Verification Reports	included	
TOTAL FIRST YEAR ANNUAL SERVICES	$ 46,140	

2.3 Cash Flow Analysis

FORM VI

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
TOWNSHIP OF PISCATAWAY - ENERGY SAVINGS IMPROVEMENT PROGRAM

ESCO Name: Schneider Electric

Note: This energy savings plan is based on the following assumptions in all financial calculations:

(a) The cost of all types of energy should be assumed to inflate at **2.4% gas, 2.2% electric** per year. No other escalators will be permitted.

1. Term of Agreement: 20 *years*
2. Construction Period [2] 24 *months*
3. Cash Flow Analysis Format:

Total Cost:	$23,020,066
EECBG Grant:	$122,360
Congressional Grant:	$250,000
Capital Contribution:	$6,900,000
Financing Costs:	$120,000
Total To Be Financed:	$15,867,706

Interest Rate: 4.00%

Year	Annual Electric Savings	Annual Natural Gas Savings	Annual Distributed Gen. Savings	Annual Solar Savings	Annual Operational Savings	Energy Rebates / Incentives	Total Annual Savings	Annual Project Costs	Annual Service Costs [3]	Town Costs	Net Cash-Flow to Client	Cumulative Cash Flow
Install	$161,940	$52,228	$552	$250,477			$465,197					$0
1	$161,940	$52,228	$3,773	$500,953	$12,208	$5,200,568	$5,931,670	$6,288,646	$98,470	$6,387,116	$9,751	$9,751
2	$165,503	$53,482	$3,856	$509,469	$12,208		$744,517	$681,631	$53,135	$734,766	$9,751	$19,503
3	$169,144	$54,765	$3,941	$518,130	$12,208		$758,188	$694,484	$53,952	$748,436	$9,751	$29,254
4	$172,865	$56,080	$4,027	$526,939	$12,208		$772,118	$707,584	$54,783	$762,367	$9,751	$39,006
5	$176,668	$57,426	$4,116	$535,897	$12,208		$786,314	$720,936	$55,626	$776,562	$9,751	$48,757
6	$180,554	$58,804	$4,206	$545,007	$0		$788,572	$712,848	$65,973	$778,820	$9,751	$58,509
7	$184,527	$60,215	$4,299	$554,272	$0		$803,313	$726,719	$66,842	$793,561	$9,751	$68,260
8	$188,586	$61,660	$4,394	$563,695	$0		$818,335	$740,857	$67,726	$808,583	$9,751	$78,012
9	$192,735	$63,140	$4,490	$573,277	$0		$833,643	$755,268	$68,623	$823,892	$9,751	$87,763
10	$196,975	$64,656	$4,589	$583,023	$0		$849,243	$769,957	$69,535	$839,492	$9,751	$97,515
11	$201,309	$66,207	$4,690	$592,935	$0		$865,141	$784,929	$70,460	$855,389	$9,751	$107,266
12	$205,738	$67,796	$4,793	$603,014	$0		$881,341	$800,190	$71,400	$871,590	$9,751	$117,018
13	$210,264	$69,423	$4,899	$613,266	$0		$897,852	$815,745	$72,355	$888,100	$9,751	$126,769
14	$214,890	$71,090	$5,006	$623,691	$0		$914,677	$831,600	$73,325	$904,925	$9,751	$136,521
15	$219,617	$72,796	$5,116	$634,294	$0		$931,823	$847,762	$74,310	$922,072	$9,751	$146,272
16	$224,449	$74,543	$5,229	$645,077	$0		$949,298	$864,235	$75,311	$939,546	$9,751	$156,024
17	$229,387	$76,332	$5,344	$656,043	$0		$967,106	$881,027	$76,327	$957,354	$9,751	$165,775
18	$234,433	$78,164	$5,462	$667,196	$0		$985,255	$898,144	$77,359	$975,503	$9,751	$175,527
19	$239,591	$80,040	$5,582	$678,538	$0		$1,003,751	$915,591	$78,408	$993,999	$9,751	$185,278
20	$244,862	$81,961	$5,705	$690,073	$0		$1,022,600	$933,377	$79,473	$1,012,850	$9,751	$195,029
Totals	**$4,175,973**	**$1,373,038**	**$94,068**	**$12,065,267**	**$61,039**	**$5,200,568**	**$22,969,953**	**$21,371,531**	**$1,403,393**	**$22,774,924**	**$195,029**	

2.4 Incentives and Rebates

A variety of incentive and rebate programs were evaluated during the development of the Project. Based upon the scope of this project and discussions with utility rebate program administrators, the following rebates and incentives are currently included:

Incentive/Rebate Summary

ECM	ECM Description	Incentive / Rebate Type	Source	Estimated Rebates
1	Solar PV	Investment Tax Credit (Direct Pay)	Federal	$ 3,802,465
1	Solar PV - DPW	Congressionally Directed Spending Project	Federal	$ 250,000
2	Microgrid & Battery Energy Storage	Investment Tax Credit (Direct Pay)	Federal	$ 1,263,103
8	New Building Controls & Optimize Existing BAS	Retro-Cxing Program	PSE&G	$ -
10	EV Chargers	NJBPU & PSE&G	NJBPU & PSE&G	$ 135,000
		Energy Efficiency & Conservation Block Grant	Federal	$ 122,360
	Total:			**$ 5,572,928**

All rebates and incentives are subject to program terms, conditions, approvals, and availability of funds. All rebates will be applied for by Schneider Electric on behalf of the Township, with all rebate funds being sent directly to the Township of Piscataway.

The ITC incentive originates from the Inflation Reduction Act legislation signed in 2022. This incentive will be leveraged for the solar PV and battery energy storage ECMs.

https://home.treasury.gov/news/press-releases/jy1533

The Township of Piscataway has already been approved for a $250,000 Congressional Spending Project, designated to be used specifically for the "installation of solar panels on the DPW canopy".

Based on the EV charger scope of work, the Township qualifies for utility and state rebates for the installation of public, level 2 EV chargers as noted in the table above.

Piscataway has already received a federal EECBG grant for $122,360 that they will put towards energy efficiency improvements that will be implemented as part of this ESIP program.

3.0 Site List and Energy Conservation Measures

3.1 Site List

Below is a list of all the sites that were audited as part of the Investment Grade Audit (IGA). Some sites do not have any scope of work within the ESIP currently, but they were audited and had energy data collected and analyzed.

ID	Facility	Nickname	Address	Area	Year Built
1	Town Hall – Muni	Town Hall	455 Hoes Ln	18,731	1968
2	Public Safety (PD & Courthouse)	Public Safety	555 Sidney Rd	27,164	1975
3	DPW Offices	DPW	505 Sidney Rd	22,536	1979
4	DPW Roads Garage	DPW Garage	505 Sidney Rd	16,067	
5	JFK Library	JFK	500 Hoes Ln	26,000	1965
6	Senior Center	Sr. Ctr	700 Buena Vista Ave	17,043	1975
7	Community Center (YMCA)	Community Ctr	520 Hoes Ln	83,000	2020
8	Westergard Library	Westergard	20 Murray Ave	10,400	1981
9	Sterling Village	Sterling	1 Sterling Dr	124,735	1990
10	DPW Salt Shed	Salt Shed	505 Sidney Rd	5,300	
11	Brine Shed	Brine Shed	505 Sidney Rd	160	
12	Little League Complex	Little League	495 Sidney Rd	3,700	2007
13	Columbus Park	Columbus Park	Mansfield Rd & 11th St	4,000	2016
14	Riverside Park	Riverside Park	430 River Rd	1,400	2013
15	Street Lights	Street Lights			
16	DPW Warehouse	Warehouse	625 North Maple Ave		1990

3.1A Facility Descriptions

Descriptions of the existing lighting, envelope, and HVAC systems within each building are provided below. They are taken from the Local Government Energy Audit reports performed by TRC in 2023. A detailed equipment list can be found in Appendix 6.3 – LGEA Reports.

Town Hall

The Town Hall and Public Safety buildings share an electric meter.

Town Hall is a single-story, 18,731 square foot building built in 1968. Spaces include offices, meeting rooms, corridors, restrooms, server room, basement, and electrical and attic mechanical spaces. An air-cooled scroll chiller serves to cool 100% of the facility along with a ductless mini split dedicated to cool the IT room. 100% of the facility is heated by two gas-fired condensing hot water boilers.

Town Hall Building walls are comprised of CMUs and a red brick façade; both of which are in good condition. The original building structure featured a flat EPDM roof. A standing seam metal roof was built over the original EPDM roof thus creating an attic space where the attic floor is the old EPDM roof.

The attic mechanical space houses HVAC equipment including exhaust fans and vertical fan coil units (VFCU). Facility windows are double paned, operable, and sealed well. The facility's exterior doors are comprised of aluminum framed glass units and are in good condition.

Town Hall lighting is provided by a mix of CFLs, LED, and linear fluorescent technology. Four-foot linear fluorescent tubes and 2-foot U-bend fluorescent tubes are the most common lamp types. Halogen spotlights with MR16 bulbs provide lighting in the Town Hall meeting room, and main north and south corridors. Double biaxial CFLs are used throughout the building. Exit signs use LED technology. Lighting fixtures include recessed can, parabolic, prismatic, and retrofit drop ceiling fixtures with two, three, or four lamps per fixture.

Manual wall switches control most Town Hall light fixtures, with a small amount of occupancy sensors used in the main corridors, restrooms, break rooms, offices, and conference rooms. Numerous spaces have not been upgraded to LED lighting, including the basement, boiler room, main corridors, offices, IT room, and restrooms. Overall, interior lighting is in good condition with sufficient light levels being met.

Photocells control the exterior lighting, which is comprised of recessed CFLs and an LED floodlight. The parking lot is shared with the Public Safety Building. Overall, exterior lighting is in good condition.

Unit ventilators (UV) throughout Town Hall are equipped with supply fan motors and digitally controlled outside air dampers. The UVs are connected to the hot and chilled water distribution systems to provide heating and cooling to various spaces. UVs also modulate ventilation. The units are in good condition.

Town Hall is conditioned by two air handling units (AHUs) located in the basement and boiler room. The BAS controls both AHUs. Vertical and horizontal fan coil units (VFCUs and HFCUs) condition the rest of the building. The AHUs are equipped with hot water and chilled water coils and supply fans. A variable frequency drive (VFD) controls AHU-2's supply fan. AHU-1 is not equipped with a VFD. The units are in good condition and are controlled by the BAS.

There are no VAV boxes at Town Hall. Valves equipped on the HFCUs and VFCUs control the temperature by modulating the amount of hot or chilled water that flows into the local coil.

A total of four, 959 MBh Raypack XTherm condensing hot water boilers serve the Public Safety Building and Town Hall with two boilers at each site. The boilers run on a lead-lag scheme at a nominal efficiency of 95%. The facility replaced old boilers in 2017 and the new units are in good condition.

Two constant speed, 7.5 hp HHW pumps located in Town Hall's boiler room distribute the hot water to AHUs and horizontal and vertical fan coil units. The addition of VFD control has been evaluated for these motors. Pipe insulation is sufficient and in good condition at both sites.

The Town Hall chiller plant consists of one, 55-ton air cooled scroll chiller. The chiller uses two constant speed, 10 hp CHW pumps located in the boiler room. The motors are operating beyond their useful life but remain in good condition. VFD control has been evaluated for these pump motors.

The chillers run based on outside air temperature (OAT). Glycol is present in the chiller loop. The chiller serves all the horizontal and vertical FCUs in the building which are responsible for most of the cooling.

Replacement has been evaluated as the chiller is 19 years old and is near the end of its useful life. Note: large HVAC upgrades and replacements often do not have a reasonable payback period based on energy savings alone. It is up to the facility to determine if a chiller replacement is appropriate.

An electric Bradford White 50-gallon, 4.5 kW water heater serves the Town Hall's domestic hot water demand. One fractional horsepower DHW pump circulates the water. The unit is brand new, in good condition, and has insulated pipes.

Public Safety

The Town Hall and Public Safety buildings share an electric meter.

The Piscataway Public Safety Building is a single-story, 27,164 square foot building built in 1975. Spaces include offices, meeting rooms, holding cells, corridors, restrooms, server room, dispatch center, and electrical and attic mechanical spaces. A parking lot canopy primed for solar panel installation covers fleet vehicles and is attached to the building's electric meter. The facility is 100% cooled by two air-cooled scroll chillers and supplementary systems such as ductless mini splits and split-system air source heat pumps. Two gas-fired condensing hot water boilers are responsible for 100% of the building's heating.

The Public Safety Building is comprised of concrete masonry units (CMUs) with a red brick façade. The original building structure featured a flat EPDM roof. A standing seam metal roof was built over the original EPDM roof thus creating an attic space where the attic floor is the old EPDM roofing. The attic space houses HVAC equipment such as exhaust fans, air handling units (AHUs), mini-split AC systems, and heating and chilled water pumps. The nearby parking lot canopy has a sloped metal roof designed to house a solar panel array.

The building envelope, EPDM attic floor, and standing seam roof are in good condition. Facility windows are non-operable, bullet proof, and have a good seal between the glass and frame. All windows are in good condition. Exterior doors consist of a mix of solid metal and aluminum framed glass units; both of which are also in good condition.

The Public Safety Building's primary lighting system includes a mix of LED and fluorescent lighting. Main indoor lighting includes 2-foot and 4-foot T8 linear fluorescent tubes, as well as T8 equivalent linear LED tubes which make up the second largest portion of the lighting. All emergency exit signs are up to date with LED technology. Other lighting technology includes T12 linear fluorescent tubes, metal halide, and compact fluorescent lamps (CFL). Common fixtures include parabolic, can, and retrofit drop ceiling fixtures with two, three, or four lamps per fixture.

Lighting is mainly controlled by manual wall switches with occupancy sensors present only in select offices and restrooms. During the audit, multiple unoccupied spaces were observed with their lighting systems operating. Retrofitting inefficient fixtures and installing automatic lighting controls such as occupancy sensors will help reduce lighting energy consumption. The mechanical room, corridors, court room, locker rooms, restrooms, and office spaces are typical of areas that have not been upgraded to LED light sources. Overall, the current lighting system is in good condition with adequate light levels.

Exterior lighting is provided by metal halide and LED technology. Fixtures are in good condition and are controlled by photocell. Most of the parking lot and exterior lighting is provided by 69-Watt LED pole lights and LED wall packs.

The Public Safety Building houses unitary HVAC equipment including a one-ton window AC unit located in a closet, two, 3.5 ton ductless mini-split AC systems located in the attic, and one, 1.5-ton split system air source heat pump located in the back parking lot. They serve a storage closet, IT closet, and other various spaces in the building, respectively.

The seasonal energy efficiency ratio (SEER) for each unit ranges from 10 to 15.6. The window AC unit and one of the ductless mini split AC systems are operating beyond their useful life and have been evaluated for replacement while the rest of the equipment is in good condition. These are controlled by programmable thermostats.

The Public Safety Building is conditioned by six air handling units (AHUs) located in the attic mechanical space. The AHUs are equipped with hot water and chilled water coils, economizers, and supply and return fans that are controlled by variable frequency drives (VFDs). Each unit contains hydronic pre-heat coils. The AHUs are operated for long hours to accommodate the needs of the facility. The units are in good condition and are controlled by the BAS.

Air distribution is provided to supply air registers by ducts concealed above the ceiling. Heated and cooled air is distributed through ductwork to variable air volume (VAV) terminals concealed above the ceiling.

A total of four, 959 MBh Raypack XTherm condensing hot water boilers serve the Public Safety Building and Town Hall with two boilers at each site. The boilers run on a lead-lag scheme at a nominal efficiency of 95%. The facility replaced old boilers in 2017 and the new units are in good condition.

Two constant speed, 3 hp heating hot water (HHW) pumps located in the Public Safety Building boiler room distribute the hot water to AHUs, hydronic unit heaters, and fin tube radiators. Each AHU is equipped with a fractional horsepower booster pump. The addition of VFD control for the two, 3 hp motors has been evaluated.

The Public Safety Building chiller plant consists of two, 60-ton air cooled scroll chillers (CH 1 and CH 2) located on an exterior pad situated at the rear of the building. The chillers have a total of four, 5 horsepower chilled water (CHW) pumps. Two primary pumps located next to the chillers circulate water between the chillers and two secondary pumps located in the attic circulate the water to the AHUs. VFDs control the two secondary pumps. The primary pumps operate at constant speed, and VFD control has been evaluated for this system. The chillers run based on outside air temperature (OAT) with water distribution temperatures around 41°F. Glycol is present in the first half of the chiller loop to prevent water from freezing outside and stops at the heat exchanger. The chiller serves the building AHUs, which are responsible for most of the cooling. In 2019 the chillers were replaced and are currently in good condition.

An electric Bradford White 80-gallon, 4.5 kW water heater serves the Public Safety Building's domestic hot water (DHW) demand. One fractional horsepower DHW pump circulates the water. The unit is in good condition, within its useful life, and water pipes are insulated.

DPW Building

The DPW Office is a two-story, 22,536 square foot building built in 1979. Spaces include offices, meeting rooms, corridors, restrooms, server room, garage, and electrical and mechanical spaces. The facility is 50% cooled by a 30-ton roof top unit (RTU) and supplementary systems including two split-system air source heat pumps. Two gas-fired hot water boilers are responsible for most of the building's heating. The garage area is served by two air handling unit (AHUs) equipped with a supply fan and a heating hot water (HHW) coil. An oil burner in the garage provides under floor radiant heating using heating coils. This unit consumes refuse oil and kerosene to produce heat; this fuel source was not accounted for in the analysis. There is no cooling present in the garage.

The DPW Office is comprised of concrete masonry units (CMUs) with a red brick façade. The roof is flat with an EPDM cover and is in good condition. A large solar panel array is housed on the roof along with exhaust fans and a roof top unit (RTU).

The building envelope and EPDM roof are in good condition. Facility windows are a mix of operable and non-operable, double-paned glass windows with aluminum frames. All windows are in good condition. Exterior doors consist of a mix of solid metal and aluminum framed glass units; both types are in good condition.

The primary lighting system for the DPW Office consists mainly of fluorescent lighting. Common indoor lighting includes 4-foot T8 linear fluorescent tubes, 8-foot T12 linear fluorescent tubes, and various sized compact fluorescent lamps (CFL). Emergency exit signs are up to date with LED technology. High bay LED fixtures illuminate the garage space with additional lighting provided by T8 and T12 linear fluorescent tubes. Other lighting technology includes 2-foot T8 U-bend fluorescent tubes and A19 LED lamps. Common fixtures include parabolic, can, and retrofit drop ceiling fixtures with one, two, or three lamps per fixture.

All interior lighting is controlled by manual wall switches. The garage is the only space that has upgraded to LED light sources. Overall, the current lighting system is in good condition with adequate light levels.

Exterior lighting is provided by high pressure sodium (HPS), CFLs, and LED technology. Fixtures are in good condition and are controlled by photocell.

One 30-ton roof top unit (RTU) serves the DPW Offices. The RTU provides cooling only and has an integrated energy efficiency ratio (EER) of 13.5. The 15 hp supply fan and a 7.5 hp return fan are both equipped with variable frequency drives (VFD). The unit is in good condition and is operating within its useful life. A building automated system (BAS) controls the RTU.

The DPW Office uses two split system air source heat pumps to supplement the conditioning of the office spaces. AC-1 is a 2-ton unit with a seasonal energy efficiency ratio (SEER) of 9; AC-2 is a 3-ton unit with a SEER of 9.11. Both units are also capable of providing heating. AC-1's heating capacity is 22 MBh and AC-2's is 34.6 MBh. Both units are operating within their useful life and are in good condition.

The DPW Office garage space is conditioned by two air handling unit (AHUs). AHU-1 is in the elevated mechanical room in the garage while HV-1 is suspended in the garage. Both units supply heating-only and are equipped with hot water coils and a constant speed supply fan. Units are controlled by a BAS.

The supply fan for AHU-1 is nearing the end of its useful life. The installation of a VFD and compatible motor has been evaluated for this system.

The DPW Office garage uses a total of nine make up air unit (MUA) CO_2 scrubbers to detect CO_2 build up in the garage and ventilate the space as needed. They are locally controlled. The units were not accessible during the audit and have been estimated.

Two, 850 MBh Lochinvar Power Fin hot water boilers serve the DPW Office. The boilers run on a lead lag scheme at a nominal efficiency of 85%. The units are from 2013 and are in good condition.

Seven constant speed heating hot water (HHW) pumps located in the boiler and mechanical rooms distribute hot water to AHUs and hydronic unit heaters. The HHW pumps range from 0.1 hp to 5.0 hp. The HHW pipes are well insulated. Overall, the boilers and pumps are in good condition and are operating within their useful life.

The BAS controls the boilers which run on an algorithm based on outside air temperature.

There is a diesel fuel boiler in the DPW car wash area that provides hot water to the car wash slab heat system and the overhead unit heaters for the car wash area.

A Bradford White 80-gallon, natural gas, water heater serves the DPW Office's domestic hot water (DHW) demand. The tank is 80% efficient. One fractional horsepower DHW pump circulates the water. The heater is in good condition, nearing the end of its useful life, and the water pipes are insulated.

There are two additional DHW tanks that serve the car wash area. A Rheem 115-gallon, natural gas water heater and a Bradford White 40-gallon, 4.5 kW electric water heater supply water to the car wash systems. The units are in good condition. The Rheem DHW tank is 80% efficient and is equipped with a DHW circulation pump. The tank is operating beyond its useful life and has been evaluated for replacement.

The car wash DHW piping systems lack insulation. The addition of insulation has been evaluated, with an estimated 60 feet of 1-inch diameter and 25 feet of 0.75-inch diameter insulation required.

The DPW offices has an existing 83.4 kW ballasted solar PV system on the roof.

DPW Roads Garage

The DPW Operations Garage is a single-story, 16,067 square foot building. Spaces include a break room, garage mechanical spaces, shop, corridors, restroom, and mechanical spaces. The facility is not cooled apart from a small, packaged terminal heat pump (PTHP) which serves the break room. The building is mainly heated by gas-fired unit heaters of varying sizes.

The DPW Operations Garage is comprised of a section of concrete masonry units (CMUs) with a red brick façade combined with a standard structural steel framed section. The roof is flat with an EPDM cover and is in good condition. A solar panel array is housed on the roof along with the garage exhaust fans.

The building envelope and EPDM roof are in good condition. Non-operable facility windows exist on the garage doors and are in good condition. Exterior doors consist of solid metal and are in good condition.

The lighting system for the DPW Operations Garage uses a mix of LED and fluorescent lighting. Common indoor lighting includes 4-foot T8 linear fluorescent tubes and 4-foot T8 equivalent linear LED tubes. Emergency exit signs are up to date with LED technology. Other lighting technology includes 8-foot T12 linear fluorescent tubes and 8-foot T8 equivalent linear LED tubes. Common fixtures include parabolic and pendant fixtures with one, two, or four lamps per fixture.

All interior lighting is controlled by manual wall switches. Overall, the current lighting system is in good condition with adequate light levels.

Exterior lighting is provided by BR30 CFLs and LED wall packs. Fixtures are in good condition and photocells control the lighting.

The Operations Garage is heated by a total of six small gas-fired unit heaters and two medium sized gas-fired unit heaters. The smaller units have a heating capacity of 166 MBh, and the heating capacity of the larger units was estimated at 249 MBh because they were inaccessible. The heaters are in good condition and are controlled by local thermostats. The units are operating beyond their useful life.

The DPW Operations Garage uses a single Friedrich packaged terminal heat pump (PTHP) to condition the small office break room in the center of the building. This unit can provide both heating and cooling and has been estimated as the nameplate was not accessible. A local thermostat controls the unit. The unit is approximately an 0.8-ton unit with a cooling and EER of 11 and heating seasonal performance factor (HSPF) of 10.5. This unit is operating beyond its useful life and is in fair condition.

A Rheem 20-gallon, 6 kW, electric water heater, provides DHW to the DPW Operations Garage. This unit is operating within its useful life; the pipes are insulated, and in good condition.

The DPW Roads Garage has an existing 21 kW ballasted solar PV system on the roof.

JFK Library

JFK Library is a one-story, 30,600 square foot building built in 1965. Spaces include offices, meeting room, computer lab, large bookshelf area, maker space, corridors, restrooms, and mechanical spaces. The facility is 100% heated by two gas-fired water boilers and 95% cooled by an air-cooled chiller.

JFK Library is comprised of concrete masonry units (CMUs) with a red brick façade. Two different roof types are present: a pitched standing seam metal roof and a flat white membrane roof. The metal roof covers most of the building. Neither roof was accessible during the audit. The building envelope is in good condition.

Facility windows are non-operable, double-paned glass windows with aluminum frames. All windows are in good condition. Exterior doors consist of a mix of solid metal and aluminum framed glass units; both types are in good condition.

The primary lighting system for JFK Library consists mainly of fluorescent lighting. Common indoor lighting includes 4-foot T8 linear fluorescent tubes, 2-foot T8 U-bend fluorescent tubes, and various sized compact fluorescent lamps (CFL). Emergency exit signs are up to date with LED technology apart from six signs, which use incandescent bulbs. Other lighting technology includes ambient LED 2-foot x 2-foot panels and 8-foot T-12 linear fluorescent tubes. Common fixtures include parabolic, can, and retrofit drop ceiling fixtures with 1-lamp, 2-lamp, or 4-lamp fixtures.

Most interior lighting is controlled by manual wall switches except the public restrooms which use wall mounted occupancy sensors. Overall, the current lighting system is in good condition with adequate light levels.

Exterior lighting is provided by high pressure sodium (HPS) bollard fixtures, recessed CFLs, and LED wall packs. Pole mounted HPS lamps illuminate the parking lot. A photocell controls the lights, and fixtures are in good condition.

Five air handling unit (AHUs) condition JFK Library. Every unit is equipped with hot and cold-water coils and supply and return fans. The supply and return fans for AHU-2A and AHU-2B were not accessible during the audit and have been confirmed using name plate data. Supply and return fans for AHU-1, 3, and 4, were not accessible during the audit and have been estimated. A building automation system (BAS) controls the units, and the AHUs are in good condition.

Two, 850 MBh PK Thermific Modu-Fire hot water boilers serve JFK Library. The boilers run on a lead lag scheme at a nominal efficiency of 85%. The units are from 2005 and are in poor condition with frequent mechanical failures according to facility staff. Staff was in the process of replacing them with new hydronic boilers at the time of the audit, therefore, boiler replacement has not been evaluated in this report.

Two, 7.5 hp heating hot water (HHW) pumps located in the mechanical room distribute hot water to AHUs and variable air volume (VAV) boxes. VFDs control the pumps. Two constant speed fractional horsepower motors act as boosters for the return HHW to the boilers. All motors and pumps appear in good condition.

The BAS controls the boilers which operate based on temperature reset algorithms. At the time of the audit, the HHW boiler was set to a temperature setpoint of 167°F.

Overall, the system is in fair condition, pipes are well insulated, and equipment is operating within its rated useful life.

The two boilers are being replaced outside of the ESIP project in the summer/fall of 2023, as described in Section 3.2.

The JFK Library chiller plant consists of one, 100-ton air cooled screw chiller located on an exterior pad on the side of the building.

The chiller has two, 10 hp chilled water (CHW) pumps, both located in the mechanical room. VFDs control both pumps. The chiller operates based on outside air temperature (OAT)°F. A BAS controls the chiller, which was maintaining a supply temperature of 55°F at the time of the audit. Glycol is present in the chiller loop to prevent water from freezing in cold weather.

The chiller serves the building AHUs and VAV boxes and is responsible for cooling all conditioned building areas. The chiller is from 2007, in good condition, and is nearing the end of its rated useful life. It has been evaluated for replacement.

A Bradford White 75-gallon, natural gas water heater serves JFK Library's domestic hot water (DHW) demand. The tank is 80% efficient. The heater is in good condition, is operating within its useful life. The water supply pipes are insulated.

Senior Center

The Senior Center is a one-story, 17,500 square foot building built in 1975. Spaces include a billiards room, card room, Piscataway Community TV recording studio, Piscataway Community TV offices, computer lab, conference room, corridors, multipurpose rooms, offices, restrooms, and electrical room.

The facility is 100% heated and cooled by eight outdoor package units and supplemented by six air source heat pumps.

The Senior Center is comprised of concrete masonry units (CMUs) with a brick façade. A pitched standing seam metal roof covering with a white membrane underlayment comprises the roof. The roof was not accessible at the time of the audit. Overall, the building envelope is in good condition.

Facility windows consist of both operable and non-operable, double-paned glass windows with aluminum frames. All windows are in good condition and are well sealed. Exterior doors consist of aluminum framed glass units and sliding aluminum framed glass units. Both door types are in good condition.

The primary interior lighting system consists of fluorescent lighting. Common indoor lighting includes 4-foot T8 linear fluorescent tubes, incandescent A19 bulbs, and various sized compact fluorescent lamps (CFL). Emergency exit signs are up to date with LED technology. Other lighting technology includes 8-foot T12 linear fluorescent tubes and various recording studio LED track lighting. Common fixtures include surface mount prismatic, can, and retrofit drop ceiling fixtures with one, two, three or four lamps per fixture.

Manual wall switches control most of the interior lighting system. Occupancy sensors control the multipurpose room, restroom, and Storage Room 2 lighting. Overall, the current lighting system is in good condition with adequate light levels.

Exterior lighting is provided by recessed can fixtures with a mix of CFLs and LED lamps, 4-foot ambient LED fixtures, high pressure sodium (HPS) wall packs, and LED wall packs. Fixtures are in good condition and are controlled by a mix of photocell and timeclock.

The Senior Center uses six air source heat pumps to supplement the conditioning of various spaces throughout the facility. These units vary in capacity between 1 ton and 3 tons of cooling and between 20 MBh and 40 MBh of heating. They range in efficiency between 14.9 and 17.5 seasonal energy efficiency ratio (SEER). The units are in good condition and are operating beyond their useful life.

Eight package units, located on the building's exterior, provide heating, cooling, and ventilation to the Senior Center. The package units provide both gas-fired heating and direct expansion (DX) cooling and vary in capacity and efficiency ratings. They are equipped with constant speed supply and return fans. The units are in good condition, however, are operating beyond their useful life. Programmable thermostats control the units. Refer to the table below or to Appendix A for detailed information about each unit.

The Senior Center uses multiple domestic hot water (DHW) heaters. An A.O Smith 38-gallon, natural gas water heater with an 80% efficiency rating is in Storage Room 2. A Whirlpool 20-gallon, electric water heater is in the electrical room. Finally, a Rinnai tankless natural gas water heater with a capacity of 199 MBh and an efficiency rating of 84% is in Storage Room 1.

All the DHW units are in good condition and are operating beyond their useful life. The DHW hot water supply pipes associated with the Whirlpool unit are not insulated. The addition of insulation has been evaluated, with an estimated 12 feet of 0.75-inch diameter insulation required.

The kitchen has a gas combination oven as well as a gas convection oven that are used to prepare meals for the guests. The gas combination oven is high efficiency however, the gas convection oven is not. The equipment is in good condition.

An electric, high temperature under-the-counter dishwasher is present in the kitchen. The unit is not ENERGY STAR labeled.

The kitchen uses two stand-up refrigerators with solid metal doors along with a walk-in freezer. The stand-up refrigerators are standard efficiency and are in good condition.

The walk-in freezer has an estimated compressor capacity of .54 tons located on top of the unit and a two-fan evaporator. The unit features both evaporator fan and electric defrost controls.

An ice machine located in the kitchen can produce an estimated 310 pounds of ice per day and is not ENERGY STAR labeled. Overall, the ice machine is in good condition.

Much of the kitchen cooking equipment is seldom used.

Community Center (YMCA)

Community Center and Splash Pad is a two-story, 84,600 square foot complex built in 2020. Spaces include offices, multipurpose rooms, locker rooms, restrooms, child watch center, teen center, fitness gym, gymnasium, indoor pool area, indoor track area, reception area, outdoor "splash" fountain, and electrical and mechanical spaces. The Community Center is 100% heated and cooled by two heating hot water boilers, seven roof top units (RTUs), two air handling units (AHUs), and smaller supplemental systems. Pools are heated by dedicated gas-fired pool heaters.

Community Center is comprised of concrete masonry units (CMUs) with a terracotta tile façade at the first-floor level. Paneling covers the upper portions of the center. Two different roof systems are present: a pitched standing seam metal roof and a flat white membrane roof. The metal roof covers half of the facility. The membrane roof houses all the RTUs, AHUs, heat pumps, and exhaust fans. The building envelope and both roof sections are in good condition.

Facility windows are non-operable, double-paned glass windows with aluminum frames. All windows are in good condition. Exterior doors consist of a mix of solid metal and aluminum framed glass units; both types are in good condition.

The primary lighting system for Community Center consists of LED lighting. Common indoor lighting includes ambient 2-foot x 2-foot LED, downlight recessed, linear strip, and high bay fixtures. Emergency exit signs are up to date with LED technology. Other lighting technology includes T8 equivalent LED linear tubes, downlight pendant, and decorative pendant fixtures. A few CFLs are present.

LED high bay fixtures illuminate the gymnasium and indoor pool area. The gymnasium lights are in good condition; however, the pool area lights are in poor condition. At the time of the audit, many of the pool area lights were failing. According to facility staff, the LED heatsinks were poorly implemented which have led to the lights overheating and failing.

Manual wall switches control most of the indoor lighting except for locker rooms, some storage areas, and corridors which use wall and ceiling mounted occupancy sensors. Overall, the current lighting system is in good condition with adequate light levels.

Exterior lighting is provided by LED wall packs, LED downlight recessed fixtures, and various LED screw-in lamps. Single and double cobra head pole lights illuminate the parking lot. A photocell controls the lights, and the fixtures are in good condition.

The Community Center uses five air source heat pumps. The units can provide 1 ton of cooling and 14.4 MBh of heating. The units have an energy efficiency ratio (EER) of 13 and a heating seasonal performance factor (HSPF) of 12.5. The units are in good condition.

The Community Center mechanical rooms are heated by electric resistance unit heaters. The heaters provide an estimated 34 MBh (10 kW) of heating and are in good condition. A dial thermostat controls the equipment.

Seven RTUs located on the roof condition various spaces throughout the Community Center. Every unit is equipped with direct expansion (DX) coils, gas-fired heating, enthalpy wheel, and supply and return fans. Variable frequency drives (VFDs) are installed in every system. Cooling capacities range from 10 tons to 70 tons of cooling and from 120 MBh to 864 MBh of heating. A BAS controls the units, and they are operating within their rated life. The RTUs are in good condition.

A single make up air unit (MUA) serves the Community Center and provides 240 MBh of heating. The unit does not provide cooling. A 2 hp supply motor equipped with a VFD drives the unit. The equipment is operating within its useful life, is in good condition, and is controlled by a BAS.

Two AHUs located on the roof provide dehumidification for the Community Center's indoor pool. Every unit is equipped with a condenser and direct expansion (DX) coils, heating hot water (HHW) coils, and supply and return fans. The supply and return fans for AHU-1 and AHU-2 were not accessible during the audit and have been confirmed using name plate data. It is unknown if the motors are equipped with VFDs. Both units provide 128 tons of cooling and 900 MBh of heating. A building automation system (BAS) controls the units, which are operating within their rated life. The AHUs are in good condition.

Two, 1880 MBh Aerco BMK 2000 condensing hot water boilers serve the Community Center. The boilers run on a lead-lag scheme at a nominal efficiency of 94%. The units are new and in good condition.

Two, 10 hp heating hot water (HHW) pumps located in the mechanical room distribute hot water to AHUs and RTUs. VFDs control the pumps. All pumps appear in good condition.

The BAS controls the boilers; at the time of the audit boilers one and two were set to a supply water temperature setpoint of 165°F and 76°F, respectively.

Overall, the system is in good condition, pipes are well insulated, and equipment is operating within its rated useful life.

Four Bradford White 100-gallon, natural gas water heaters serve the domestic hot water (DHW) demand of the Community Center. The tanks are 80% efficient.

A fractional horsepower DHW return circulation pump operates continuously for all four boilers. At the time of the audit, the DHW tanks were set to supply water at 140°F. The heaters are in good condition and operating within their useful life. The water supply pipes are insulated.

The kitchen uses gas equipment to prepare food for visitors. Most cooking is done using a gas griddle and two gas large vat fryers. A gas convection oven is also used to prepare food. These units are standard efficiency and are in good condition.

The kitchen uses several stand-up refrigerators and freezers with solid metal and glass doors along with freezer chests. The stand-up refrigerators are standard efficiency and are in good condition.

An ice machine located in the kitchen can produce an estimated 350 pounds of ice per day and is not ENERGY STAR labeled. Overall, the ice machine is in good condition.

The Community Center features three indoor pools: the competition pool, exercise pool, and activity pool. These pools vary in size and capacity.

Pool Name	Dimensions (Decimal Feet)	Approximate Gallons
Competition Pool	Length: 75 Width: 59 Shallow Depth: 3.5 Deep Depth: 9.5	220,000
Exercise Pool	Length: 60 Width: 21 Shallow Depth: 3.5 Deep Depth: 5	41,000
Activity Pool	Length: 59.5 Width: 30.5 Shallow Depth: 0 Deep Depth: 3	16,500

Three Lochinvar natural gas heaters warm the indoor pools. The units each have an input capacity of 650 MBh and a thermal efficiency rating of 85%. All three pools have a temperature set point of 78°F. When the temperature drops two degrees below the set point, the pool heaters turn on.

Each pool uses a Neptune Benson Defender filtration system. A panel located on each unit allows for equipment scheduling and control. An air compressor which runs approximately four hours a day controls the pool filters' pneumatic valves. The filters are served by three pool filtration pumps which vary from 7.5 hp to 15 hp and are all controlled by VFDs. Numerous chlorine pumps run continuously to ensure that the pool chemical balance remains within acceptable levels. Multiple UV light sanitation systems are also present in the pool mechanical room and are accounted for in Section 2.11 Plug Loads.

Operations for the Splash Pad water features are housed in the Splash Pad mechanical room and include a water supply and filtration pumps, both of which operate seasonally.

Westergard Library

Westergard Library is a single-story, 10,400 square foot building built in 1981. Spaces include offices, corridors, restrooms, break room, teen space, children's space, large book shelving area, meeting room, and electrical and mechanical spaces. The facility is 100% cooled, mainly by a split system air handling unit (AHU) and a 3-ton roof top unit (RTU). A single condensing hot water boiler is responsible for heating 100% of the building.

Westergard Library is comprised of concrete masonry units (CMUs) with a red brick façade. The roof is flat with a white membrane cover and is in good condition. The RTU and a large condensing unit that serves the AHU are both housed on the roof along with two exhaust fans. The building envelope is in good condition.

Facility windows are operable, double-paned glass windows with aluminum frames. All windows are in good condition and are well sealed. Exterior doors consist of a mix of solid metal and aluminum framed glass units; both types are in good condition.

The primary lighting system for Westergard Library consists mainly of fluorescent lighting. Common indoor lighting includes 4-foot T8 linear fluorescent tubes, 2-foot U-bend fluorescent tubes, 4-foot T8 equivalent LED linear tubes, and various sized compact fluorescent lamps (CFL). Most emergency exit signs are up to date with LED technology, apart from four signs which still utilize incandescent lighting. Other lighting sources includes 2-foot x 4-foot ambient LED panels and incandescent lamps. Common fixtures include parabolic, and retrofit drop ceiling fixtures with one, two, or three lamps per fixture.

All interior lighting is controlled by manual wall switches. Overall, the current lighting system is in good condition with adequate light levels.

Exterior lighting is provided by high pressure sodium (HPS) wall packs, CFLs, and LED pole lights. Fixtures are in good condition and are controlled by photocell.

Unit ventilators (UVs) serving the teen space and break room are equipped with supply fan motors and digitally controlled outside air dampers. The UVs are equipped with a direction expansion (DX) coil to provide cooling and are connected to the hot water distribution system to provide heating. The UVs also modulate ventilation. The units are in good condition and are not frequently used.

One, 25-ton roof top unit (RTU) provides cooling and ventilation for most building areas. The RTU has an energy efficiency ratio (EER) of 10.4. It has a 7.5 hp supply fan that is equipped with a variable frequency drive (VFD). The unit is controlled by a local control panel building automation system (BAS). The RTU is in good condition and is nearing the end of its useful life.

The Westergard Library meeting room is conditioned by one air handling unit (AHU) equipped with a supply fan, hot water coil, and a DX coil. A 3-ton condensing unit located on the roof serves the AHU. The condensing unit has an estimated EER of 11. The AHU was located above ceiling and was not accessible during the audit. A local thermostat controls the AHU.

The AHU and the condensing unit are in good condition and are nearing the end of their useful life service. Both units have been evaluated for replacement.

A single 414 MBh Patterson Kelley condensing hot water boiler serves Westergard Library. The boiler runs at a nominal efficiency of 92%. The unit is from 2009, operating within its useful life, and is in good condition.

Two constant speed supply and one constant speed return heating hot water (HHW) pumps located in the mechanical room distributes hot water to the AHU and unit ventilators. The HHW pumps range from 0.3 hp to 1.0 hp.

The HHW pipes are well insulated. Overall, the boiler and the pumps are in good condition and are operating within their useful life. The installation of a VFD for the HHW supply pumps has been evaluated.

An A.O Smith 20-gallon, 2.5 kW electric water heater serves Westergard Library's domestic hot water (DHW) demand. The heater is in good condition, nearing its end of useful life, and the water pipes are insulated. The replacement of the electric water heater with a larger heat pump water heater has been evaluated.

Sterling Village

Sterling Village is a five-story, 124,735 square foot building built in 1990. Spaces include an office, corridors, restrooms, apartments, laundry room, garbage disposal rooms, utility rooms, and electrical and mechanical spaces. The facility is 80% cooled by window AC units installed in the apartments. Some common areas are conditioned with a 5-ton single package unit capable of cooling and heating located on exterior grounds. A boiler system consisting of eight boiler modules and the single package unit are responsible for heating the residential areas.

Sterling Village is made of multiple individual buildings which have been connected by corridors to form a singular complex. Sterling Village buildings are comprised of concrete masonry units (CMUs) with an exterior red brick façade on the first floor and vinyl siding on floors two through five. Two different roof types are present at Sterling Village. Residential buildings have pitched roofs with asphalt shingles while a white membrane EPDM roof covers the hallways that connect the different building sections together. The white EPDM roof was not accessible during the audit.

The building envelope and pitched roof are in good condition. Facility windows consist of operable, double-paned glass windows with aluminum frames. All windows are in good condition and are well sealed. Exterior doors consist of a mix of solid metal and aluminum framed glass units; both types are in good condition.

Sterling Village includes a total of 150 apartments which vary in size and accommodation needs, shown in the table below. TRC audited each apartment type and extrapolated the data to account for all the apartments. Accuracy was verified by comparing the utility history of the site to the extrapolated data.

Apartment Type	Apartment Quantity
1 Bedroom	103
1 Bedroom ADA	3
Studio	5
Studio ADA	2
2 Bedroom	5
Corner Bedroom	32

Sterling Village's primary lighting system consists mainly of fluorescent lighting. Common indoor lighting includes 3-foot T12 linear fluorescent lamps, U-bend T12 fluorescent lamps, 4-foot T8 linear fluorescent and U-bend T8 lamps. T12 lamps typically use magnetic ballasts while T8 lamps use solid state ballasts. Other lighting sources include A19 LED bulbs, halogen incandescent, and compact fluorescent biaxial plug-in lamps (CFL).

All emergency exit signs are up to date with LED technology. Common fixtures include, socket, wall mounted sconces, can, and retrofit drop ceiling fixtures with one, two, three, or four lamps per fixture.

All interior lighting is controlled by manual wall switches. During the audit, all corridor and stairwell lighting were observed to be running continuously. Additionally, numerous corridor lights were close to failing and or had failed. Retrofitting inefficient fixtures and installing automatic lighting controls such as occupancy sensors and high-low control sensors will help reduce lighting energy consumption. Overall, the current lighting system is in fair condition with adequate light levels.

Exterior lighting includes pole mounted LED lights, LED recessed can lights, and CFL wall pack lighting. Fixtures are in good condition and a timeclock controls all exterior lighting.

Unit ventilators (UVs) throughout Sterling Village are equipped with supply fan motors and are controlled by local thermostats. The UVs are connected to the hot water distribution system to provide heating to various spaces. UVs also modulate ventilation. The units are in good condition.

Window AC units provide most of the cooling at Sterling Village. Each apartment typically contains at least one window unit. Multiple window AC units can be installed in the larger apartments. Units have an estimated capacity of 0.8 tons of cooling and an energy efficiency ratio (EER) of 10.7. The units are in good condition and are not Energy Star labeled.

One ground mounted exterior package unit supplements the cooling and heating for some Sterling Village common areas. The unit has 5-ton cooling capacity and a Seasonal Energy Efficiency Ratio (SEER) of 14. The gas-fired burner has a heating capacity of 120 MBh. The 1 hp supply fan and 0.3 hp exhaust fan operate at constant speed. The unit is in good condition and is operating within its useful life.

Eight Slant Fin modular hot water boilers with a total capacity of 2,432 MBh serve the building's heating demand. The boilers are configured to modulate the load and have a heating efficiency rating of 81%. The units are in good condition and the pipes are insulated.

Two, 7.5 horsepower heating hot water (HHW) pumps located in the boiler room distribute hot water to fan coil units and baseboard radiators which are controlled by local thermostats. These motors operate at constant speed and are not controlled by variable frequency drives (VFDs). The HHW pipes are insulated, and the pumps are in good condition. At the time of the audit, the outside air temperature was 56°F and the HHW supply temperature was 168°F.

Domestic hot water (DHW) demand at Sterling Village is mainly supplied by individual 38-gallon electric storage water heaters located in each apartment. These units have an input capacity of 4.5 kW and are well insulated. The age and make of each unit varies, however, they are in good condition.

The laundry room at Sterling Village uses a dedicated Bradford White electric water heater located in the mechanical room. This tank has estimated capacity of 80 gallons and a 4.5 kW input capacity. Two fractional horsepower DHW pumps circulate the water. The storage tank is in good condition and the water pipes are insulated.

Every apartment at Sterling Village is equipped with a four-burner residential gas range except for five ADA compliant apartments which use electric ranges. The electric ranges have been accounted for in Section 2.10 Plug Load. The 145 gas ranges vary in age and make and are in good condition. The daily usage for the ranges are low. These units are not rated by ENERGY STAR.

Plug loads at Sterling Village include standard office equipment and residential appliances. Typical residential loads include computers, refrigerators, printers, coffee machines, microwaves, electric ranges, and televisions. There are an estimated 35 desktops throughout Sterling Village. Office plug loads include computers, printers, and a server room. There are 152 full-size residential refrigerators and an estimated 150 heat-light-exhaust fan units in restrooms. Equipment conditions and efficiencies vary.

The above descriptions of the existing buildings were pulled from the Local Government Energy Audit reports performed by TRC in 2023. For more detailed descriptions of each site, with sizes, quantities, and capacities of assets, please reference Appendix 6.3 – LGEA Reports.

3.2 ECM Descriptions

Please see the following descriptions of ECMs currently included in the ESIP project. Reference Appendix 6.2 – Preliminary Mech-Elec Designs and Appendix 6.4 – Scope of Work Details for additional project scope details.

1. Solar PV

This ECM involves the procurement and installation of solar PV panels across eight buildings. The Town Hall and Public Safety Building (PSB) are two separate buildings, but they share the same electric meter (located in PSB), so for this ECM these two buildings are considered to be one site. The PV systems will allow Piscataway to produce renewable energy onsite. The solar power generated onsite will offset a significant amount of energy that would otherwise be purchased from the utility, PSE&G. These savings are realized for as long as the PV systems are producing power, which is oftentimes over 30 years.

In addition to these financial benefits, there are many positive societal and environmental impacts as well. Not only will the Township's carbon footprint be drastically reduced so each building's impact on the environment is smaller, but the Township of Piscataway will be a model town for renewable energy, showcasing to other communities and the private sector how sustainability and energy efficiency objectives can both be achieved in a fiscally responsible way.

Interconnection applications have already been submitted to PSE&G, and approval has been granted for all of these sites. Most of the sites will be remote net metered, meaning the building usage and the solar production are trued up every 12 months. The Community Center was approved for solar PV, but that site cannot export PV production. The PV system size is still very small with respect to the overall building consumption, but some solar clipping will be required at times to ensure no PV power is sent back to the grid. The DPW is slated for remote net metering, so 100% of the PV production from the DPW canopy will be credited to the Community Center electric account.

The following table summarized the solar systems, which are a combination of roof mounted, ballasted rooftop, carport structures, and canopy structures. In our savings calculations, we took 2% off the helioscope production numbers for AC and soiling losses, and derated the solar production 0.5% every year thereafter.

Building	Intercxn Type	PV Size (kW DC)	Post ESIP Baseline (kWh)	Expected PV Production (kWh)	PV% of Post ESIP Baseline	1st Year Savings
Public Safety	Net Meter	509.3	787,788	579,258	74%	$ 97,092
DPW	Remote NM	374.0	164,069	426,216	260%	$ 66,364
JFK	Net Meter	391.6	342,834	446,885	130%	$ 71,402
Senior Center	Net Meter	110.0	188,538	134,270	71%	$ 22,417
Community Center	Non-Export	676.5	2,199,087	782,777	36%	$ 121,948
Westergard	Net Meter	110.0	109,547	133,725	122%	$ 10,946
Sterling Village	Net Meter	704.6	874,879	888,850	102%	$ 110,784
Total		**2,876.0**	**4,666,742**	**3,391,981**	**73%**	**$ 500,953**

PV systems have been developed to 60% design using CAD and Helioscope. Please reference Appendix 6.4 for additional PV design details, such as the Helioscopes, layouts, and shading reports.

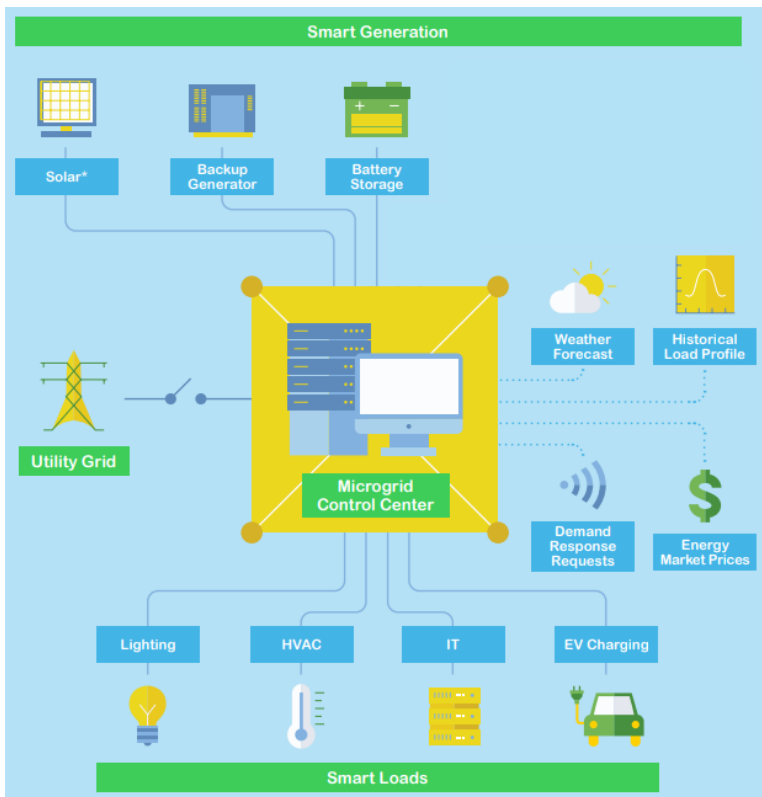
2. Microgrid – Battery Energy Storage

A Battery Energy Storage System (BESS) would be very beneficial to the Township of Piscataway in terms of making them more resilient, and allow them to better serve their community and residents when emergencies or disasters strike.

A microgrid is a collection of local, onsite distributed energy resources (DER) that work together as a single system, enabling facilities to function as their own separate versions of the grid. The DERs for Piscataway would be the existing 350kW diesel backup generator, the new solar PV system, and the new BESS. The BESS would be a 250kW / 1000kWh battery.

A microgrid leverages control technology to intelligently manage and optimize onsite generation and storage resources, enabling the Township to automatically make choices that provide economic and energy resilience benefits. The microgrid for the Public Safety and Town Hall buildings (they share the same PSE&G electric service) would be grid-tied, but have the capability to be islanded, so it would allow the site to function if the grid is down.

The energy control center (ECC) simplifies the electrical integration of onsite DER into one energy system and safely distributes and control electric power flow between the utility grid, DER, and building loads. The energy management software (Microgrid Advisor) will continuously monitor and control the various energy resources to optimally make, use, store, and export energy to ensure resiliency and achieve the most economical energy spend.



The various inputs and outputs of a microgrid.

Savings from the microgrid would come from the discharging of the battery to use in the building, or it can be exported to the grid through several of PJM's demand programs: Economic DR Program, Synchronized Reserves Program, and the Frequency Regulation Program. The battery can be charged from the solar PV system, and discharged as needed. The microgrid is designed to keep the entire Public Safety and Town Hall buildings operational (except the EV chargers) for five days, while islanded from the grid, and without having to refuel the emergency generator. Outside of PJM DR programs, the battery can shave peak demand to help reduce energy costs from the utility.

A microgrid will allow Piscataway to:

- Gain resilience during outages or emergencies
- Gain flexibility to either consume onsite solar energy, store that energy, or sell that energy to the grid
- Gain control to monitor and manage energy use and maximize their DER for energy savings

3. LED Lighting Retrofit – Interior & Exterior

The LED lighting includes mostly interior lights, but some exterior as well. Appendix 6.4 – Scope Details includes a lighting line-by-line (LxL) of the scope of work for this ECM, and product cutsheets. An onsite audit was performed at each site to determine what the best LED solution is for each space. In general, fluorescent tubes will be replaced with direct-wire LEDs, except in the Westergard Meeting Room, where new flat panel LED fixtures will be installed with the new ceiling going in there. For exterior lights that haven't been previously upgraded to LEDs, in general new LED fixtures will be installed.

The Township of Piscataway is contracting out with a separate 3rd party to perform the LED lighting upgrade.

4. Building Envelope & Weatherization

This ECM addresses the shell of the building and how well it is keeping conditioned air in and ambient air out. During the IGA, we performed an onsite building envelope audit to identify and measure what specific improvements could be made to each site. Our onsite testing and analysis of energy consumption indicate there is an opportunity to improve the indoor air quality, occupant comfort, and reduce energy use by upgrading the existing air barrier systems. A detailed description of the scope, with measurements, floor plan layouts, and pictures, is in Appendix 6.4 – Scope of Work Details.

A tighter building envelope will provide the following benefits for Piscataway:

- Drafts will be reduced providing greater comfort for the building occupants. A tighter building envelope will lower the possibility of "hot" or "cold" spots brought on by unconditioned air infiltrating into conditioned spaces.
- Decreased Energy Consumption – Less conditioned air will be lost through the building envelope and the heating and cooling equipment will operate less to maintain the indoor temp setpoints. This will decrease the energy consumed and save on energy costs.
- Improved Air Quality – Decreasing infiltration of contaminated air promotes less humidity and greater air quality. This allows for the existing systems to run at peak performance and maintain the highest level of air quality for the occupants.
- Reduced Maintenance Costs – Reducing the load on HVAC equipment will increase its operating life and performance.

The descriptions below describe the specific findings and improvements as part of the scope:

- Attic Air Barrier Retrofit – There is no air barrier between the conditioned space and the vented area above the dropped ceiling. Fiberglass insulation alone does not stop air leakage. The air leakage reduces the effectiveness of the existing insulation.
- Attic Bypass Sealing – Interior walls, plumbing, electrical, and HVAC penetrations entering the attic that are not properly sealed allow conditioned air to escape into the vented attic space. Since warm air rises, sealing the attic from the conditioned space is crucial to maintaining an efficient building. Air movement through fibrous insulation reduces the effectiveness of the existing insulation.
    - Install Attic Access Hatch – There is no material place currently that allows for easy coverage of the attic access areas of the first floor attic of Sterling Village. A properly treated attic hatch will allow access while still maintaining an airtight and well insulated surface area at the top of the thermal envelope of the building.
- Caulking – There are unsealed perimeter joints and holes found at the window systems at Westergard Library. These gaps allow air to find its way into the wall and window frame cavities or directly from outside to inside resulting in unwanted energy losses.

- Door Weather Stripping – Deteriorated weather stripping materials, ineffective weather stripping installation and daylight showing at the perimeter of door systems create direct pathways for unwanted infiltration/ exfiltration throughout the Township's buildings.
- Overhang Air Sealing – Overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction were misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system was incorrectly "connected" to the interior heated spaces of the building in many locations. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope.
- Overhead Door Weather Stripping/ Roll-up Door Weather Stripping – Remove existing weather stripping and replace with new commercial grade weather stripping to create a full air seal around the door. With low grade, none, or deteriorating materials in place, overhead and roll-up doors are a major air leakage source.
- Roof-Wall Intersection Air Sealing – The roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/ exfiltration.

Task	Town Hall	Public Safety	DPW Offices	JFK Library	Senior Center	Community Center	Westergard Library	Sterling Village	Total
Caulking (LF)							114		114
Door - Install Jamb Spacer (Units)	7		2			2			11
Door Weather Striping - Doubles (Units)	4	2	2	2	2	4	1	7	24
Door Weather Stripping - Singles (Units)	5	6	5	5	6	11	3	10	51
Overhang Air Sealing (SF)		159	128				198		485
Overhead Door Weather Stripping (Units)			11						11
Roof-Wall Intersection Air Sealing (LF)	233	643	784	408			472		2540
Roof-Wall Intersection Air Sealing (SF)	72		96	490			256		914
Attic Air Barrier Retrofit (SF)								1350	1350
Install New Attic Hatch (Units)								1	1

5. Hot Water Pipe Insulation

Energy is lost in the hot water distribution systems through radiant heat from un-insulated pipes, piping assemblies, valves, and fittings. With hot water pipe surfaces reaching 180 degrees, the exposed pipes are also a safety hazard, as well as a source of wasted energy. Un-insulated piping will inadvertently heat the space it's in, which is typically unconditioned areas. During the IGA, we performed an onsite insulation audit to identify specific improvements that could be made to each site. Below is a table summarizing the insulation scope of work to reduce unwanted heat losses.

Task	Community Center	Westergard Library	Sterling Village	Total
Balance Valve Insulation			1	1
Ball Valve Insulation		11	21	44
Bonnet Insulation		1		1
Butterfly Valve Insulation	7		5	12
Check Valve Insulation	2	1	2	7
End Cap Insulation	2	1		3
Flange Insulation	27	9	20	60
Flex Fitting Insulation	2			2
Flo-Check Insulation		1		6

Task	Community Center	Westergard Library	Sterling Village	Total
Gate Valve Insulation		1		8
Pipe Fitting Insulation		11	21	94
Pipe Reducer Insulation	2	1	2	5
Pump Insulation		3	3	13
Straight Pipe Insulation (LF)	4	21	42	163
Strainer Insulation	2	4	1	7
Suction Diffuser Insulation	2		2	4
Tank Insulation	1	1	1	3
Triple Duty Valve Insulation	2	1		4

6. Replace Existing RTUs and Split System AHU

The Senior Center has eight DX packaged units with natural gas heating. They are 10 years old and nearing the end of their useful life. Eight DX packaged units of the same size will be installed in their place, and connected back to the existing air-distribution system.

Westergard Library has two AHUs: a DX packaged unit with duct mounted hot water heating that serves existing VAV boxes, and a DX split system with electric resistance heating that serves a meeting room. Both units are 16 years old and nearing the end of their useful life. One DX packaged unit of the same size will replace the existing packaged unit. Existing VAV boxes served by this unit will have their damper actuators replaced for upgraded operation of the VAV system. The existing duct-mounted hot water coil will remain for reuse. One DX split system will replace the existing split system; the new split system will be correctly sized for the space and therefore is smaller than the existing unit. The new split system will utilize heat pump heating with supplemental hot water heating.

Replacing the packaged DX units and split system will bring improved cooling efficiencies, which will result in lower electric usage and less energy spend to operate the equipment. Additionally, the switch from electric resistance heating to heat pump heating in the split system at Westergard will result in additional electric usage savings. The table below specifies the old and new equipment at each building. Please see Appendix 6.4 – Scope of Work Details for information on this ECM.

Building	Existing Packaged Units	New Units
Senior Center	(1) Lennox LGH036, 3-ton, Packaged Unit (2) Lennox LGH092, 7.5-ton, Packaged Unit (4) Lennox LGH102, 8.5-ton, Packaged Unit (1) Lennox LGH120, 10-ton, Packaged Unit	(1) Lennox LGT036, 3-ton, Packaged Unit (2) Lennox LGT092, 7.5-ton, Packaged Unit (4) Lennox LGT102, 8.5-ton, Packaged Unit (1) Lennox LGT120, 10-ton, Packaged Unit
Westergard Library	(1) Aaon RM-025, 25-ton, HW Heat Packaged Unit (1) Aaon CA-08-2, 7.5-ton, Electric Resistance Heat Split System	(1) Aaon RN-025, 25-ton, HW Heat Packaged Unit (1) Trane TWA072/TWE072 Heat Pump + HW Heat Split System

	
Existing packaged units (RTUs) at JFK Library.	*Existing packaged and split system units at Westergard Library*

7. Enhanced Air Purification – Bi-Polar Ionization (BPI)

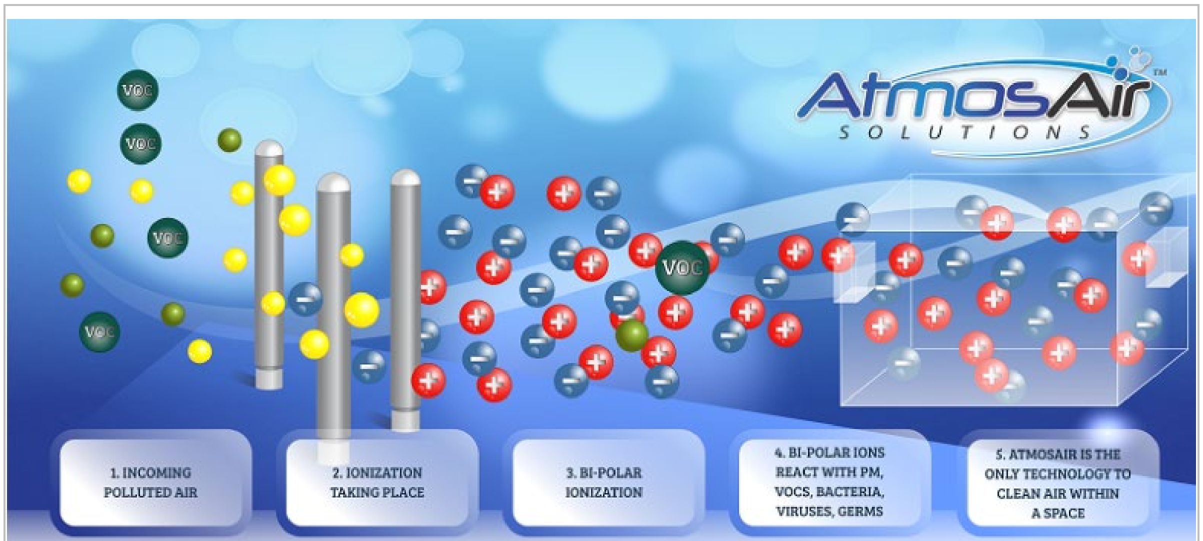
Bringing in fresh outside air is a code requirement for buildings to remain healthy for people. Reducing the outside air flow rates, when permissible, and installing air purification technology will reduce particulate matter, volatile organic compounds, pathogens, other VOCs, and will create a healthier indoor environment. One such method of purifying the air is bi-polar ionization. A BPI device will be installed in each rooftop unit or air handling unit that is not going to have demand-controlled ventilation installed as a scope of work. Bi-polar ionization allows less outside air to be brought into the building because of the enhanced purification performed by the BPI device. BPI will provide two critical benefits for the Township of Piscataway:

- Improved indoor air quality
- Energy and cost savings from bringing in less OA

A small device will be installed in the airstream. This device will consume a small amount of power to generate ions. These ions will bond to particulate molecules in the space, and these bonded ions become heavier than air and fall out of the air, or increase in size so they are more easily captured in the HVAC unit's air filters. For the Public Safety Building, the existing AHU airflow monitoring stations in the outside air stream will be replaced to accurately measure the OA flow.

BPI Scope:

Building	AHUs / RTUs
Town Hall	13
Public Safety	5
DPW	1
Senior Center	8
Community Center	1
Sterling Village	1



Atmos Air is a reputable manufacturer of air purification technology.

8. Install Air-Cooled Chillers at Town Hall and JFK Library

The Town Hall has one air-cooled chiller serving the building cooling load. The air-cooled chiller is 19 years old and nearing the end of its useful life. Existing pumps will be replaced along with the air-cooled chiller.

JFK Library has one air-cooled chiller serving the building cooling load. The air-cooled chiller is 16 years old and nearing the end of its useful life. Existing pumps will be replaced along with the air-cooled chiller. The existing CHW pumps operated at constant flow, but the new CHW pumps will be provided with VFDs to allow for pump energy savings when full flow is not required. In order to allow for variable flow savings, existing three-way control valves throughout the building will be replaced with two-way control valves. A CHW plant bypass will be installed in the mechanical room to allow the chiller to maintain minimum flow through the evaporator. Hooking the new chillers and equipment into the Building Automation System is included in the scope, along with implementing energy-efficient sequences of operation.

Replacing old, air-cooled chillers with new energy efficient air-cooled chillers will bring improved cooling efficiencies, which will result in lower electrical usage and less energy spend to operate the air-cooled chillers. The table below specifies the old and new air-cooled chillers at each building. Please see Appendix 6.4 – Scope of Work Details for information on this ECM.

Building	Existing Air-Cooled Chillers	New Air-Cooled Chillers
Town Hall	(1) McQuay AGZ055, 55-ton Air-Cooled Chiller	(1) Daikin AGZ004F, 54-ton Air-Cooled Chiller
JFK Library	(1) Trane RTAA100A, 100-ton Air-Cooled Chiller	(1) Daikin AGZ006F, 100-ton Air-Cooled Chiller

	
Existing air-cooled chiller at the Town Hall.	*Existing air-cooled chiller at JFK Library.*

9. Install Suction Diffusers on Inlet of Boiler Circulator Pumps at DPW Building

Existing circulator pumps serving two boilers do not have a suction diffuser or the proper straight length of pipe on the inlet side of the pump. It is recommended that pumps have 5-10 times the pipe diameter of straight pipe on the inlet of the pump or an optional suction diffuser for proper pump operation. Without the required length of straight pipe or a suction diffuser the pump's expected service life is reduced. Piscataway replaces the boiler circulation pumps every year at DPW, so this measure will result in operational and maintenance savings by replacing each 90° elbow into the circulator pumps with a suction diffuser.

	
Existing boiler circulation pump at DPW (typical of 2).	*Pile of recently replaced boiler circulation pumps.*

10. Optimize BAS & HVAC Controls

Opportunities exist in each Piscataway facility to improve the operation of space conditioning equipment. The majority of the Township's buildings utilize an existing building automation system (BAS), but several do not. Where there is a current BAS, the Township would benefit from modifications to the existing sequences of operation as well as setpoints, alarms, and occupancy schedules. Where no BAS currently exists, Piscataway would benefit from installing a new BAS to gain better control of, and visibility into, their HVAC system operations.

Building	Current BAS	ESIP Scope
Town Hall	ALC	Schedules/Setpoints + Implement Energy Efficiency Sequences
Public Safety	ALC	Schedules/Setpoints + Implement Energy Efficiency Sequences
DPW	ALC	Schedules/Setpoints + Implement Energy Efficiency Sequences
DPW Garage	None	Schedules/Setpoints
JFK Library	Johnson	Schedules/Setpoints + Implement Energy Efficiency Sequences
Senior Center	None	Install new ALC BAS
Community Center	Honeywell	Schedules/Setpoints + Implement Energy Efficiency Sequences
Sterling Village	None	No Scope
Westergard Library	None	Install new ALC BAS

Install New ALC Control System

The Senior Center, DPW Garage, and Westergard Library do not have a building automation system. The existing equipment operates to thermostatic controls with no means of central scheduling or monitoring. For these sites, implementing schedules, consistent heating and cooling setpoints, and setup and setback controls will provide significant energy and cost savings, because the most effective way to save energy is to turn off equipment when it is not needed. The ESIP scope includes adding ALC

A new ALC building automation system will be installed at Senior Center and Westergard Library. This will provide Piscataway enhanced scheduling and setpoint controls, as well as improved monitoring, troubleshooting, trending, and alarming capabilities. Energy efficiency sequences will be programmed for these sites as well.

Programmable Thermostats

The six, large gas-fired unit heaters at the DPW Garage will have schedule and setpoint controls installed through programmable thermostats; this site in not on the Township's WAN, and a full BAS system here would be overkill.

Setpoints and Schedules

Across all sites with existing building automation systems, the existing temperature setpoints and occupancy schedules will be optimized to better reflect the types of spaces served as well as hours of occupancy. User configurable daily, weekly, and holiday time schedules will be implemented for the controlled equipment. Temp setpoints will be standardized where possible, and customized where needed. The occupancy schedules and temperature setpoints for each space were recorded during the IGA. Schneider Electric and the Township of Piscataway have collaborated to determine new acceptable schedules and setpoints to implement across all of their sites.

HW/CHW Temp Resets on Boilers and Chillers

Some sites that have existing building automation systems were identified as good candidates for implementing energy conscious sequences. Town Hall, Public Safety, JFK Library, and the Community Center have temperature reset control strategies that will be implemented under this ESP. This includes a chilled water and hot water temperature reset strategy for the hydronic equipment. These strategies allow for the hydronic equipment to reset the temperature setpoint using the airside equipment valve positions to reflect the conditions within the space. This is a better determination of load than a reset schedule based on outside air temperature, and it has better energy savings, too. These resets will provide gas and electric energy savings, so the boilers and chillers do not have to work as hard during medium and low-load times. This will be especially critical since condensing boilers are being installed (or already exist), and the correct range of hot water return temperatures are needed for the condensing boilers to operate at their high efficiency ratings.

Control Attic Relief/Exhaust Fans

For proper ventilation, IAQ, and building pressurization at the Public Safety Building, it was assessed, measured, and determined that the building's exhaust system needs to be upgraded or modified in order to operate properly. The current layout and operation of the exhaust air system at the Public Safety Building would not allow for proper ventilation, which compromises air quality, building pressurization, and occupant comfort. It was confirmed through airflow TAB, that the current pressure of the building is negative relative to the outside (-0.087"). The scope of work is to modify the sequences of operation to control the exhaust fans to a slightly positive pressure in the building compared to the pressure outside of the building. This solution will work with the BPI ECM, which includes the airflow monitoring stations to help maintain the correct building and attic static pressures.

Install Freeze-stats

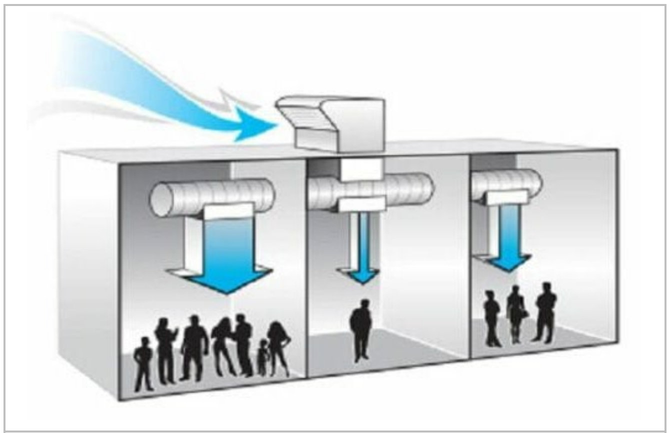
Freeze-stats for the AHUs at Public Safety do not provide adequate coil coverage. In the winter of 2022/2023, an AHU coil froze when an OA damper failed. Freeze-stats existed, but because of the poor coil coverage, it did not trip the AHU off. The freeze-stats will be upgraded for the AHUs to provide proper coil coverage and protect the coils from freezing in the future.

The savings incorporate an outside air baseline adjustment at Town Hall, Public Safety, and DPW Offices, which account for the energy penalty associated with bringing more outside air in these buildings, as compared to the baseline period where little to no outside air was being introduced to the spaces. A pre-TAB assessment was performed by an air balancer to measure outside air flows at several buildings and confirmed the lack of OA flow for these buildings.

11. Demand Controlled Ventilation (DCV)

Conditioning outdoor air (both heating and cooling) is one of the single largest energy-consuming tasks for a building. Any space that uses more ventilation than its occupancy levels require, results in excess energy usage to condition that outdoor air unnecessarily. HVAC systems are designed to provide a specified quantity of ventilation air corresponding to the maximum occupancy conditions for the space served. However, there are periods throughout the day when spaces within the building may be partially occupied or even unoccupied (such as gyms and cafeterias), yet ventilation rates are maintained at the maximum level, as though it were fully occupied. Demand Controlled Ventilation (DCV) can greatly reduce the energy consumed by the HVAC system by providing the right level of ventilation based on occupancy.

DCV is a ventilation control strategy that measures the carbon dioxide levels in a space (CO_2 is a great indicator of occupancy) and uses that measurement to adjust the amount of outdoor air supplied to a space at any given time. This strategy continuously adjusts the ventilation rate as dictated by ASHRAE ventilation requirements. By ventilating the space only as required, the energy and associated costs spent to heat and cool outdoor air are reduced. DCV will be implemented in the Township's large rooms that also have highly variable and unpredictable occupancy, such as conference rooms, court rooms, libraries, multi-purpose activity areas, etc.



Demand controlled ventilation varies outside air rates based on building occupancy. Blue arrows indicate amounts of fresh, outdoor air.

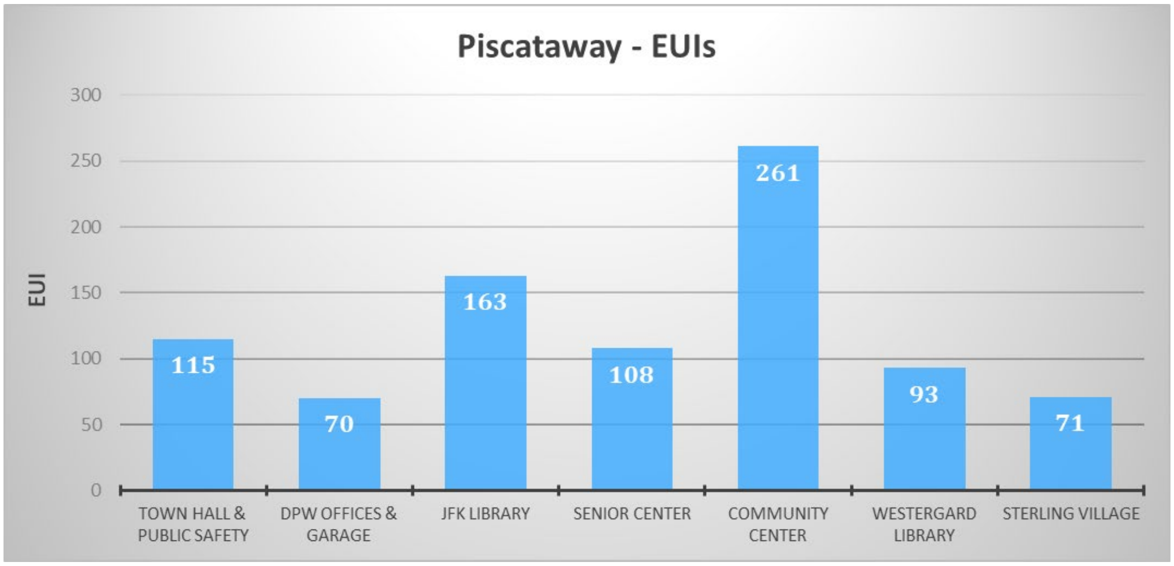
DCV scope includes:

- (1) AHU at Town Hall
- (5) AHUs at JFK Library
- (2) AHUs at Westergard Library

12. Recommission BAS and Sequences of Operation at Community Center

The Community Center that was built in 2020 has an Energy Use Intensity (EUI) of 261, which is extraordinarily high. During the site audits, there were many observations and questions about the operations of the HVAC equipment and general curiosity around the sequences of operation implemented through the BAS. Because of these observations and the high EUI, the Community Center will undergo a BAS recommissioning in order to identify areas where controllability and energy use can be improved. New temperature setpoints, occupancy schedules, and trending will be implemented.

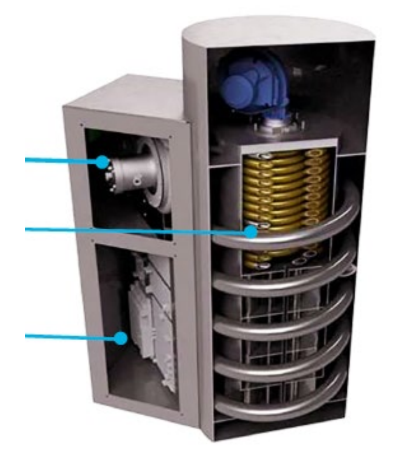
Some areas for energy savings that were initially identified as likely solutions from a recommissioning exercise are: setpoint adjustments, schedule adjustments, hot water temperature reset for the heating water boilers, demand-controlled ventilation, and likely other energy-savings upgrades that will not negatively impact occupant comfort. Functional performance testing will be performed as well. It was noted that the heating hot water temp setpoint was being maintained at 180°F year-round, which is unnecessary, especially with condensing boilers.



13. Micro Combined Heat & Power (mCHP)

Traditional fossil fuel burning power plants are limited to a thermal efficiency of electricity production of approximately 40%. The remainder of the thermal energy produced by burning fossil fuels is lost to internal process demands or rejected from the system through cooling towers or other means which heat the atmosphere. On-site power generation provides the opportunity to recover useful waste heat that would otherwise be lost to the atmosphere.

This CHP system would be installed at Westergard Library to generate electricity, while simultaneously using the waste heat for the heating hot water system. CHP does save energy by reducing losses in the electricity-generation process from utility providers, while also using the waste heat from the combustion process within the building's heating system to help offset the heat load and decrease the amount of heating the HW boiler needs to produce. Per equivalent energy unit, the cost of electricity from a utility is higher than the cost for natural gas from the utility. The main benefit from CHP comes from the cost savings of using natural gas to generate electricity onsite and utilizing the waste heat to further increase heating efficiencies, rather than purchasing electricity from the utility.



Cutaway of a mCHP boiler that consists of a condensing boiler and a generator.

Savings for this measure are derived by incorporating the mCHP into the existing heating plant of the building. The mCHP boiler will function as the primary boiler, which allows this efficient condensing boiler to take a portion of the building heating load off the other boiler in the plant. Along with this ability to reduce building heating load for the boiler plant, the mCHP will be able to generate electricity for the building when the building is in heating mode. The mCHP unit will be integrated into the Building Automation System for monitoring purposes. Please see Appendix 6.2 Preliminary Mech-Elec Designs for more detail on this ECM.

The table below shows the emissions calculations related to just the CHP scope, using the BPU protocols.

Therms Savings	kWh Savings	Emission Product	Emission Reduction (lbs)
62	6,102	CO_2	8,609
		NO_x	6
		SO_2	4

The emissions reductions are calculated based on the following factors.

- 1,292 lbs. CO_2 per MWh saved
- 0.83 lbs. NO_x per MWh saved
- 0.67 lbs. SO_2 per MWh saved
- 11.7 lbs. CO_2 per therm saved
- 0.0092 lbs. NO_x per therm saved

14. EV Chargers

One of Piscataway's major goals with ESIP is to provide public EV chargers for their residents and visitors. They want to be the township that is leading the charge with EV charging. For this measure, twenty-six chargers will be installed at six different locations across the township. EV chargers sometimes require a significant amount of electrical work in order to have the chargers work correctly, and to capacity. Electrical conditions and required upgrades have been analyzed and are included in the project scope.

With EV chargers come additional electrical load and costs. The additional load has been accounted for in the ESIP project calculations. The additional costs for the electricity to use the EV chargers will be offset by the fees charged by the Township to recoup their costs. The chargers will be networked, so Piscataway will have to ability to easily modify how they charge customers (rate, time-of-day, idle time, etc.) whenever they want. The basis of design for EV chargers is the Zerova AX Series 80A charger. Load management software that can limit the total EV charger power draw is included, so Piscataway can easily manage the charging loads at each site. This will be helpful if they continue to build out their charging network.

The table below summarized the EV Charger scope of work. The estimated usages were determined collaboratively with Piscataway to try to be as accurate as possible; it is difficult to estimate future EV charger use. Because EV chargers consume more energy, not save energy, this EV Chargers measure is considered an energy-related capital improvement, not and energy conservation measure (ECM). It is showing this way in Section 2.2, with no associated energy savings.

Please see Appendix 6.2 – Prelim Mech-Elec Designs and Appendix 6.4 – Scope Details for additional information and drawings for this scope.

Site	Charger Qty	Bldg Voltage	Charger Power	Est. Annual Usage (hrs)	Est. Annual kWh
Public Safety	6	240 V	19.2 kW	650	74,880
JFK Library	6	208 V	16.6 kW	1,716	171,325
Community Center	8	240 V	19.2 kW	2,184	335,462
Westergard Library	2	208 V	16.6 kW	1,404	46,725
Sterling Village	4	240 V	19.2 kW	819	62,899
Total	**26**			**6,773**	**691,292**

Customer-Driven Projects with Energy Savings

Replace Boilers at JFK Library

The Township of Piscataway contracted out to replace their two non-condensing boilers (850 MBH output each) with a rated efficiency of 85%. They are 16 years old one had already failed. Two new 825 MBH output condensing boilers with 97% rated efficiencies, will be installed in their place, and connected back to the existing heating water system. Each new boiler will receive a new circulator pump, but the existing hot water distribution pumps will be reused. This work is scheduled for October 2023.

Replacing non-condensing boilers with condensing boilers will bring improved heating efficiencies, which will result in lower gas usage and less energy spend to operate the boilers. The table below specifies the old and new boilers, but please see Appendix 6.4 – Scope of Work Details for additional information on this ECM.

<u>Existing Boilers</u> (2) P-K Thermific Model NM-1000, 850 MBH output, 85% eff. **<u>New Boilers</u>** (2) IBC model EX-850, 825 MBH output, 97% eff.	
	Existing non-condensing boilers at JFK Library.

3.3 Optional ECMs

The following opportunities were identified and investigated during the Investment Grade Audit but are not currently included in the Energy Savings Plan.

1. **LED Lighting Controls –** Install lighting controls to further save on energy costs, including dimming controls were investigated as part of the IGA.
2. **LED Field Lighting –** Converting existing field lighting to LED was investigated at the parks, but ultimately didn't make it into the final scope of work.
3. **Street Lighting** – Upgrading street lights to LEDs was an original ECM for this ESIP, however the lack of a defined street light replacement program with PSE&G, and a low interest level from PSE&G to cooperate forced with ECM to be out-of-scope currently.
4. **Walk-in Freezers and Coolers** – There are large walk-in coolers and freezers at Senior Center, that could be upgraded to more energy efficient refrigeration technologies and equipment. During the IGA audit, it was decided to not pursue this as part of the final ESIP scope.
5. **Vending Machine Controls** – a
6. **Low Flow Hot Water Devices** – Faucet aerators across all buildings could provide gas or electric domestic water heating savings to Piscataway.
7. **Water Conservation Measures** – Water fixtures in the buildings are a mix of low-flow and older high-flow, and the Township could benefit from recommissioning, valve replacement, or fixture replacement in order to save on water and sewer costs, as well as conserve the natural resource of water.
8. **HVAC Replacements & Upgrades** – Replacing HVAC units at Town Hall, DPW, JFK Library, and Sterling Village were investigated during the IGA. Based on replacement costs, current age and condition of equipment, Piscataway's priorities, and BAS integration costs, some HVAC replacements or upgrades were not included in the final ESIP scope.
9. **Building Exhaust System –** Replacing the Public Safety Building's exhaust fans completely, and integrating new fans into the BAS sequences to properly maintain building pressure was a scope item that was explored during the IGA.
10. **Destratification Fans –** During the IGA, the installation of destratification fans at the JFK Library and the natatorium of the Community Center were developed as scopes of work. Payback and complexities (natatorium) were contributors as to why destratification fans were not included in the final scope.
11. **Chilled Water System Enhancements –** Removing glycol from the existing chilled water systems was looked into at Town Hall, Public Safety, and JFK Library, but ultimately abandoned as scope items.
12. **Replace Boilers –** Boiler replacements were investigated and priced out, with savings, for Town Hall, Public Safety, DPW, and Westergard Library. Old age, efficiency, and high O&M costs and customer dissatisfaction (Town Hall & Public Safety) were reasons that these scopes were looked into during the IGA. Replacement of the diesel/oil boiler at the DPW main garage, used for the car wash, was explored during the IGA. Minimal use was a cause for not pursuing this scope into final IGA.
13. **Advanced Humidity Controls –** Because of high humidity levels during the IGA audit, and humidity concerns from the Township, measures that decreased the humidity levels at the Community Center and Town Hall were studied. There would be occupant comfort and energy savings benefits from this measure.
14. **Natatorium Upgrades –** Reducing the energy usage for the Community Center, especially the natatorium, were examined during the IGA. This includes air flow, reheats, humidity, air balancing, BAS sequencing, and OA flow energy-saving improvements. Also, chemical upgrades were studied for the pool water. This includes pool water distribution systems, filtration systems, pool heating systems, chemical treatment, onsite chemical production and chemical procurement, and pool covers (LPC).
15. **Water Reclamation System –** The DPW has a car wash which uses a significant amount of water. A system that reclaims water and filters it for use in the car wash was investigated, but not included in the final scope of work.

16. **Replace Electrical Infrastructure –** The electrical switchgear and components at Public Safety Building, Town Hall, DPW, JFK, and Westergard are all old and very outdated. The electrical equipment is well past its useful life expectancy and is due for replacements. The reason for replacing old switchgears is more safety, reliability, and maintenance-related, rather than energy savings driven.
17. **Solar PV PPA** – Providing Solar PV through a Power Purchase Agreement (PPA) instead of through Direct Purchase was investigated, but the long-term benefits of owning solar were much greater than a PPA. Piscataway also has two existing PV arrays that they own, so they are comfortable with PV ownership.
18. **Remote Net Metering Solar** – Additional solar installations are possible and reasonable, to further expand the Township's solar portfolio. For example, they are building or remodeling several buildings which could incorporate solar.
19. **Combined Heat & Power –** CHP was examined for several sites, including the DPW, Public Safety, and Community Center, in order to become more energy efficient.
20. **Replace Domestic Water Heaters –** Replacement of water heaters with in-kind and with heat pump water heaters was developed, but not included in the final ESIP scope.
21. **Air Balancing TAB –** Building-wide airside test, adjust, and balance (TAB) scope was explored for several buildings, especially those with existing temperature or humidity issues, in order to help reduce hot/cold areas during the winter and summer months, and improve occupant comfort and provide energy savings.
22. **Secondary Transformers –** Secondary transformers were audited and analyzed for replacement; however, the scope wasn't able to fit into the ESIP project at this time.
23. **Window Replacement** – Some windows across the Township are old and leaky, and thus are quite poor in energy efficiency ratings. These were looked into during the IGA.
24. **Energy-Related Improvements** – Other energy-related improvement measures that would save Piscataway energy, O&M costs, or energy costs.

3.4 Ongoing Maintenance

Under the New Jersey ESIP legislation, all maintenance contracts are required to be procured separately from the ESIP contract. As part of the ESIP, Schneider Electric will:

- Properly commission all new equipment provided
- Provide meaningful equipment and operational training to Piscataway staff for all new equipment
- Provide a comprehensive Operation and Maintenance (O&M) Manual for Piscataway to follow
    - This will provide a roadmap of how to properly maintain the new equipment and ensure it is operating efficiently and as intended by the manufacturer and per the design documents
    - The O&M Manual will also include all warranty information

Below are expected O&M impacts for the Township of Piscataway.

Improvement Measure	O&M Impact
Solar PV	Maintenance of a solar PV system is critical to ensure optimal performance, and thus maximize energy savings. Solar PV O&M would be performed by a 3rd party, not the Township themselves. The cost for this ongoing O&M by others is included in the cash flow of the ESIP project, as shown in the Form VI Annual Services Cost column in Section 2.3 – Cash Flow Analysis.

Improvement Measure	O&M Impact
Microgrid & Battery Energy Storage	A microgrid and battery energy storage system (BESS) require additional maintenance compared to what Piscataway is accustomed to for their electrical systems. The Township is not expected to perform this needed ongoing maintenance for the BESS, as it does require very specific expertise. They will hire out a 3rd party to perform O&M on the microgrid, and these costs are included in annual cash flow in Form VI, just like solar PV O&M is.
LED Lighting	Reduced O&M by replacing non-LEDs with LEDs. Less frequent lamp or ballast changeouts will be required, as well as very minimal maintenance during the warranty period.
Building Envelope & Insulation	No change to current envelope maintenance.
RTU/AHU Replacements	Reduced O&M by having HVAC equipment that is 10-20 years younger than existing. All equipment will be fully commissioned and started up before turning equipment over to Piscataway. Preventive maintenance will be required to keep equipment operating as designed and extend its lifespan. These tasks will be specified in the O&M Manual, but would be no more than what is already performed on existing equipment.
Advanced Air Purification	These improvement measures (BPI) do not require ongoing maintenance once they are initially installed and commissioned.
Chillers & Boilers	New boilers and chillers should improve the long-term O&M requirements for the heating water and chilled water systems. There will be ongoing preventive maintenance to the boilers and chillers which will be very similar to current practices. Decreased maintenance would be observed due to the equipment being new, not 15-20 years old. These tasks will be specified in the O&M Manual.
New or Upgraded BAS Controls	BAS controls will be fully commissioned (point-to-point) and sequences of operation will be fully verified as well. Upgrading the controls and HVAC equipment together will lead to less O&M because the equipment is new and will have been verified to be working according to designs. When a new BAS is installed where one didn't previously exist, there could be some additional O&M costs if a BAS service contract is desired by the Township.
Micro CHP	This will require some additional maintenance that the Township doesn't currently provide, as they do not have a micro-CHP. The O&M requirements are the same as a condensing boiler, so the O&M tasks will not be unfamiliar to Piscataway. The specific O&M tasks will be clearly identified in the O&M Manual provided at project closeout, and will be covered during customer training. The tasks required for annual maintenance, as laid out in the IO&M Manual in Appendix 6.4, is very minimal.
EV Chargers	There will be minimal O&M tasks associated with the EV chargers. Typically, just break-fix work will be needed if/when a charger stops working as intended. The specific O&M tasks will be clear in the O&M Manual provided at project closeout, and will be covered in detail during customer training.

4.0 Energy Savings

4.1 Baseline Energy Use

This baseline includes all facilities and was created by taking utility data from August 2020 – March 2023, and utilizing the following:

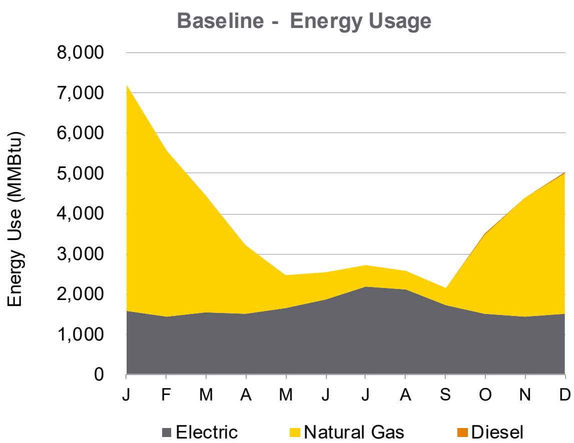
- Prorating the usage into clean monthly bins
- Weather normalizing the baseline to represent a typical meteorological year
- Weather normalized data during the period of Jan 2022 – Dec 2022 was taken as the baseline for all the facilities except for JFK Library. JFK Library had an operational change, and one of the air handlers was shut down in 2022. In order to model the typical usage of the building rather than a non-typical operation, the year ending in Feb 2022 was taken as the baseline for JFK Library.

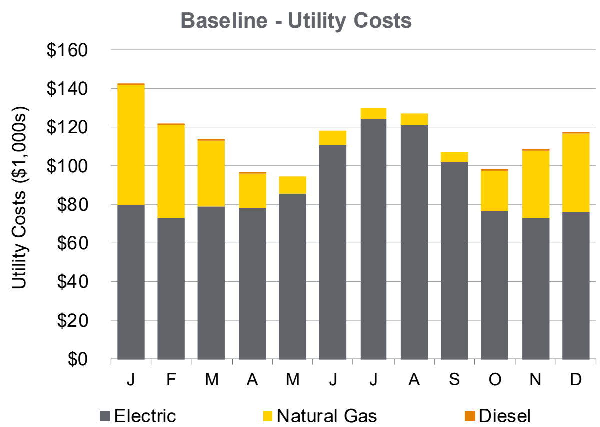
The following tables and graphs show the combined baseline usage for all the sites listed in Section 3.1, except Street Lighting.

Piscataway Township - All Sites - Baseline

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	461,404	1,351	$80,169	56,169	$62,201	95	$462	7,204	$142,832
Feb	419,079	1,317	$73,449	41,400	$47,595	73	$354	5,580	$121,398
Mar	456,153	1,308	$79,000	29,020	$34,460	52	$253	4,466	$113,712
Apr	444,385	1,477	$78,088	17,064	$18,274	32	$156	3,227	$96,517
May	488,538	1,617	$85,594	7,999	$9,039	0	$0	2,467	$94,633
Jun	546,923	1,755	$110,955	6,769	$7,729	0	$0	2,544	$118,684
Jul	637,791	1,708	$124,089	5,321	$6,329	0	$0	2,709	$130,418
Aug	622,166	1,704	$121,637	4,581	$5,622	0	$0	2,582	$127,260
Sept	506,533	1,559	$102,022	4,136	$5,185	0	$0	2,142	$107,207
Oct	439,785	1,432	$77,035	19,825	$20,964	24	$116	3,487	$98,114
Nov	417,102	1,347	$73,212	29,562	$35,059	48	$236	4,386	$108,506
Dec	443,283	1,178	$76,394	34,937	$40,707	69	$339	5,016	$117,439
Year	**5,883,141**	**17,754**	**$1,081,643**	**256,783**	**$293,163**	**393**	**$1,915**	**45,809**	**$1,376,721**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	50.6	**4.4**	**$2.72**	**64.7**	**$0.74**	**0.1**	**$0.00**	**115.4**	**$3.47**





Baseline MMBtu (Table for Graphs)

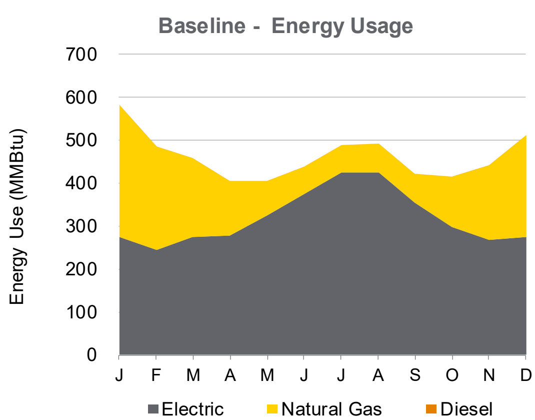
	Baseline								
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	1,575	-	-	5,617	-	12	-	7,204	-
F	1,430	-	-	4,140	-	9	-	5,580	-
M	1,557	-	-	2,902	-	7	-	4,466	-
A	1,517	-	-	1,706	-	4	-	3,227	-
M	1,667	-	-	800	-	0	-	2,467	-
J	1,867	-	-	677	-	0	-	2,544	-
J	2,177	-	-	532	-	0	-	2,709	-
A	2,123	-	-	458	-	0	-	2,582	-
S	1,729	-	-	414	-	0	-	2,142	-
O	1,501	-	-	1,982	-	3	-	3,487	-
N	1,424	-	-	2,956	-	6	-	4,386	-
D	1,513	-	-	3,494	-	9	-	5,016	-
	20,079			**25,678**		**51**		**45,809**	

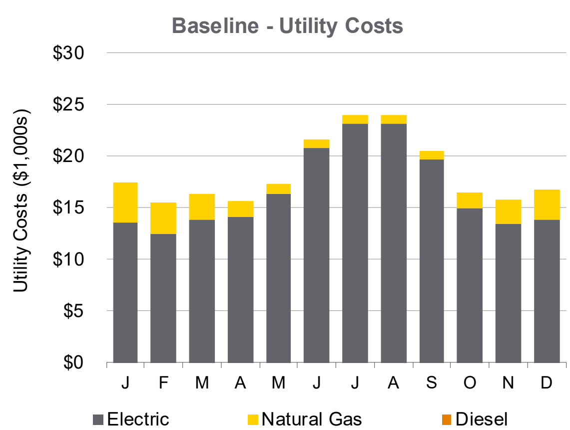
The following charts depict the month-by-month energy baseline for each facility:

Town Hall & Public Safety

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	80,185	144	$13,594	3,099	$3,802	0	$0	584	$17,396
Feb	72,123	155	$12,384	2,400	$3,052	0	$0	486	$15,435
Mar	80,831	183	$13,878	1,825	$2,418	0	$0	458	$16,296
Apr	81,582	203	$14,090	1,270	$1,503	0	$0	405	$15,593
May	95,121	220	$16,282	823	$1,012	0	$0	407	$17,294
Jun	109,836	236	$20,779	646	$821	0	$0	439	$21,600
Jul	124,341	244	$23,151	636	$809	0	$0	488	$23,960
Aug	124,513	240	$23,119	678	$850	0	$0	493	$23,969
Sept	103,691	226	$19,689	665	$839	0	$0	420	$20,528
Oct	87,317	208	$15,011	1,184	$1,400	0	$0	416	$16,412
Nov	78,516	172	$13,463	1,731	$2,314	0	$0	441	$15,778
Dec	80,821	166	$13,798	2,367	$3,014	0	$0	513	$16,812
Year	**1,118,877**	**2,397**	**$199,238**	**17,325**	**$21,835**	**0**	**$0**	**5,551**	**$221,073**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	79.4	**5.1**	**$4.14**	**36.0**	**$0.45**	**0.0**	**$0.00**	**115.4**	**$4.59**





Baseline MMBtu (Table for Graphs)

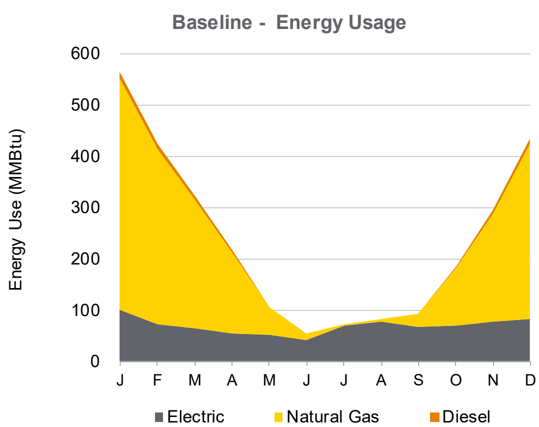
Baseline									
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	274	-	-	310	-	0	-	584	-
F	246	-	-	240	-	0	-	486	-
M	276	-	-	183	-	0	-	458	-
A	278	-	-	127	-	0	-	405	-
M	325	-	-	82	-	0	-	407	-
J	375	-	-	65	-	0	-	439	-
J	424	-	-	64	-	0	-	488	-
A	425	-	-	68	-	0	-	493	-
S	354	-	-	67	-	0	-	420	-
O	298	-	-	118	-	0	-	416	-
N	268	-	-	173	-	0	-	441	-
D	276	-	-	237	-	0	-	513	-
	3,819			**1,732**		**0**		**5,551**	

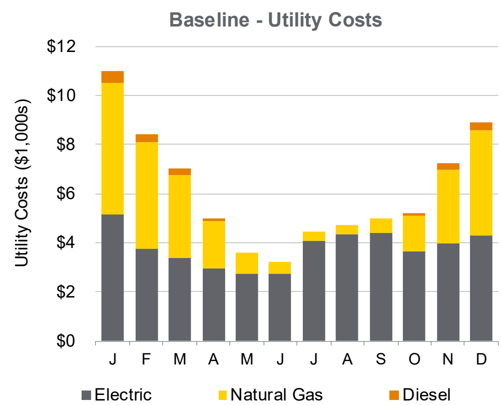
DPW Offices & Roads Garage

Piscataway Township - DPW Offices & Garage - Baseline

	Electricity				Natural Gas		Diesel		Total	
Month	Electricity form Utility	PV Production	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	29,446	4,508	66	$5,143	4,508	$5,371	95	$462	564	$10,976
Feb	21,308	6,993	60	$3,781	3,406	$4,295	73	$354	423	$8,430
Mar	19,001	9,521	53	$3,369	2,523	$3,411	52	$253	324	$7,033
Apr	16,283	10,216	59	$2,959	1,566	$1,901	32	$156	216	$5,016
May	15,251	11,928	48	$2,734	529	$868	0	$0	105	$3,602
Jun	12,458	16,898	52	$2,756	130	$469	0	$0	55	$3,225
Jul	20,319	14,187	55	$4,061	25	$374	0	$0	72	$4,435
Aug	22,474	11,195	50	$4,324	51	$398	0	$0	82	$4,722
Sept	20,084	7,125	81	$4,408	244	$571	0	$0	93	$4,979
Oct	20,517	5,514	54	$3,622	1,133	$1,468	24	$116	186	$5,206
Nov	22,580	4,351	60	$3,992	2,113	$3,003	48	$236	295	$7,231
Dec	24,483	5,249	55	$4,275	3,414	$4,303	69	$339	434	$8,916
Year	**244,203**	**107,686**	**693**	**$45,423**	**19,641**	**$26,432**	**393**	**$1,915**	**2,849**	**$73,770**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	20.5	**2.0**	**$1.12**	**48.3**	**$0.65**	**1.3**	**$0.05**	**70.0**	**$1.81**





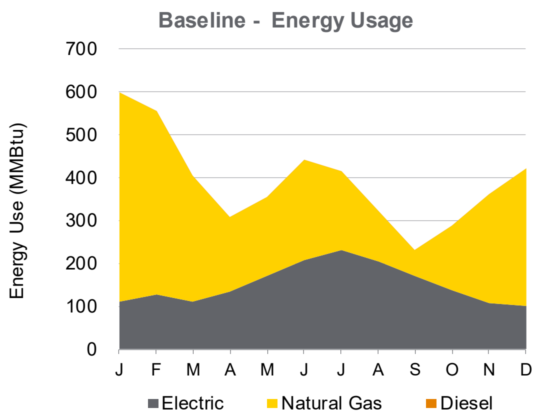
Baseline MMBtu (Table for Graphs)

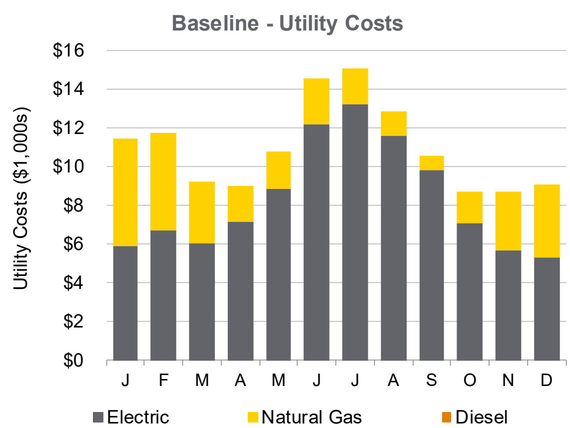
	Baseline								
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	100	-	-	451	-	12	-	564	-
F	73	-	-	341	-	9	-	423	-
M	65	-	-	252	-	7	-	324	-
A	56	-	-	157	-	4	-	216	-
M	52	-	-	53	-	0	-	105	-
J	43	-	-	13	-	0	-	55	-
J	69	-	-	2	-	0	-	72	-
A	77	-	-	5	-	0	-	82	-
S	69	-	-	24	-	0	-	93	-
O	70	-	-	113	-	3	-	186	-
N	77	-	-	211	-	6	-	295	-
D	84	-	-	341	-	9	-	434	-
	833	**0**	**$0**	**1,964**	**$0**	**51**	**$0**	**2,849**	**$0**

JFK Library

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	32,672	93	$5,901	4,887	$5,549	0	$0	600	$11,451
Feb	37,596	98	$6,688	4,288	$5,032	0	$0	557	$11,720
Mar	32,990	110	$6,030	2,940	$3,235	0	$0	407	$9,265
Apr	39,862	127	$7,181	1,732	$1,796	0	$0	309	$8,977
May	50,283	148	$8,898	1,838	$1,900	0	$0	355	$10,797
Jun	61,088	170	$12,220	2,343	$2,336	0	$0	443	$14,557
Jul	67,911	164	$13,199	1,842	$1,873	0	$0	416	$15,072
Aug	59,767	142	$11,628	1,183	$1,265	0	$0	322	$12,893
Sept	50,345	117	$9,827	602	$730	0	$0	232	$10,557
Oct	40,343	99	$7,120	1,513	$1,569	0	$0	289	$8,690
Nov	31,435	83	$5,659	2,535	$3,058	0	$0	361	$8,718
Dec	29,351	76	$5,304	3,229	$3,759	0	$0	423	$9,063
Year	**533,643**	**1,426**	**$99,657**	**28,932**	**$32,103**	**0**	**$0**	**4,714**	**$131,759**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	62.9	5.9	$3.44	99.9	$1.11	0.0	$0.00	162.8	$4.55





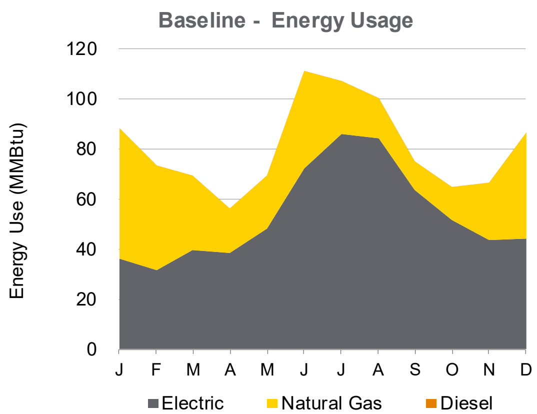
Baseline MMBtu (Table for Graphs)

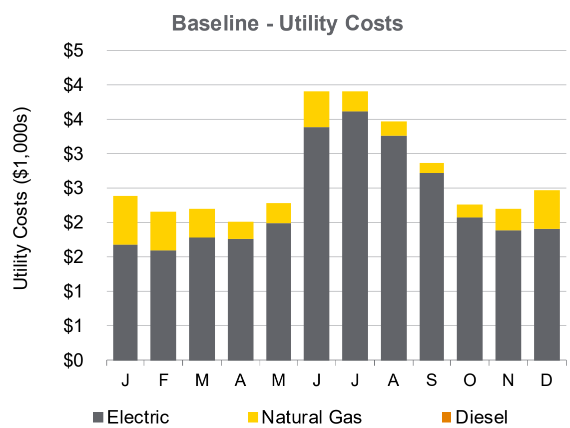
Baseline									
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	112	-	-	489	-	0	-	600	-
F	128	-	-	429	-	0	-	557	-
M	113	-	-	294	-	0	-	407	-
A	136	-	-	173	-	0	-	309	-
M	172	-	-	184	-	0	-	355	-
J	208	-	-	234	-	0	-	443	-
J	232	-	-	184	-	0	-	416	-
A	204	-	-	118	-	0	-	322	-
S	172	-	-	60	-	0	-	232	-
O	138	-	-	151	-	0	-	289	-
N	107	-	-	253	-	0	-	361	-
D	100	-	-	323	-	0	-	423	-
	1,821			**2,893**		**0**		**4,714**	

Westergard Library

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	10,670	35	$1,685	519	$707	0	$0	88	$2,392
Feb	9,269	40	$1,597	417	$569	0	$0	73	$2,166
Mar	11,655	41	$1,790	298	$406	0	$0	70	$2,196
Apr	11,234	42	$1,761	180	$248	0	$0	56	$2,010
May	14,118	43	$1,997	213	$290	0	$0	69	$2,287
Jun	21,271	77	$3,396	388	$512	0	$0	111	$3,908
Jul	25,194	72	$3,618	212	$290	0	$0	107	$3,908
Aug	24,740	51	$3,258	158	$220	0	$0	100	$3,479
Sept	18,765	44	$2,715	110	$159	0	$0	75	$2,874
Oct	15,200	42	$2,075	129	$183	0	$0	65	$2,258
Nov	12,780	42	$1,885	228	$310	0	$0	66	$2,195
Dec	13,017	43	$1,907	421	$573	0	$0	87	$2,480
Year	**187,914**	**573**	**$27,686**	**3,273**	**$4,468**	**0**	**$0**	**969**	**$32,153**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	61.7	**7.4**	**$2.66**	**31.5**	**$0.43**	**0.0**	**$0.00**	**93.1**	**$3.09**





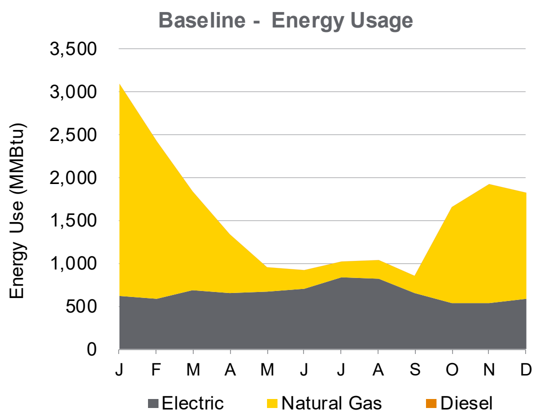
Baseline MMBtu (Table for Graphs)

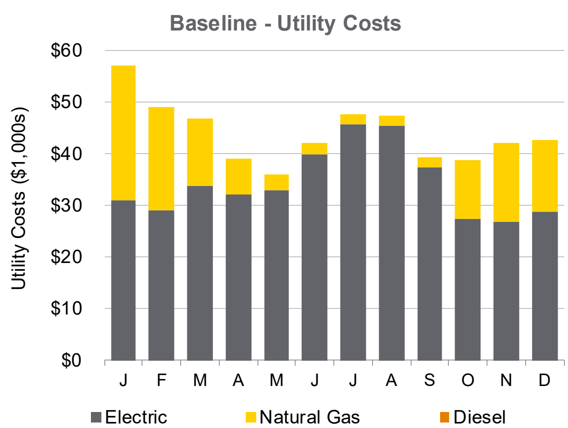
Baseline									
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	36	-	-	52	-	0	-	88	-
F	32	-	-	42	-	0	-	73	-
M	40	-	-	30	-	0	-	70	-
A	38	-	-	18	-	0	-	56	-
M	48	-	-	21	-	0	-	69	-
J	73	-	-	39	-	0	-	111	-
J	86	-	-	21	-	0	-	107	-
A	84	-	-	16	-	0	-	100	-
S	64	-	-	11	-	0	-	75	-
O	52	-	-	13	-	0	-	65	-
N	44	-	-	23	-	0	-	66	-
D	44	-	-	42	-	0	-	87	-
	641			**327**		**0**		**969**	

Community Center (YMCA)

Month	Electricity Energy Use	Electricity Energy Demand	Electricity Cost	Natural Gas Energy Use	Natural Gas Cost	Diesel Energy Use	Diesel Cost	Total Energy Use	Total Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	184,702	373	$30,902	24,638	$26,073	0	$0	3,094	$56,975
Feb	172,364	395	$29,083	18,457	$19,871	0	$0	2,434	$48,953
Mar	201,336	431	$33,767	11,601	$12,949	0	$0	1,847	$46,716
Apr	191,227	435	$32,210	6,851	$6,872	0	$0	1,338	$39,082
May	195,770	458	$33,025	2,895	$2,884	0	$0	958	$35,909
Jun	209,168	503	$39,887	2,162	$2,142	0	$0	930	$42,029
Jul	245,723	520	$45,819	1,935	$1,935	0	$0	1,032	$47,753
Aug	242,772	517	$45,320	2,181	$2,159	0	$0	1,047	$47,479
Sept	192,659	503	$37,314	2,050	$2,040	0	$0	863	$39,353
Oct	160,005	461	$27,473	11,213	$11,258	0	$0	1,667	$38,731
Nov	158,680	388	$26,921	13,809	$15,179	0	$0	1,922	$42,100
Dec	172,520	355	$28,919	12,399	$13,752	0	$0	1,829	$42,672
Year	**2,326,925**	**5,339**	**$410,639**	**110,192**	**$117,113**	**0**	**$0**	**18,961**	**$527,752**

Indices	Electricity kBtu/sf	Electricity W/sf	Electricity $/sf	Natural Gas kBtu/sf	Natural Gas $/sf	Diesel kBtu/sf	Diesel $/sf	Total kBtu/sf	Total $/sf
	109.3	**7.2**	**$5.65**	**151.7**	**$1.61**	**0.0**	**$0.00**	**261.0**	**$7.27**





Baseline MMBtu (Table for Graphs)

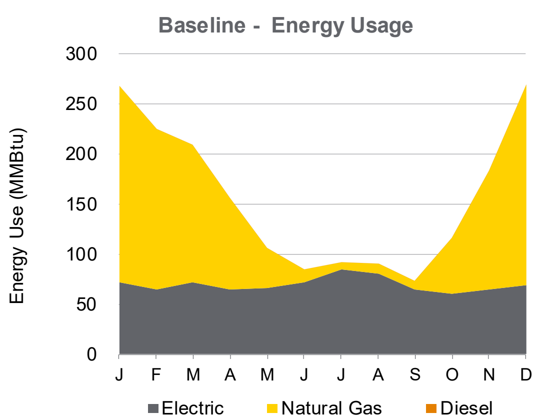
Month	Baseline Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	630	-	-	2,464	-	0	-	3,094	-
F	588	-	-	1,846	-	0	-	2,434	-
M	687	-	-	1,160	-	0	-	1,847	-
A	653	-	-	685	-	0	-	1,338	-
M	668	-	-	290	-	0	-	958	-
J	714	-	-	216	-	0	-	930	-
J	839	-	-	194	-	0	-	1,032	-
A	829	-	-	218	-	0	-	1,047	-
S	658	-	-	205	-	0	-	863	-
O	546	-	-	1,121	-	0	-	1,667	-
N	542	-	-	1,381	-	0	-	1,922	-
D	589	-	-	1,240	-	0	-	1,829	-
	7,942			**11,019**		**0**		**18,961**	

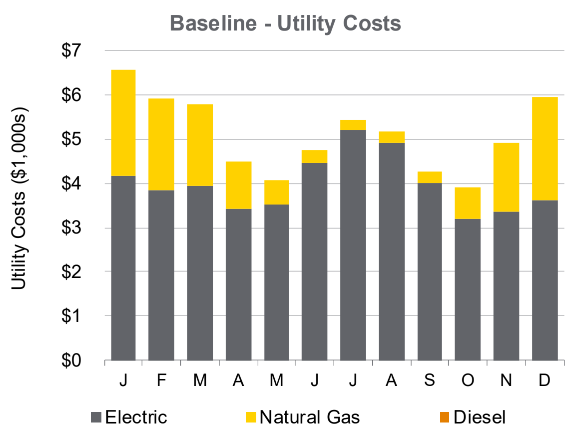
Internal

Senior Center

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	20,923	146	$4,158	1,963	$2,420	0	$0	268	$6,578
Feb	18,898	146	$3,828	1,612	$2,077	0	$0	226	$5,905
Mar	21,173	98	$3,955	1,369	$1,837	0	$0	209	$5,792
Apr	19,226	56	$3,423	907	$1,053	0	$0	156	$4,476
May	19,595	66	$3,536	391	$549	0	$0	106	$4,085
Jun	21,265	73	$4,475	122	$284	0	$0	85	$4,758
Jul	25,055	81	$5,197	70	$237	0	$0	92	$5,434
Aug	23,561	78	$4,916	97	$262	0	$0	90	$5,178
Sept	18,964	67	$4,015	85	$251	0	$0	73	$4,266
Oct	17,941	55	$3,211	557	$711	0	$0	117	$3,922
Nov	18,849	54	$3,351	1,188	$1,555	0	$0	183	$4,906
Dec	20,426	54	$3,611	1,993	$2,345	0	$0	269	$5,956
Year	**245,876**	**975**	**$47,676**	**10,355**	**$13,579**	**0**	**$0**	**1,875**	**$61,256**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	48.1	**8.4**	**$2.73**	**59.4**	**$0.78**	**0.0**	**$0.00**	**107.5**	**$3.51**





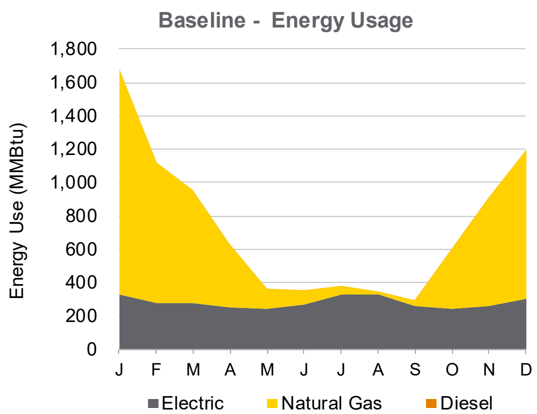
Baseline MMBtu (Table for Graphs)

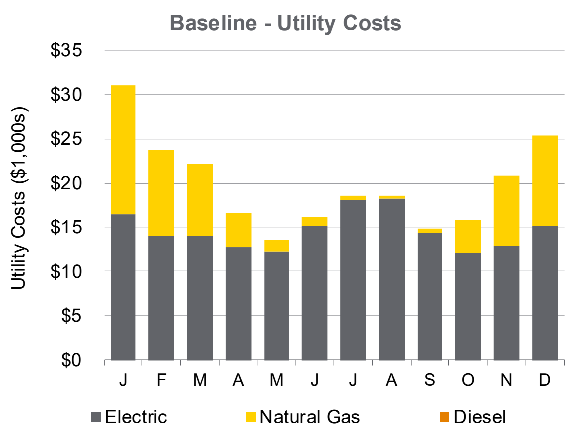
Baseline									
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	71	-	-	196	-	0	-	268	-
F	65	-	-	161	-	0	-	226	-
M	72	-	-	137	-	0	-	209	-
A	66	-	-	91	-	0	-	156	-
M	67	-	-	39	-	0	-	106	-
J	73	-	-	12	-	0	-	85	-
J	86	-	-	7	-	0	-	92	-
A	80	-	-	10	-	0	-	90	-
S	65	-	-	9	-	0	-	73	-
O	61	-	-	56	-	0	-	117	-
N	64	-	-	119	-	0	-	183	-
D	70	-	-	199	-	0	-	269	-
	839			**1,036**		**0**		**1,875**	

Sterling Village

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	96,452	228	$16,513	13,529	$14,539	0	$0	1,682	$31,052
Feb	81,156	201	$13,997	8,408	$9,717	0	$0	1,118	$23,714
Mar	82,206	180	$14,057	6,765	$8,079	0	$0	957	$22,136
Apr	73,858	166	$12,688	3,800	$3,906	0	$0	632	$16,594
May	71,799	152	$12,302	1,150	$1,269	0	$0	360	$13,571
Jun	78,966	181	$15,205	827	$917	0	$0	352	$16,122
Jul	95,451	199	$18,014	518	$639	0	$0	378	$18,653
Aug	96,954	195	$18,201	197	$352	0	$0	351	$18,553
Sept	75,641	155	$14,324	380	$516	0	$0	296	$14,840
Oct	70,632	139	$12,053	3,626	$3,731	0	$0	604	$15,785
Nov	75,273	158	$12,871	6,609	$7,925	0	$0	918	$20,796
Dec	88,322	210	$15,159	8,944	$10,246	0	$0	1,196	$25,406
Year	**986,711**	**2,164**	**$175,386**	**54,751**	**$61,836**	**0**	**$0**	**8,843**	**$237,221**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	27.0	1.8	$1.41	43.9	$0.50	0.0	$0.00	70.9	$1.90





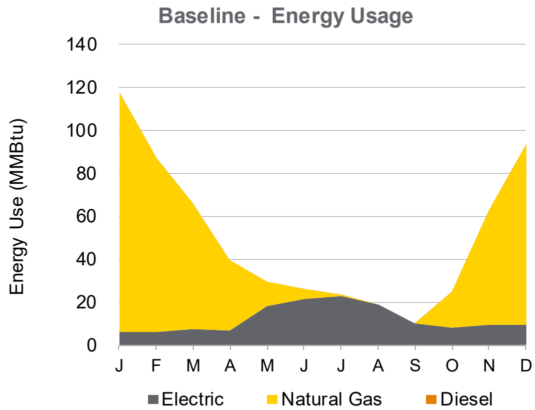
Baseline MMBtu (Table for Graphs)

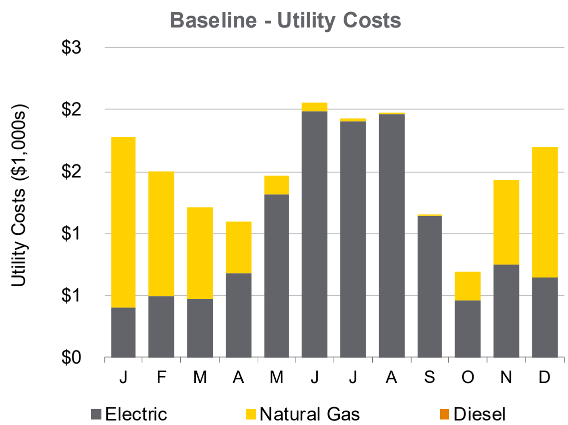
Baseline									
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	329	-	-	1,353	-	0	-	1,682	-
F	277	-	-	841	-	0	-	1,118	-
M	281	-	-	676	-	0	-	957	-
A	252	-	-	380	-	0	-	632	-
M	245	-	-	115	-	0	-	360	-
J	270	-	-	83	-	0	-	352	-
J	326	-	-	52	-	0	-	378	-
A	331	-	-	20	-	0	-	351	-
S	258	-	-	38	-	0	-	296	-
O	241	-	-	363	-	0	-	604	-
N	257	-	-	661	-	0	-	918	-
D	301	-	-	894	-	0	-	1,196	-
	3,368			**5,475**		**0**		**8,843**	

Little League Complex

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	1,913	16	$396	1,111	$1,386	0	$0	118	$1,782
Feb	1,918	34	$488	806	$1,010	0	$0	87	$1,499
Mar	2,131	24	$472	589	$743	0	$0	66	$1,215
Apr	2,080	66	$679	325	$419	0	$0	40	$1,098
May	5,396	84	$1,310	113	$158	0	$0	30	$1,467
Jun	6,299	65	$1,981	50	$76	0	$0	26	$2,057
Jul	6,802	55	$1,909	4	$24	0	$0	24	$1,933
Aug	5,603	71	$1,959	0	$20	0	$0	19	$1,979
Sept	2,958	44	$1,137	0	$20	0	$0	10	$1,157
Oct	2,381	14	$464	171	$229	0	$0	25	$693
Nov	2,739	59	$750	536	$678	0	$0	63	$1,428
Dec	2,817	36	$646	840	$1,053	0	$0	94	$1,699
Year	**43,037**	**569**	**$12,191**	**4,545**	**$5,815**	**0**	**$0**	**601**	**$18,006**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	39.7	**22.8**	**$3.29**	**122.8**	**$1.57**	**0.0**	**$0.00**	**162.5**	**$4.87**





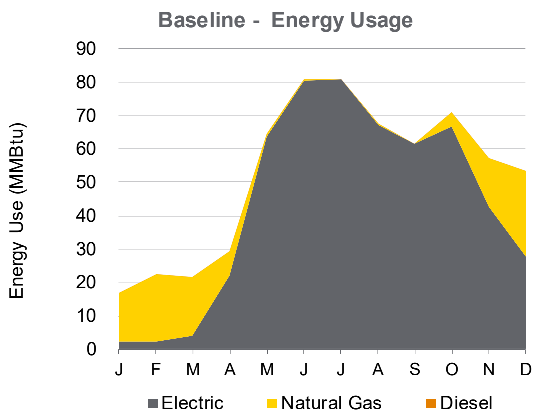
Baseline MMBtu (Table for Graphs)

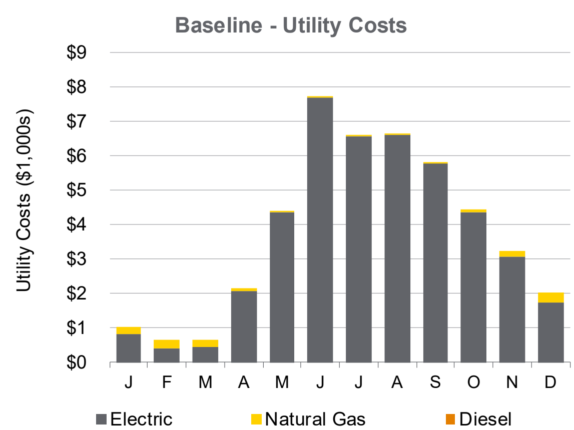
	Baseline								
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	7	-	-	111	-	0	-	118	-
F	7	-	-	81	-	0	-	87	-
M	7	-	-	59	-	0	-	66	-
A	7	-	-	33	-	0	-	40	-
M	18	-	-	11	-	0	-	30	-
J	21	-	-	5	-	0	-	26	-
J	23	-	-	0	-	0	-	24	-
A	19	-	-	0	-	0	-	19	-
S	10	-	-	0	-	0	-	10	-
O	8	-	-	17	-	0	-	25	-
N	9	-	-	54	-	0	-	63	-
D	10	-	-	84	-	0	-	94	-
	147			**454**		**0**		**601**	

Columbus Park

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	712	143	$841	146	$191	0	$0	17	$1,032
Feb	697	52	$385	200	$254	0	$0	22	$639
Mar	1,188	45	$440	177	$227	0	$0	22	$667
Apr	6,526	192	$2,050	72	$104	0	$0	29	$2,154
May	18,624	262	$4,380	9	$30	0	$0	64	$4,410
Jun	23,540	262	$7,674	4	$24	0	$0	81	$7,698
Jul	23,750	187	$6,585	0	$20	0	$0	81	$6,605
Aug	19,624	232	$6,608	6	$26	0	$0	68	$6,634
Sept	18,041	192	$5,762	0	$20	0	$0	62	$5,782
Oct	19,530	231	$4,376	43	$70	0	$0	71	$4,446
Nov	12,480	199	$3,052	147	$192	0	$0	57	$3,244
Dec	8,138	77	$1,729	254	$318	0	$0	53	$2,047
Year	**152,849**	**2,073**	**$43,882**	**1,058**	**$1,477**	**0**	**$0**	**628**	**$45,359**

	Electricity			Natural Gas		Diesel		Total	
Indices	**kBtu/sf**	**W/sf**	**$/sf**	**kBtu/sf**	**$/sf**	**kBtu/sf**	**$/sf**	**kBtu/sf**	**$/sf**
	74.5	**37.5**	**$6.27**	**15.1**	**$0.21**	**0.0**	**$0.00**	**89.6**	**$6.48**





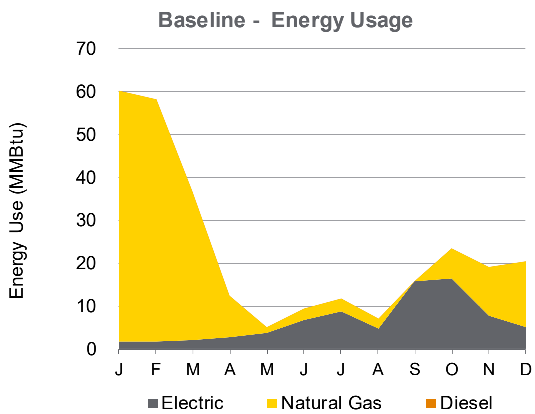
Baseline MMBtu (Table for Graphs)

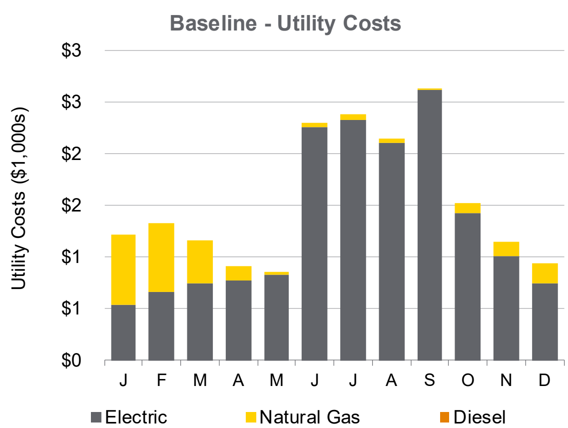
	Baseline								
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	2	-	-	15	-	0	-	17	-
F	2	-	-	20	-	0	-	22	-
M	4	-	-	18	-	0	-	22	-
A	22	-	-	7	-	0	-	29	-
M	64	-	-	1	-	0	-	64	-
J	80	-	-	0	-	0	-	81	-
J	81	-	-	0	-	0	-	81	-
A	67	-	-	1	-	0	-	68	-
S	62	-	-	0	-	0	-	62	-
O	67	-	-	4	-	0	-	71	-
N	43	-	-	15	-	0	-	57	-
D	28	-	-	25	-	0	-	53	-
	522			**106**		**0**		**628**	

Riverside Park

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	553	86	$534	583	$689	0	$0	60	$1,224
Feb	497	112	$656	564	$667	0	$0	58	$1,323
Mar	666	125	$746	347	$417	0	$0	37	$1,163
Apr	840	125	$776	98	$130	0	$0	13	$906
May	1,119	126	$826	14	$35	0	$0	5	$861
Jun	1,994	129	$2,254	28	$50	0	$0	10	$2,304
Jul	2,584	127	$2,328	29	$51	0	$0	12	$2,379
Aug	1,442	124	$2,106	23	$44	0	$0	7	$2,150
Sept	4,597	125	$2,616	0	$20	0	$0	16	$2,636
Oct	4,788	125	$1,423	72	$100	0	$0	24	$1,523
Nov	2,252	125	$1,005	113	$148	0	$0	19	$1,154
Dec	1,503	98	$746	154	$195	0	$0	21	$941
Year	**22,835**	**1,427**	**$16,016**	**2,025**	**$2,547**	**0**	**$0**	**280**	**$18,563**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	21.1	34.7	$4.33	54.7	$0.69	0.0	$0.00	75.8	$5.02





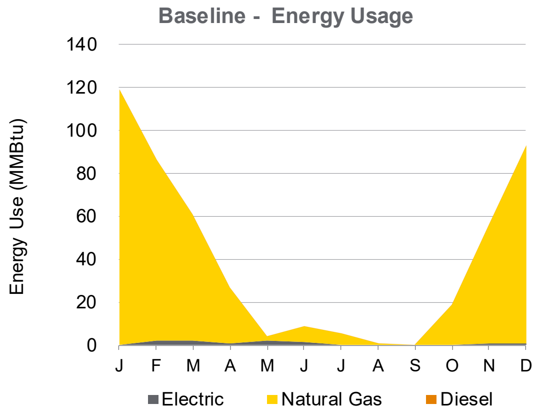
Baseline MMBtu (Table for Graphs)

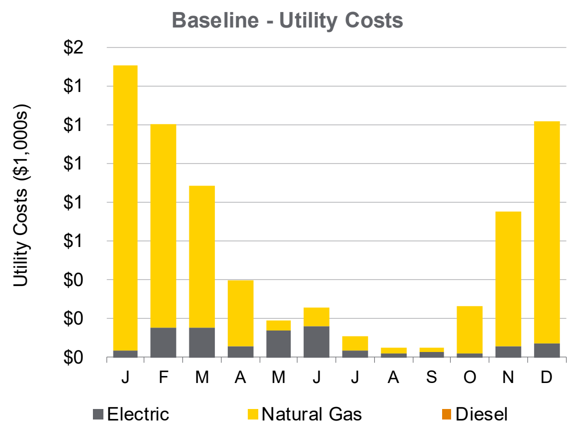
Baseline									
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	2	-	-	58	-	0	-	60	-
F	2	-	-	56	-	0	-	58	-
M	2	-	-	35	-	0	-	37	-
A	3	-	-	10	-	0	-	13	-
M	4	-	-	1	-	0	-	5	-
J	7	-	-	3	-	0	-	10	-
J	9	-	-	3	-	0	-	12	-
A	5	-	-	2	-	0	-	7	-
S	16	-	-	0	-	0	-	16	-
O	16	-	-	7	-	0	-	24	-
N	8	-	-	11	-	0	-	19	-
D	5	-	-	15	-	0	-	21	-
	78			**203**		**0**		**280**	

DPW Warehouse

Month	Electricity Energy Use	Electricity Energy Demand	Electricity Cost	Natural Gas Energy Use	Natural Gas Cost	Diesel Energy Use	Diesel Cost	Total Energy Use	Total Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	154	1	$37	1,186	$1,474	0	$0	119	$1,511
Feb	696	8	$156	842	$1,051	0	$0	87	$1,207
Mar	687	7	$150	588	$739	0	$0	61	$889
Apr	249	2	$57	263	$340	0	$0	27	$397
May	645	7	$142	22	$45	0	$0	4	$187
Jun	489	5	$159	69	$99	0	$0	9	$257
Jul	92	1	$33	51	$77	0	$0	5	$110
Aug	50	1	$20	6	$27	0	$0	1	$47
Sept	80	1	$29	0	$20	0	$0	0	$49
Oct	90	1	$24	184	$243	0	$0	19	$267
Nov	241	3	$57	553	$696	0	$0	56	$752
Dec	302	3	$69	921	$1,149	0	$0	93	$1,218
Year	**3,775**	**39**	**$933**	**4,686**	**$5,959**	**0**	**$0**	**481**	**$6,892**

Indices	Electricity kBtu/sf	Electricity W/sf	Electricity $/sf	Natural Gas kBtu/sf	Natural Gas $/sf	Diesel kBtu/sf	Diesel $/sf	Total kBtu/sf	Total $/sf
	0.8	0.5	$0.06	29.2	$0.37	0.0	$0.00	30.0	$0.43





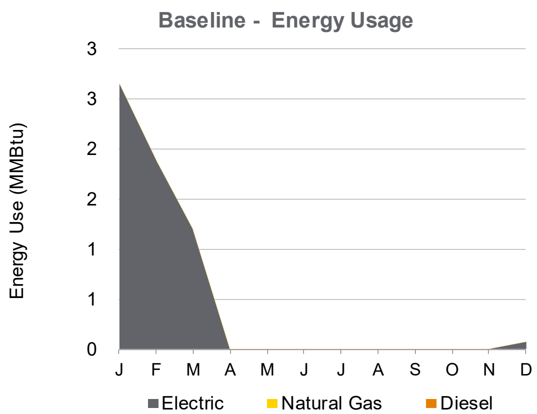
Baseline MMBtu (Table for Graphs)

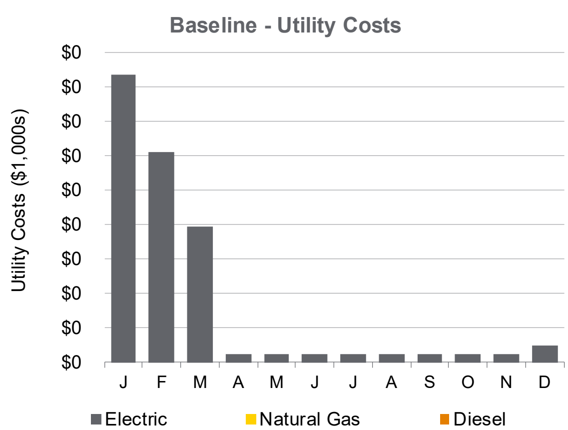
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	1	-	-	119	-	0	-	119	-
F	2	-	-	84	-	0	-	87	-
M	2	-	-	59	-	0	-	61	-
A	1	-	-	26	-	0	-	27	-
M	2	-	-	2	-	0	-	4	-
J	2	-	-	7	-	0	-	9	-
J	0	-	-	5	-	0	-	5	-
A	0	-	-	1	-	0	-	1	-
S	0	-	-	0	-	0	-	0	-
O	0	-	-	18	-	0	-	19	-
N	1	-	-	55	-	0	-	56	-
D	1	-	-	92	-	0	-	93	-
	13			**469**		**0**		**481**	

DPW Salt Shed

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	779	8	$167	0	$0	0	$0	3	$167
Feb	550	6	$122	0	$0	0	$0	2	$122
Mar	353	4	$79	0	$0	0	$0	1	$79
Apr	0	0	$5	0	$0	0	$0	0	$5
May	0	0	$5	0	$0	0	$0	0	$5
Jun	0	0	$5	0	$0	0	$0	0	$5
Jul	0	0	$5	0	$0	0	$0	0	$5
Aug	0	0	$5	0	$0	0	$0	0	$5
Sept	0	0	$5	0	$0	0	$0	0	$5
Oct	0	0	$5	0	$0	0	$0	0	$5
Nov	0	0	$5	0	$0	0	$0	0	$5
Dec	23	0	$10	0	$0	0	$0	0	$10
Year	**1,705**	**18**	**$418**	**0**	**$0**	**0**	**$0**	**6**	**$418**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	16.6	21.9	$1.19	0.0	$0.00	0.0	$0.00	16.6	$1.19





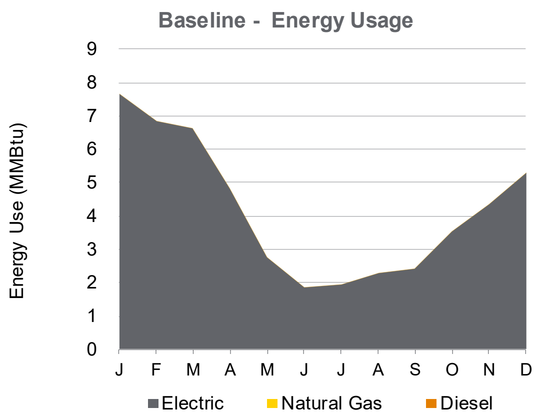
Baseline MMBtu (Table for Graphs)

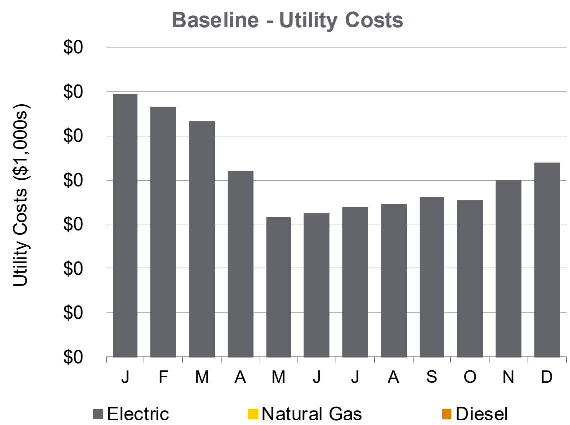
Baseline									
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	3	-	-	0	-	0	-	3	-
F	2	-	-	0	-	0	-	2	-
M	1	-	-	0	-	0	-	1	-
A	0	-	-	0	-	0	-	0	-
M	0	-	-	0	-	0	-	0	-
J	0	-	-	0	-	0	-	0	-
J	0	-	-	0	-	0	-	0	-
A	0	-	-	0	-	0	-	0	-
S	0	-	-	0	-	0	-	0	-
O	0	-	-	0	-	0	-	0	-
N	0	-	-	0	-	0	-	0	-
D	0	-	-	0	-	0	-	0	-
	6			**0**		**0**		**6**	

DPW Brine Shed

	Electricity			Natural Gas		Diesel		Total	
Month	Energy Use	Energy Demand	Cost	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
mmm	*kWh*	*kW*	*$*	*Therm*	*$*	*gal*	*$*	*MMBtu*	*$*
Jan	2,244	10	$298	0	$0	0	$0	8	$298
Feb	2,008	11	$283	0	$0	0	$0	7	$283
Mar	1,936	8	$266	0	$0	0	$0	7	$266
Apr	1,417	5	$210	0	$0	0	$0	5	$210
May	815	3	$158	0	$0	0	$0	3	$158
Jun	550	3	$163	0	$0	0	$0	2	$163
Jul	569	3	$170	0	$0	0	$0	2	$170
Aug	665	3	$173	0	$0	0	$0	2	$173
Sept	708	3	$180	0	$0	0	$0	2	$180
Oct	1,041	4	$177	0	$0	0	$0	4	$177
Nov	1,278	5	$200	0	$0	0	$0	4	$200
Dec	1,558	5	$220	0	$0	0	$0	5	$220
Year	**14,789**	**62**	**$2,500**	**0**	**$0**	**0**	**$0**	**50**	**$2,500**

	Electricity			Natural Gas		Diesel		Total	
Indices	kBtu/sf	W/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf	kBtu/sf	$/sf
	2.2	0.5	$0.11	0.0	$0.00	0.0	$0.00	2.2	$0.11





Baseline MMBtu (Table for Graphs)

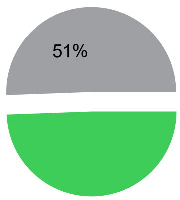
	Baseline								
Month	Electric			Natural Gas		Diesel		Total	
mmm	*MMBtu*	-	-	*MMBtu*	-	*MMBtu*	-	*MMBtu*	-
J	8	-	-	0	-	0	-	8	-
F	7	-	-	0	-	0	-	7	-
M	7	-	-	0	-	0	-	7	-
A	5	-	-	0	-	0	-	5	-
M	3	-	-	0	-	0	-	3	-
J	2	-	-	0	-	0	-	2	-
J	2	-	-	0	-	0	-	2	-
A	2	-	-	0	-	0	-	2	-
S	2	-	-	0	-	0	-	2	-
O	4	-	-	0	-	0	-	4	-
N	4	-	-	0	-	0	-	4	-
D	5	-	-	0	-	0	-	5	-
	50			**0**		**0**		**50**	

4.2 Energy Savings

The following table highlights projected energy savings as a result of implementing the recommended ECMs.

Piscataway Township - Project Summary

Energy Cost Savings



Energy Indicies		
	Energy	Cost
	kBtu/sf	*$/sf*
Baseline	115.4	$3.47
Post Project	70.0	$1.71
% Savings	**39.3%**	**50.6%**

Project Summary by Site			
Project	**Electricity Costs**	**Fossil Fuels Costs**	**Total Costs**
Phase	*$*	*$*	*$*
Baseline	**$1,081,643**	**$295,078**	**$1,376,721**
Town Hall & Public Safety	$151,414	$337	$151,751
DPW Offices	$14,830	$3,173	$18,003
JFK Library	$103,440	$13,926	$117,366
Westergard Library	$18,294	$2,519	$20,813
Community Center (YMCA)	$208,575	$17,833	$226,409
Senior Center	$32,724	$4,694	$37,418
Sterling Village	$123,369	$1,226	$124,594
Post Project	**$428,996**	**$251,371**	**$680,367**
Savings	**$652,647**	**$43,707**	**$696,354**
Percent Savings	**60.3%**	**14.8%**	**50.6%**

To estimate savings from the proposed project, Schneider Electric utilized energy modeling software and engineering formulas. Schneider Electric used Excel spreadsheets to accurately quantify savings for measures that have low interactivity. For measures that are significantly affected by interactions of different components, such as mechanical and BAS upgrades, Schneider Electric utilized eQuest ("Quick Energy Simulation Tool"), a free DOE2 modelling tool developed by the U.S. Department of Energy and other industry leaders, to develop baselines and savings for some builds. Using these modeling tools allows for the ability to model existing conditions and proposed retrofits to assess potential energy savings.

For detailed savings calculations for each ECM, please see the Appendix 6.1 Savings Calculations & Documentation and Appendix 6.1 Box Folder.

ECM Savings Summary by Site														
ECM Detail		Total Energy Savings			Total Cost Savings			Detail Unit Savings				Detailed Cost Savings		
Site	ECM	Energy Savings	EUI Savings	Site % Savings	Cost Savings	ECI Savings	Site % Savings	Electric	Electric	Natural Gas	Diesel	Electric	Natural Gas	Diesel
Name	*Name*	*MMBtu*	*kBtu/sf*	*%*	*$*	*$/sf*	*%*	*kWh*	*kW*	*Therm*	*gal*	*$*	*$*	*$*
Town Hall & Public Safety	Building Envelope & Weatherization	24	0.5	0.4%	$575	$0.01	0.3%	1,750	-7.6	177	0	$275	$300	$0
Town Hall & Public Safety	Interior Lighting Upgrades	128	2.7	2.3%	$8,904	$0.19	4.0%	52,814	150.3	-521	0	$9,514	-$610	$0
Town Hall & Public Safety	Exterior Lighting Upgrades	29	0.6	0.5%	$1,332	$0.03	0.6%	8,552	0.0	0	0	$1,332	$0	$0
Town Hall & Public Safety	OA Adjustment	-383	-8.0	-6.9%	-$12,803	-$0.27	-5.8%	-51,647	-155.9	-2,064	0	-$9,789	-$3,013	$0
Town Hall & Public Safety	Bipolar Ionization	176	3.7	3.2%	$7,819	$0.16	3.5%	39,465	78.4	417	0	$7,161	$657	$0
Town Hall & Public Safety	Replace Chiller	10	0.2	0.2%	$630	$0.01	0.3%	2,944	26.6	0	0	$630	$0	$0
Town Hall & Public Safety	DCV	55	1.1	1.0%	$742	$0.02	0.3%	345	13.0	540	0	$56	$686	$0
Town Hall & Public Safety	BAS Upgrade	1,094	22.7	19.7%	$44,251	$0.92	20.0%	276,866	-179.5	1,492	0	$41,934	$2,317	$0
Town Hall & Public Safety	Solar PV	1,977	41.1	35.6%	$90,220	$1.87	40.8%	579,258	0.0	0	0	$90,220	$0	$0
Town Hall & Public Safety	Solar PV - Demand Savings	0	0.0	0.0%	$6,872	$0.14	3.1%	0	454.9	0	0	$6,872	$0	$0
Town Hall & Public Safety	Battery Storage	-54	-1.1	-1.0%	$3,210	$0.07	1.5%	-15,861	1,250.4	0	0	$3,210	$0	$0
JFK Library	Building Envelope & Weatherization	27	0.9	0.6%	$466	$0.02	0.4%	525	8.2	255	0	$186	$280	$0
JFK Library	Interior Lighting Upgrades	52	1.8	1.1%	$7,932	$0.27	6.0%	50,257	124.3	-1,197	0	$9,091	-$1,158	$0
JFK Library	Exterior Lighting Upgrades	25	0.9	0.5%	$1,134	$0.04	0.9%	7,237	1.8	0	0	$1,134	$0	$0
JFK Library	Replace Chiller	160	5.5	3.4%	$7,769	$0.27	5.9%	46,973	49.4	0	0	$7,769	$0	$0
JFK Library	DCV	623	21.5	13.2%	$11,808	$0.41	9.0%	33,977	33.1	5,072	0	$5,910	$5,898	$0
JFK Library	BAS Upgrade	936	32.3	19.9%	$15,126	$0.52	11.5%	52,859	-6.4	7,557	0	$8,120	$7,006	$0
JFK Library	Solar PV	1,504	51.9	31.9%	$68,589	$2.37	52.1%	440,753	0.0	0	0	$68,589	$0	$0
JFK Library	Solar PV - Demand Savings	0	0.0	0.0%	$2,813	$0.10	2.1%	0	179.6	0	0	$2,813	$0	$0
JFK Library	Replace Boiler	163	5.6	3.4%	$1,727	$0.06	1.3%	-1,019	-1.2	1,661	0	-$172	$1,899	$0
DPW Offices & Garage	Building Envelope & Weatherization	29	0.7	1.0%	$432	$0.01	0.6%	184	0.4	280	2	$40	$380	$12
DPW Offices & Garage	Interior Lighting Upgrades	84	2.1	3.0%	$7,793	$0.19	10.6%	43,829	172.9	-626	-21	$8,530	-$632	-$105
DPW Offices & Garage	OA Adjustment	-351	-8.6	-12.3%	-$5,028	-$0.12	-6.8%	-2,167	-29.3	-3,439	0	-$744	-$4,283	$0
DPW Offices & Garage	Bipolar Ionization	54	1.3	1.9%	$736	$0.02	1.0%	267	4.8	531	0	$101	$635	$0
DPW Offices & Garage	BAS Upgrade	783	19.2	27.5%	$14,069	$0.35	19.1%	43,207	-5.6	6,356	0	$6,903	$7,167	-$1
Community Center (YMCA)	Building Envelope & Weatherization	79	1.1	0.4%	$1,176	$0.02	0.2%	688	3.3	764	0	$143	$1,033	$0
Community Center (YMCA)	Bipolar Ionization	226	3.1	1.2%	$2,841	$0.04	0.5%	-855	14.5	2,285	0	$41	$2,799	$0
Community Center (YMCA)	DCV	738	10.2	3.9%	$8,942	$0.12	1.7%	-4,488	19.5	7,538	0	-$429	$9,370	$0
Community Center (YMCA)	BAS Upgrade	871	12.0	4.6%	$24,331	$0.33	4.6%	132,493	13.7	4,192	0	$20,507	$3,823	$0
Community Center (YMCA)	Solar PV	4,040	55.6	21.3%	$184,302	$2.54	34.9%	1,183,656	0.0	0	0	$184,302	$0	$0
Community Center (YMCA)	Solar PV - Demand Savings	0	0.0	0.0%	$4,011	$0.06	0.8%	0	473.7	0	0	$4,011	$0	$0
Community Center (YMCA)	Pipe Insulation	80	1.1	0.4%	$807	$0.01	0.2%	0	0.0	804	0	$0	$807	$0
Senior Center	Building Envelope & Weatherization	40	2.3	2.1%	$565	$0.03	0.9%	531	3.3	385	0	$124	$441	$0
Senior Center	Interior Lighting Upgrades	25	1.4	1.3%	$4,598	$0.26	7.5%	27,665	93.6	-697	0	$5,273	-$675	$0
Senior Center	Exterior Lighting Upgrades	4	0.2	0.2%	$169	$0.01	0.3%	1,046	0.0	0	0	$169	$0	$0
Senior Center	Bipolar Ionization	155	8.9	8.3%	$1,955	$0.11	3.2%	793	5.6	1,526	0	$203	$1,752	$0
Senior Center	BAS Upgrade	440	25.2	23.5%	$7,430	$0.43	12.1%	26,322	5.2	3,501	0	$4,321	$3,108	$0
Senior Center	Solar PV	458	26.3	24.4%	$21,646	$1.24	35.3%	134,270	0.0	0	0	$21,646	$0	$0
Senior Center	Solar PV - Demand Savings	0	0.0	0.0%	$771	$0.04	1.3%	0	74.3	0	0	$771	$0	$0
Senior Center	Replace RTU	-5	-0.3	-0.3%	$284	$0.02	0.5%	982	6.9	-81	0	$217	$66	$0
Westergard Library	Building Envelope & Weatherization	12	1.1	1.2%	$189	$0.02	0.6%	347	1.8	107	0	$43	$146	$0
Westergard Library	Interior Lighting Upgrades	22	2.2	2.3%	$1,861	$0.18	5.8%	25,375	84.1	-641	0	$2,682	-$821	$0
Westergard Library	Exterior Lighting Upgrades	2	0.2	0.2%	$54	$0.01	0.2%	680	0.3	0	0	$54	$0	$0
Westergard Library	DCV	64	6.1	6.6%	$1,074	$0.10	3.3%	5,702	3.8	443	0	$472	$602	$0
Westergard Library	BAS Upgrade	138	13.2	14.2%	$2,781	$0.27	8.6%	33,357	-5.8	239	0	$2,453	$327	$0
Westergard Library	Solar PV	456	43.9	47.1%	$10,177	$0.98	31.7%	133,725	0.0	0	0	$10,177	$0	$0
Westergard Library	Solar PV - Demand Savings	0	0.0	0.0%	$769	$0.07	2.4%	0	66.7	0	0	$769	$0	$0
Westergard Library	Replace Condensing Unit & AHU	-42	-4.0	-4.3%	-$506	-$0.05	-1.6%	875	7.1	-448	0	$101	-$607	$0
Westergard Library	Replace RTU	233	22.4	24.1%	$3,736	$0.36	11.6%	5,929	54.4	2,130	0	$1,063	$2,672	$0
Westergard Library	Micro CHP	27	2.6	2.8%	$563	$0.05	1.7%	6,102	0.2	62	0	$479	$83	$0
Westergard Library	Pipe Insulation	8	0.8	0.9%	$115	$0.01	0.4%	0	0.0	85	0	$0	$115	$0
Sterling Village	Building Envelope & Weatherization	-8	-0.1	-0.1%	-$542	$0.00	-0.2%	-3,915	-3.3	55	0	-$613	$71	$0
Sterling Village	Interior Lighting Upgrades	258	2.1	2.9%	$12,669	$0.10	5.3%	75,699	108.3	-8	0	$12,678	-$9	$0
Sterling Village	Bipolar Ionization	18	0.1	0.2%	$229	$0.00	0.1%	128	0.8	172	0	$30	$199	$0
Sterling Village	BAS Upgrade	53	0.4	0.6%	$961	$0.01	0.4%	2,987	2.0	429	0	$489	$472	$0
Sterling Village	Solar PV	2,414	19.4	27.3%	$110,132	$0.88	46.4%	707,200	0.0	0	0	$110,132	$0	$0
Sterling Village	Solar PV - Demand Savings	0	0.0	0.0%	$653	$0.01	0.3%	0	64.0	0	0	$653	$0	$0
Sterling Village	Pipe Insulation	50	0.4	0.6%	$493	$0.00	0.2%	0	0.0	497	0	$0	$493	$0
Total Project Savings		**18,003**	**45.3**	**39.3%**	**$696,354**	**$1.75**	**50.6%**	**4,108,663**	**3,260.9**	**39,828**	**-19**	**$652,647**	**$43,802**	**-$94**

**There are two distributed energy generation measures in the ESP. The electricity generated from the micro-CHP or the demand shaving from Battery Storage is actually Distributed Generation (DG), not energy savings. The modeling and calculation tools do not distinguish the difference in this report, but it is important to note the DG compared to energy savings. The DG is separated out from energy savings in Form VI, shown in Section 2.3.*

ECMs or ECM names may change during the course of the IGA development, so some of the ECM names in the ECM Savings Summary by Site table above do not perfectly match up with the ECM name on Form II. The table below correlates ECMs between the two tables.

<table>
<tr><th>ECM Savings Summary by Site Description</th><th>Correlated ECM Name on Form II</th></tr>
<tr><td>Solar PV</td><td>Solar PV</td></tr>
<tr><td>Battery Storage (Distributed Generation)</td><td>Microgrid + Battery Energy Storage</td></tr>
<tr><td>Lighting Upgrades</td><td>LED Lighting</td></tr>
<tr><td>Building Envelope & Weatherization</td><td rowspan="2">Building Envelope & Insulation</td></tr>
<tr><td>Pipe Insulation</td></tr>
<tr><td>Replace RTU</td><td rowspan="3">RTU / AHU Replacements</td></tr>
<tr><td>Replace Condensing Unit & AHU</td></tr>
<tr><td>OA Baseline Adjustment</td></tr>
<tr><td>Bipolar Ionization</td><td>Advanced Air Purification</td></tr>
</table>

ECM Savings Summary by Site Description	Correlated ECM Name on Form II
Replace Chiller	Replace Chillers & Boilers
Replace Boiler	
BAS Upgrade	New Building Controls & Optimize Existing BAS
DCV	
Micro CHP (Distributed Generation)	Micro CHP

In addition to the energy savings noted above, this project will provide O&M savings for the Township.

ECM	Annual O&M Savings	Years Claimed
LED Lighting	$3,258	5
RTU/AHU Replacements	$2,450	2
Chiller Replacements	$3,000	2
Boiler Suction Diffusers	$500	2
Replace Freeze-Stats	$3,000	2

4.3 Environmental Impact

The following table summarizes the environmental impact of the project.

Therms Savings	kWh Savings	Diesel Savings (Gallons)	Emission Product	Emission Reduction (lbs)
39,828	4,108,663	- 19	CO_2	5,774,380
			NO_x	3,777
			SO_2	2,753

The emissions reductions are calculated based on the following factors, based on BPU protocols.

- 1,292 lbs. CO_2 per MWh saved
- 0.83 lbs. NO_x per MWh saved
- 0.67 lbs. SO_2 per MWh saved
- 11.7 lbs. CO_2 per therm saved
- 0.0092 lbs. NO_x per therm saved

The emission factors for Diesel were not provided in the BPU protocols. Based on information from EPA, we are using the following factors.

- 21.22 lbs. CO_2 per gallon saved
- 0.02 lbs. NOx per gallon saved
- 0.0071 lbs. NOx per gallon saved

4.4 Savings Calculations

This section contains a high-level summary of how savings were calculated for each measure included in this report. Examples are provided within this ESP for one building. **For further documentation of savings calculations, please see Appendix 6.1 – Additional Savings Calcs & Docs in the Box folder.** Savings calculations for every building and ECM are included in Appendix 6.1.

Energy Analysis Methodology

Many tools and approaches exist for effectively analyzing energy conservation measures. Some ECMs are best analyzed in an individual spreadsheet calculation while other more comprehensive ECMs require higher levels of computer modeling to capture the entirety of their impact on energy consumption and demand. In general, the complexity of analysis tools escalates from spreadsheet calculations to more sophisticated computer software-based building simulation tools such as eQuest. Aspects such as total savings potential, influence on other ECMs, influence from weather, and overall complexity are all considered when selecting the analysis approach or tool for an ECM.

Below is a table displaying the ECMs and the analysis tool used for calculating the savings. Following the table are descriptions for each of the analysis tool and approaches used for calculating savings.

ECM	Analysis Tool
Building Envelope & Weatherization	eCalc / eQuest
Pipe Insulation	eQuest / Spreadsheet Calculations
Lighting Upgrades	eQuest
OA Baseline Adjustment	eQuest
Bipolar Ionization	eQuest
Replace Boiler	eQuest
Replace Chiller	eQuest
Replace Condensing Unit & AHU	eQuest
Replace RTU	eQuest
Demand Controlled Ventilation	eQuest
BAS Upgrade	eQuest
Micro CHP (Distributed Generation)	eQuest / Spreadsheet Calculations
Solar PV	HelioScope / Spreadsheet Calculations
Battery Storage (Distributed Generation)	Energy Toolbase / Spreadsheet Calculations

Savings Methods – eCalcs

Schneider Electric utilizes a mixture of spreadsheet calculations and basic formula calculation tools. eCalcs is a proprietary Microsoft Excel based spreadsheet calculation tool used for calculating energy consumption and savings for an ECM, rather than a comprehensive building analysis approach. Often an approach using eCalcs or other spreadsheet calculations is the most accurate and reasonable way of approaching ECMs in which their operation, situation, or contribution to the baseline is limited.

What separates eCalcs from other spreadsheet-based tools is its integration of bin weather data into many of its standard calculations. Equipment or infiltration often has fluctuating savings opportunity as outside air reaches new high and low average temperatures through different seasons. By capturing the quantity of hours inside specific temperature ranges, these ECMs can better replicate the demand on the system, run hours, and heating and cooling loads. In this project, for the facilities that did not have whole building models in eQuest, we calculated the building envelope savings using eCalcs.

For the buildings that did have eQuest models, we obtained a Bin-Temperature weighted average CFM reduction using eCalcs, and reduced the infiltration CFM in eQuest by this amount. Further, in the eQuest models, the CFM reduction was separated based if the infiltration was reducing in the conditioned space or the unconditioned plenum. Below is an example of an eCalcs spreadsheet for calculating hour weighted infiltration reduction.

eCalcs: Energy Calculation Suite

Life Is On | Schneider Electric

projectName - Public Safety - CS

Infiltration

Building Data

Building Name	Public Safety - CS
Weather City	NJ, Newark
Building Height, ft	9
Building Orientation, deg	-20
Building L/W Ratio	1.4
Internal Draft Coefficient	0.7

Building Operating Conditions

Occupied Set Point Temp, oF	72.0
Cooling Setup Temp, oF	72.0
Percent of Building Cooled, %	100%
Cooling Seasonal Efficiency, %	302%
Heating Setback Temp, oF	72.0
Percent of Building Heated, %	100%
Heating Seasonal Efficiency, %	96%

Shelter Characteristics

Direction	Shelter Class	Terrain Category
See Reference Tables for Descriptions		
North	3	3
East	3	3
South	3	3
West	3	3

Building Crack Definitions

Penetration	Type	H	Qty	Length	Gap	% Open	Total Area	Wall Only
Name	Select	ft	#	ft	inches	%	sqft	sqft
Double Door - Sides, Top, Sweep, Center (UT)	Door	-1.5	1	66	1/8	100%	0.7	0.7
Single Door - Sides, Top, Sweep (UT)	Door	-1.5	6	20	1/8	100%	1.3	1.3
Crack 3	Wall	0.0				100%	0.0	0.0
Crack 4	Wall	0.0				100%	0.0	0.0
Crack 5	Wall	0.0				100%	0.0	0.0
Crack 6	Wall	0.0				100%	0.0	0.0
Crack 7	Wall	0.0				100%	0.0	0.0
Crack 8	Wall	0.0				100%	0.0	0.0
Crack 9	Wall	0.0				100%	0.0	0.0
Crack 10	Wall	0.0				100%	0.0	0.0
Crack 11	Wall	0.0				100%	0.0	0.0
Crack 12	Wall	0.0				100%	0.0	0.0
Crack 13	Wall	0.0				100%	0.0	0.0
	Effective H (Wall Only)	-1.5					1.9	1.9

Notes: H is the height difference between the crack and the neutral pressure level of the building.

Effective Building Coefficients

Shelter Coefficient	0.7
Wind Shear Exponent	0.14
Boundary Layer Thickness, ft	900
Wall Pressure Coefficient	0.11
Roof Pressure Coefficient	-0.30

Site Parameters

Average Wind Speed, mph	9.9
Site Corrected Wind Speed, mph	8.3
Model Wind Coefficient	0.22
Draft Factor	0.13
Volume Factor, ft/min (in-wg)^0.5	2,603

Energy Engineering Calculations

Temperature Bin Hours						Calculated Infiltration Rates			
Mid Pt				Schedule1		Occupied Rates		Unoccupied Rates	
Temp	MCWB	Density	Enthalpy	Occupied	Unocc	Wall	Roof	Wall	Roof
oF	oF	lb/ft3	Btu/lb	hrs/yr	hrs/yr	cfm	cfm	cfm	cfm
2	-0.7	0.086	0.7	5	2	106	0	106	0
6	3.7	0.085	2.0	17	6	87	0	87	0
10	8.4	0.084	3.4	32	13	62	0	62	0
14	12.5	0.083	4.6	61	29	15	0	15	0
19	16.3	0.083	5.9	106	33	57	0	57	0
23	19.9	0.082	7.1	163	64	82	0	82	0
27	23.6	0.081	8.5	337	89	101	0	101	0
31	28.0	0.080	10.2	392	114	117	0	117	0
36	31.2	0.080	11.4	410	118	130	0	130	0
40	34.9	0.079	12.9	374	135	142	0	142	0
44	39.0	0.078	14.7	462	142	154	0	154	0
48	43.0	0.077	16.6	394	112	165	0	165	0
53	46.6	0.077	18.4	498	107	174	0	174	0
57	51.4	0.076	21.0	494	146	185	0	185	0
61	55.1	0.075	23.2	522	166	194	0	194	0
65	59.1	0.074	25.8	442	113	202	0	202	0
70	62.2	0.074	27.9	519	161	210	0	210	0
74	65.3	0.073	30.2	487	163	218	0	218	0
78	67.9	0.072	32.2	540	97	225	0	225	0
82	67.9	0.072	32.2	326	13	229	0	229	0
87	69.9	0.071	33.8	205	2	235	0	235	0
91	70.6	0.071	34.4	106	0	240	0	240	0
95	74.8	0.070	38.2	32	0	248	0	248	0
99	76.0	0.069	39.2	10	0	253	0	253	0
104		0.000	0.0	0	0	0	0	0	0
				6,934	1,825				

Hour weighted CFM Reduction	173

Savings Methods – Pipe Insulation (Spreadsheets)

Standard heat transfer engineering calculations were used to compute heat loss from bare and insulated mechanical systems (piping, valves, fittings, tanks, and ductwork). Energy savings were calculated as the difference in heat loss.

Energy Use

Existing and proposed energy use are computed as follows:

Pipes & Fittings

Heat Loss (Btu/h) = (Heat Loss / lin.ft. bare pipe) * (lin.ft. of pipe) * [1 – (%insulated)] + (Heat Loss / lin.ft. insulated pipe) * (lin.ft. of pipe) * (%insulated)

Fuel Loss (MMBTU/yr) = (Heat Loss Btu/h) * (heating hrs/year) ÷ (efficiency)
Electric Loss (kWh/yr) = (Heat Loss Btu/h) * (cooling hrs/year) ÷ (12,000 Btu/ton-hr) x (cooling kW/ton)

Tanks, Plates, & Ductwork

Existing and proposed heat loss for tanks, plates, and ductwork are calculated as follows:

Heat Loss (Btu/h) = (Heat Loss / sq.ft.) * (sq.ft. of component) * (qty) * [1 – (%insulated)] + (Heat Loss / sq.ft. insulated) * (qty) * (sq.ft. of component) * (%insulated)

Fuel Loss (MMBTU/yr) = (Heat Loss Btu/h) * (heating hrs/year) ÷ (efficiency)
Electric Loss (kWh/yr) = (Heat Loss Btu/h) * (cooling hrs/year) ÷ (12,000 Btu/ton-hr) x (cooling kW/ton)

Energy Savings

Energy savings are the difference between existing and proposed heat loss:

Fuel Savings (MMBTU/yr) = (Existing Fuel Loss) – (Proposed Fuel Loss)
Electric Savings (MMBTU/yr) = (Existing Electric Loss) – (Proposed Electric Loss)

Heat Transfer: Bare Systems

Bare systems are subject to convection and radiation heat transfer. We ignore conductive heat transfer through the pipe/fitting material (e.g. steel, copper, PVC etc.) as this is negligible as compared to heat transfer through insulation and air convection.

Pipes & Fittings

Following are the heat transfer calculations for pipes and fittings for indoor systems subject to natural convection (no wind). The calculations for outdoor systems subject to forced convection (wind) are similar except that the formulas are more complicated.

For fittings (valves, elbows, strainers, etc.), we estimate heat loss based on equivalent length of straight pipe, which is the ratio of the area of the fitting to the area of 1 linear foot of pipe of the same size (fitting equivalent length = Area of fitting, ft^2 / Area of pipe of equivalent diameter, ft^2).

$$q_{pipe} = \frac{2 * \pi * \Delta T}{\frac{1}{h * \left(D_{outer}/2 \right)}}$$

Where:
q_{pipe} = *heat loss per linear foot = Btu/h/lin.ft.*

$$h = total\ convective\ heat\ transfer\ factor = h_{convection} + h_{radiation}$$

$$h_{convection} = 0.213 * \left(\frac{\Delta T}{D} \right)^{\left(\frac{1}{4} \right)}$$ [ASHRAE 2005, Ch. 3, Eq. T10.16]

□T = $T_{surface} - T_{air}$
$\Delta T = T_{surface} - T_{air}$
D = Outer diameter

$$h_{radiation} = \varepsilon * \sigma * \left(T_{surface}^4 - T_{air}^4 \right) / \left(T_{surface} - T_{air} \right)$$

e = emissivity of surface
s = Stefan-Boltzmann constant = 0.1714 x 10-8 Btu / (hr-ft^2-°R^4)
$T_{surface} = Temperature\ of\ surface$
$T_{air} = Average\ ambient\ air\ temperature$

Heat Transfer: Insulated Systems

Insulated systems are subject to convection, radiation, and conductive heat transfer. We ignore conductive heat transfer through the pipe/fitting material (e.g. steel, copper, PVC etc.) as this is negligible when compared to heat transfer through insulation and air convection.

$$q_{pipe} = \frac{2 * \pi * \Delta T}{\frac{ln\left(D_{outer}/D_{inner}\right)}{k} + \frac{1}{h * \left(D_{outer}/2\right)}}$$

Where:

q_{pipe} = *heat loss per linear foot = Btu/h/lin.ft.*

$$h_{convection} = 0.213 * \left(\frac{\Delta T}{D}\right)^{\left(\frac{1}{4}\right)}$$ [ASHRAE 2005, Ch. 3, Eq. T10.16]

$\square T = T_{surface} - T_{air}$

$\Delta T = T_{surface} - T_{air}$

D = Outer diameter

$$h_{radiation} = \varepsilon * \sigma * \left(T_{surface}^4 - T_{air}^4\right) / \left(T_{surface} - T_{air}\right)$$

e = emissivity of surface

s = Stefan-Boltzmann constant = 0.1714 x 10-8 Btu / (hr-ft^2-°R^4)

$T_{surface} = Temperature\ of\ surface$

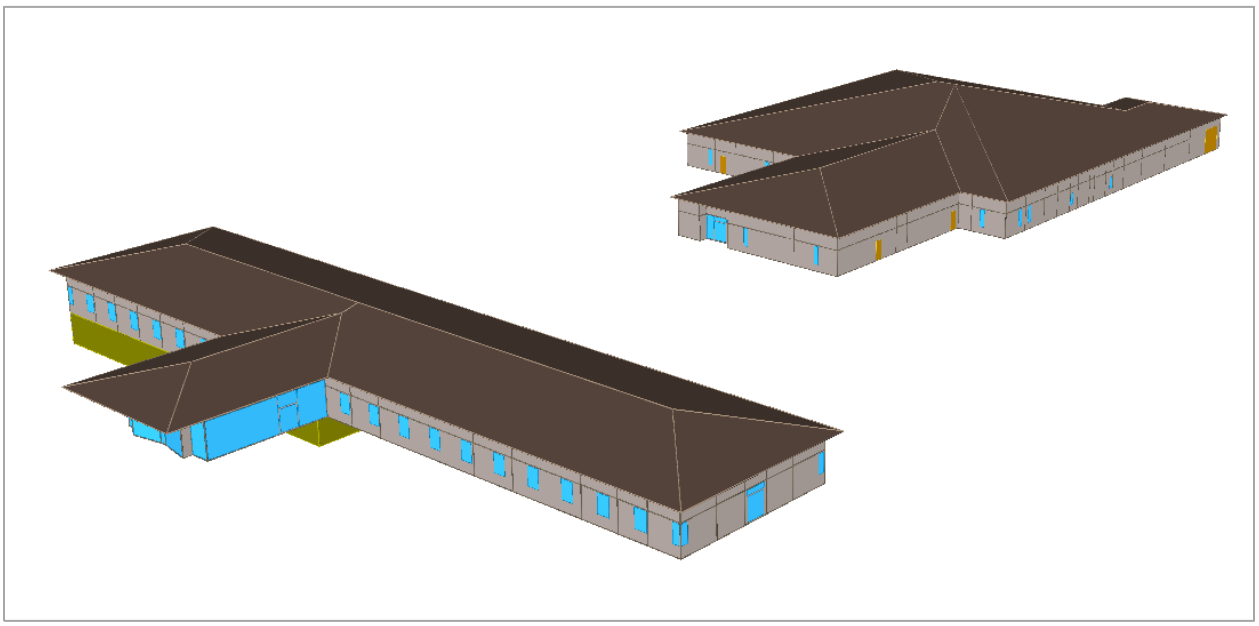
$T_{air} = Average\ ambient\ air\ temperature$

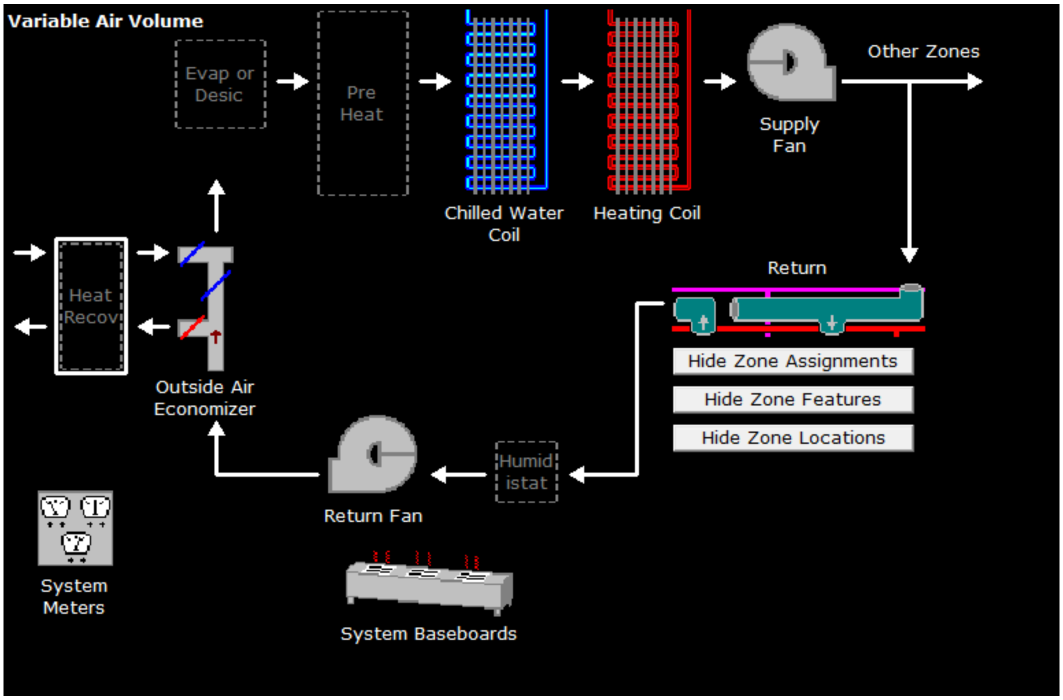
L = Pipe length or fitting equivalent length

Savings Methods – eQuest

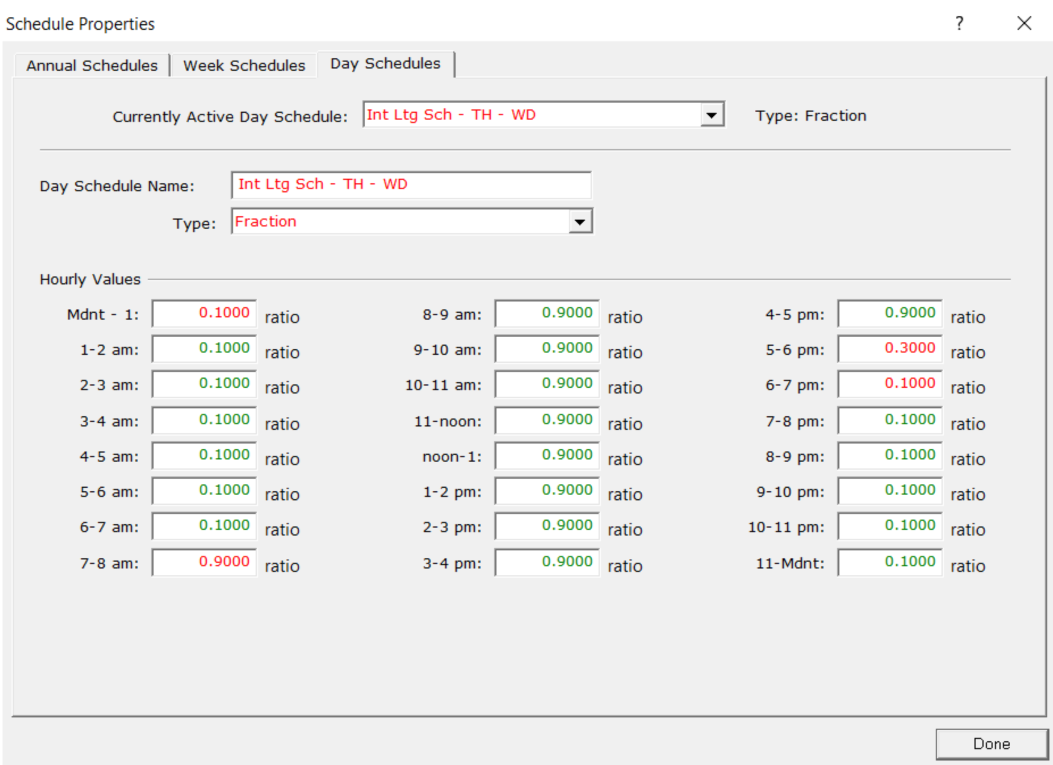
To estimate savings for key buildings, Schneider Electric modeled energy use of buildings using eQuest. eQuest was developed through funding by the United States Department of Energy (USDOE) and is used as the preferred tool for energy modeling in the industry. This modeling tool provides the unique ability to model current conditions, including combined heat and power, and proposed retrofits in order to assess energy savings.

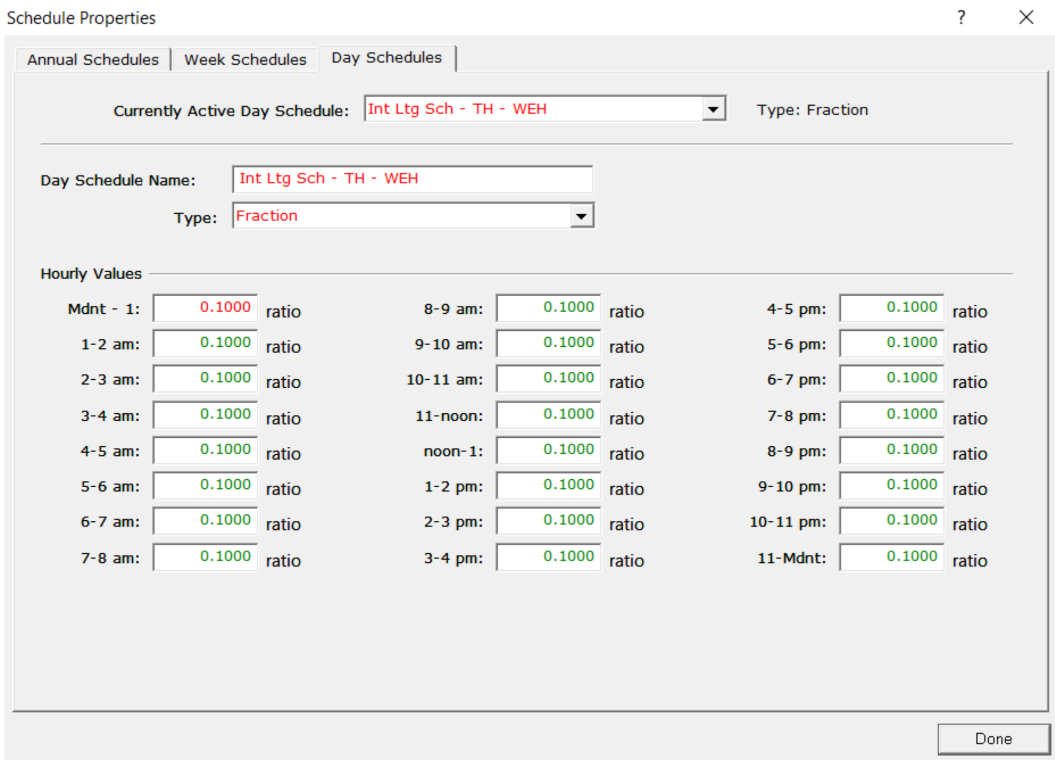
Spaces are defined by their construction to determine thermal conductivity and mass for heat loss/gain calculations. Also included are ventilation rates, lighting, equipment, and occupant loads and schedules. Individual spaces or groups of spaces are assigned to thermal zones that are served by an air distribution system. A thermal zone is defined by the conditioned area that is served by one thermostat controlling one terminal device (if applicable). Systems may include either a central air handler or distributed equipment such as water source heat pumps. Systems are then assigned to a loop that serves heating and/or cooling coils. Loops can include chillers, cooling towers, boilers, ground source wells, and all associated pumps. Plants are then assigned to a building. Below is a screen shot of the eQuest model for Town Hall and Public Safety buildings.





Defining accurate schedules is imperative to creating an accurate model. Schedules are used to describe when and to what capacity the building is operated and occupied. Varying load levels and runtime for lighting, electrical equipment, occupancy, ventilation, fans, and temperature set-points are all modeled using schedules. Below are two screen shots showing a typical lighting schedule.





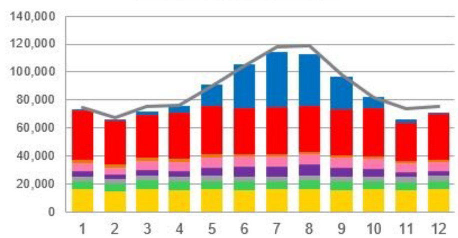
Calibrating the Model

To accurately predict the energy and demand savings of the project, the model must be calibrated to replicate closely the weather normalized energy and demand use profiles of the baseline building. This is accomplished by first running the model as constructed. These results are then compared to the baseline energy consumption data described above to assess how closely the model matches the baseline. After examining the results, it becomes apparent where energy or demand is too high or too low and where adjustments may need to be made. The end goal is replicating all parameters such as electric energy, electric demand, and gas use to align simultaneously. These parameters typically involve adjusting operating schedules, internal loads, equipment efficiencies, and temperature setpoints. The calibration process typically requires between fifteen and twenty iterations (possibly more for complex models) to achieve a satisfactorily calibrated model. The following graphic shows the output of the energy model vs. baseline for an example project.

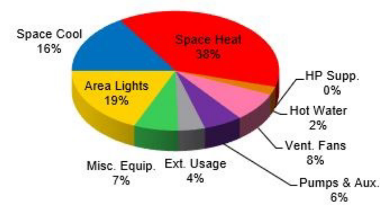
Baseline Calibration

1	Electric Consumption - kWh												
Electric	1	2	3	4	5	6	7	8	9	10	11	12	Total
Space Cool	36	43	3,077	4,898	15,423	31,185	39,341	37,306	23,351	7,908	2,035	49	164,651
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0
Space Heat	35,561	31,014	30,329	33,103	34,589	33,103	33,579	32,952	32,618	34,552	27,786	33,209	392,394
HP Supp.	17	10	3	0	0	0	0	0	0	0	3	7	39
Hot Water	2,147	2,089	2,435	2,228	2,049	1,858	1,616	1,623	1,515	1,594	1,741	2,019	22,915
Vent. Fans	6,202	5,560	6,085	6,481	7,331	7,100	7,339	7,339	7,098	7,339	5,901	6,126	79,901
Pumps & Aux.	3,468	3,133	4,051	4,246	5,957	7,054	7,169	7,423	6,780	5,186	3,850	3,468	61,784
Ext. Usage	3,615	3,265	3,615	3,498	3,615	3,498	3,615	3,615	3,498	3,615	3,498	3,615	42,559
Misc. Equip.	5,970	5,450	6,157	5,880	6,032	5,942	5,970	6,157	5,880	5,970	5,817	6,032	71,255
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0
Area Lights	15,870	14,496	16,389	15,642	16,043	15,815	15,870	16,389	15,642	15,870	15,469	16,043	189,538
Total	72,886	65,059	72,138	75,977	91,038	105,555	114,498	112,802	96,383	82,033	66,101	70,566	1,025,037
Utility Baseline	74,757	67,475	75,611	76,346	89,596	104,184	118,288	118,496	98,080	81,818	73,456	75,746	1,053,853
Error	-3%	-4%	-5%	0%	2%	1%	-3%	-5%	-2%	0%	-10%	-7%	-2.7%
													4.29%
													2.98%

Monthly End Use Consumption



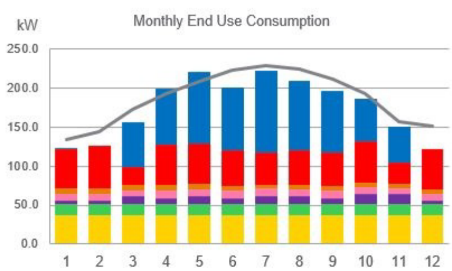
Annual Consumption End-Use Comparison



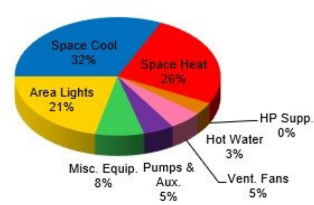
Baseline Calibration

1	Electric Demand - kW												
Electric	1	2	3	4	5	6	7	8	9	10	11	12	Total
Space Cool	0.2	0.0	56.8	71.7	92.0	80.6	105.2	88.3	79.0	54.5	45.6	0.0	674.0
Heat Reject.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Refrigeration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Space Heat	51.3	55.2	23.2	51.2	51.6	45.7	41.7	45.1	43.1	52.9	27.2	52.1	540.1
HP Supp.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hot Water	6.7	7.0	7.0	6.9	6.2	5.6	5.0	4.7	4.6	4.9	5.5	6.1	70.3
Vent. Fans	8.5	8.4	8.1	9.8	9.9	9.9	9.9	9.9	9.9	9.8	8.1	8.3	110.5
Pumps & Aux.	4.6	4.7	9.6	7.9	9.7	8.0	9.7	9.7	7.9	12.5	12.4	4.7	101.4
Ext. Usage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Misc. Equip.	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	162.3
Task Lights	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Area Lights	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	37.8	453.2
Total	122.6	126.6	156.1	198.8	220.7	201.0	222.7	208.9	195.8	186.0	150.2	122.5	2,112.0
Utility Baseline	133.5	144.3	172.4	192.4	209.3	223.3	229.4	225.2	211.8	193.4	156.8	151.7	2,243.7
Error	-8%	-12%	-9%	3%	5%	-10%	-3%	-7%	-8%	-4%	-4%	-19%	-5.9%
													8.66%
													6.40%

Monthly End Use Consumption

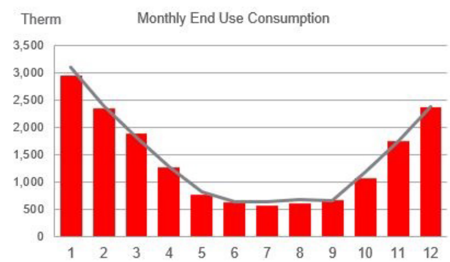


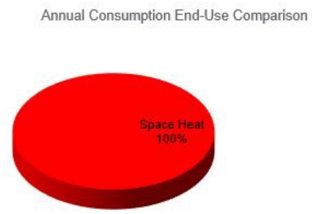
Annual Consumption End-Use Comparison



Baseline Calibration

2	Natural Gas Consumption - Therm												
Natural Gas	1	2	3	4	5	6	7	8	9	10	11	12	Total
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0
Space Heat	2,949	2,342	1,897	1,276	779	633	579	613	673	1,080	1,751	2,359	16,931
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2,949	2,342	1,897	1,276	779	633	579	613	673	1,080	1,751	2,359	16,931
Utility Baseline	3,099	2,400	1,825	1,270	823	646	636	678	665	1,184	1,731	2,367	17,325
Error	-5%	-2%	4%	1%	-5%	-2%	-9%	-10%	1%	-9%	1%	0%	-2.3%
													4.77%
													2.48%





Modeling the ECMs

After the model has been calibrated, changes are made to the model, which represent implementation of the proposed scope conditions of the energy and water conservation measure. ECMs are implemented and run individually to assess the energy savings of each ECM. All ECMs are modeled with consideration to potential overlap inflating modeled savings. ECMs are run in sequentially, building upon each other. This results in a more accurate estimate of savings than if each ECM were run in comparison to the baseline.

Savings Methods – Micro CHP (Spreadsheets)

Heating output and fractional runtime of the micro-CHP boiler was obtained for each of the 8,760 hours through an hourly report generated from eQuest. This was used to calculate the electricity generated by the micro-CHP boiler for each hour based on its part load ratio.

See Appendix 6.1 – Additional Savings Calcs & Docs for additional savings information.

Savings Methods – HelioScope & Spreadsheets

HelioScope is a PV system design tool that integrates shading analysis, simulation, and CAD in one package, helping to reduce the cost of PV design. The hourly PV generation profiles from helioscope were aligned with the hourly energy use profiles of the corresponding buildings from eQuest post implementation of other ECMs to quantify the net import and next export for each of the 8760 hours. The savings were calculated based on the consolidation policies of PSEG.

See Appendix 6.1 – Additional Savings Calcs & Docs for additional savings information.

Savings Methods – Energy Toolbase & Spreadsheets

Energy Toolbase is an industry-leading software platform that provides a cohesive suite of project modeling, storage control, and asset monitoring products that enable solar and storage developers to deploy projects more efficiently. The tool takes the input of hourly building energy use profiles obtained from eQuest post implementation of other ECMs and the hourly PV generation profiles from Helioscope. Additionally, the capacity and discharge characteristics of the proposed battery energy storage (BESS) are provided as inputs. Energy Toolbase provides hourly load profile of the building with demand shaving and energy used by the BESS to charge. Savings are calculated based on the difference between the post ECM energy profile with solar included and the energy profile with battery included.

See Appendix 6.1 – Additional Savings Calcs & Docs for additional savings information.

5.0 Implementation

5.1 Design & Compliance Issues

This project was developed using the proper Building Codes, Energy Codes, and Electrical Codes. Safety is of the utmost important to Schneider Electric, not only for our customers, but also for our employees and subcontractors. SE will comply with all the required safety codes and protocols to ensure a successful implementation.

5.2 Assessment of Risks

This assessment of risks is meant to provide the Township of Piscataway with an idea of the potential risks that lie within the ESIP project. By no means is this an effort to eliminate responsibility of the ESCO to provide an Energy Savings Plan that meets industry standards of engineering, energy analysis, and expertise. This is included to allow the Township to understand where potential failure points could be that would result in savings not being achieved or operational issues.

- If actual operation of the buildings deviates significantly from the parameters outlined in the Energy Savings Plan with respect to temperature setpoints and occupied times, energy savings associated with the building automation system and HVAC upgrades could be affected.
- Building Automation System sequences of operation should not be overridden or changed permanently. Overrides are permitted for maintenance or special occasions, but must be reset to maintain energy savings.
- If outside air dampers or control sequences are overridden for extended periods, it would have an impact on the savings realized by Piscataway.
- Solar PV systems require ongoing maintenance to keep the systems operating at peak performance. An O&M contract is advised (and accounted for in the ESIP cash flow) for the lifetime of the solar systems.
- The microgrid will have a large battery energy storage system as one of its critical components. The microgrid, battery included, will require annual maintenance and validation to ensure proper operation and long-term longevity.

5.3 Post Project Support

The following is a description of services and terms that are used within this section.

Remote Energy Management, Training & Technical Support

This involves live remote telephone and internet support used to provide instruction, assisted troubleshooting, and system training. This on-call service provides technical support for all installed systems and measures and helps reduce system downtime.

Remote System Monitoring and Reporting

Activities include monitoring live conditions, reviewing and analyzing trends, recording deficiencies, as well as tuning, adjusting, and optimizing parameters. This also includes reporting operational performance of specific systems and equipment necessary to sustain energy savings, comfort, and safety. This helps manage and ensure key variables for energy measures are maintained to allow for sustained savings, performance, and comfort.

On-site Visits

On-site visits include a review and report of changes to operations (past, present, and future), usage, status, and conditions of building systems and equipment relative to their impact on energy performance. ECM and systems training can be provided upon request. Benefits include:

- Expert advice to aid in energy planning based on operational and future commitments
- Identifying excess energy targets and recommendations for improvement
- An increase in overall energy awareness

Resource Advisor

Resource Advisor is Schneider Electric's enterprise-level application providing secure access to data reports and summaries to drive the City's energy and sustainability programs. Resource Advisor combines quality assurance and data capture capabilities of utility information into one energy management solution.

Client Services Program

Schneider Electric's Client Services program is designed to assist the Township of Piscataway in sustaining savings over the long term. Based on the scope of this project, Schneider Electric recommends an ongoing services and post-project support program as described below. The Installation scope is included in the ESIP project already, and the 1st year of post project support is included in the project's cash flow as well. After the first year, Piscataway will have the option to select whichever services they would like, and enter into a separate agreement with Schneider Electric for them.

	Initial Term			
	Installation	**Year 1**	**Year 2**	**Year 3**
Measurement & Verification with Savings Reporting Portal	Included	Included	Included	Included
Remote Energy Management Training and Technical Support - Total Hours	Included	27	27	Customer Option
Remote System Monitoring and Reporting	Included	Monthly	Monthly	Customer Option
On-Site Visits – Energy Consulting and Assessment	Included	Quarterly	Quarterly	Customer Option
On-Site Training - Total Hours	Included	8	8	Customer Option
Resource Advisor - with Energy Star Module Package (12 Total meters) - Setup and Annual Subscription (Setup Fee only included during Installation Period)	Included	Included	Included	Customer Option
	Installation	**Year 1**	**Year 2**	**Year 3**
Total (Base Price)	**$64,851**	**$46,160**	**$46,160**	**Customer Option**
Total (Add Option)	TBD	TBD	TBD	TBD

5.4 Measurement and Verification (M&V) Plan

The International Performance Measurement & Verification Protocol (IPMVP) was created to determine standards and best practices in the measurement & verification of energy efficiency investments. The M&V Plan that is recommended for Piscataway for this ESIP project is a combination of Option B for the solar PV and Option C for 6 of the larger meters with higher savings. The cost of this M&V plan is included and shown in the table above.

"Option B" Measurement and Verification

The IPMVP Option B, retrofit isolation involves localized measurements to isolate the impact of specific ECMs. For the Township of Piscataway, this will ensure performance of the solar PV system is proven without having to be concerned about any other energy consuming interaction behind the utility meter, as it isolates the solar from other ECMs.

"Option C" Measurement and Verification

The IPMVP Option C, Whole Building Analysis, involves using utility meters and a weather normalized baseline to measure and verify savings. Option C is a good fit for buildings receiving comprehensive upgrades with a high degree of interactivity of the ECMs within this plan.

Non-measured Savings

Due to the small nature of some of the Township's facilities, providing IPMVP measurement & verification is cost prohibitive for a handful of the facilities. Any meters not included in the Option B and Option C M&V plan are recommend as non-measured.

6.0 Appendices

6.1 Additional Savings Calcs & Docs

Section 4.4 – Savings Calculations shows an example of the savings calcs performed and formulas/models used to calculate energy and cost savings.

Please see Appendix 6.1 – Additional Savings Calcs & Docs in the Box folder for additional savings information and details, for all buildings and ECMs.

6.2 Preliminary Mechanical-Electrical Designs

Please see the Appendices folder in Box for preliminary mechanical and electrical designs.

6.3 Local Government Energy Audit (LGEA)

Please see the Appendices folder in Box for the Local Government Energy Audit reports.

6.4 Scope of Work Details

Please see the Appendices folder in Box for scope of work specifics that are not detailed in the body of the Energy Savings Plan.

6.5 Third Party Review & Approval Report

This review is in process; all correspondence will be saved, stored, and tracked.

6.6 Board of Public Utilities (BPU) Approval

This review has not been started; it will be completed after the 3rd Party Review is complete.