West Windsor-Plainsboro Regional School District

Energy Savings Plan

Rev4

December 20, 2019

Schneider Electric

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1.0 Executive Summary

On March 19, 2019, Schneider Electric was selected by the West Windsor-Plainsboro Board of Education as the District's Energy Services Company. On May 3, 2019, the Investment Grade Energy Audit (IGA) contract was signed, commencing the project development phase. Since that time, Schneider Electric and District staff have worked collaboratively to develop WW-P's Energy Savings Improvement Program (ESIP). We are pleased to provide the following Energy Savings Plan (ESP) as a result of the IGA process. This report is a draft and will be updated following the District's input on desired scope for the project.

We have spent significant time visiting the schools, speaking with staff, performing preliminary engineering, analyzing utility information, and creating energy models. We would like to thank the administration, faculty and staff, and the members of the Board of Education for providing their time, assistance, and input.

ESIP Core Team Members

Dr. David Aderhold, Superintendent
Dr. Chris Russo, Assistant Superintendent for Finance
James Earle, Assistant Superintendent, Pupil Services/Planning
Thomas Daly, Director of Buildings & Grounds
Jason Harris, Assistant Director of Buildings & Grounds
Kerwin Garcia, Assistant Director of Buildings & Grounds

Daniel Riggle, Account Executive
Kirby Slear, Senior Development Engineer
Sam Ringelberg, Development Engineer
Pam Janney, Director of Project Development
Weston Ernst, Regional Manager
Brad Hamm, Construction Services Manager
Willem Pennings, Project Manager
Paul Kutsko, Senior Automation Engineer
Paul Ciamaglia, Mechanical Engineer
Bob Loprete, Senior Estimator
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Derek White, Energy Engineer
Donna Benwitz, Client Advocate
Wes Henise, Performance Assurance
Michael Ortiz Rivera, Performance Assurance
Rebecca Rucker, Marketing
George Duthie, Architect, FVHD
Mary Lyons, Phoenix Advisors

The following next steps are required prior to the implementation phase of this ESIP program:

1. Board of Public Utilities review & approval
2. Close on ESIP financing
3. Finalize engineering / begin construction

Current State of the District

The following factors were taken into account to develop a successful ESIP program for WW-P.

Coordination with existing capital projects. Currently, WW-P is in the construction or planning phases of multiple building projects. Maurice Hawk Elementary School and Town Center Elementary School have new additions nearing completion. Other projects associated with the $115 M referendum are in the planning, engineering, bidding, or construction phases. This ESIP project will require close coordination with the referendum projects in order to ensure a holistic solution, a smooth construction process, and consistency of designs and equipment types.

Energy benchmarking reveals that usage is high. WW-P schools have several factors leading to high energy usage including many after school, weekend, and summer activities, and a high percentage of air-conditioned spaces. On an annual basis, WW-P spends over $3 M on energy, and 8 out of 10 schools have an Energy Star score below the median of 50. This indicates that a major opportunity for energy savings exists within the facilities.

Many Heating, Ventilation, and Air Conditioning (HVAC) systems are in need of repair or replacement. At the outset of the IGA, Schneider Electric performed a detailed HVAC Equipment Study, or “point to point checkout” of the systems at all seven schools that are not receiving a comprehensive HVAC upgrade through the referendum. This analysis determined that there is significant equipment in need of replacement immediately or in the near future. Many of these identified projects will address a capital need and reduce deferred maintenance, but more importantly will improve the indoor air quality for students and staff.

While enrollment growth continues, there are limited funding options to address existing infrastructure. While WW-P recently passed a major referendum and District administration has done an effective job of maintaining capital reserve, there are more needs within the existing facilities than there is money to invest. Furthermore, the enrollment growth in the community is expected to continue. We expect that future budgets and referenda will be used to fund new construction, making it more difficult to fund projects in existing facilities. This ESIP program is an opportunity to reduce the impact to local taxpayers for future projects, while provide budgetary relief and significant occupant benefits.

Project Goals

This ESIP will allow WW-P to:

1. Reduce energy and operations & maintenance (O&M) costs
2. Fund priority capital needs including Heating, Ventilation, and Air Conditioning (HVAC) equipment and building control systems
3. Improve indoor air quality, humidity control, and comfort
4. Reduce the District’s carbon footprint through a solar power purchase agreement (PPA)
5. Achieve Sustainable Jersey certification in all schools
6. Provide unique educational opportunities through collaboration with school green teams and implementation of the Sustainable Jersey Grant for an Energy Reduction Competition
7. Provide options to support ongoing O&M and energy management

Capital Needs & Savings Opportunities

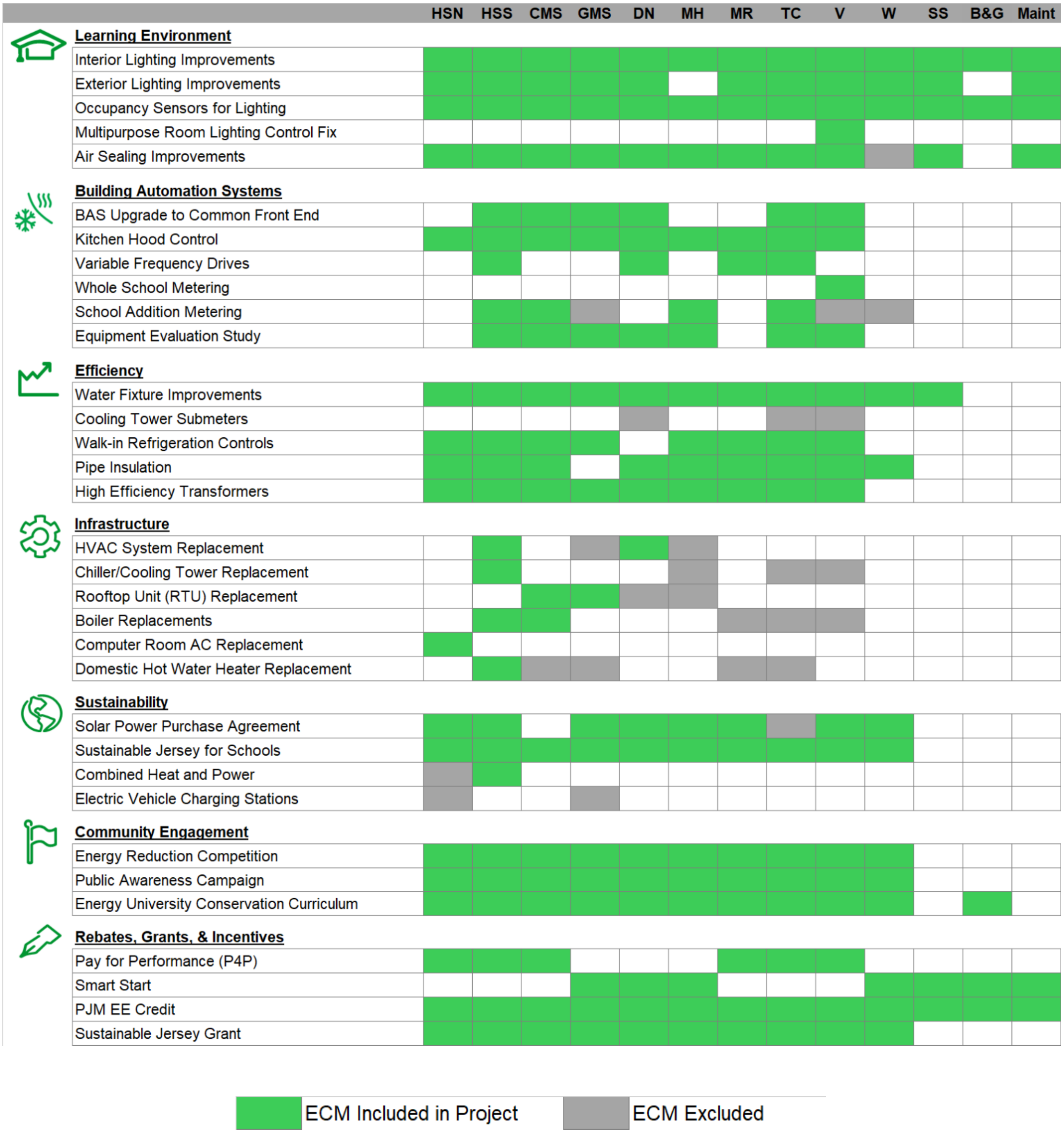
Through the course of the Investment Grade Audit, Schneider Electric identified $45 million in facility needs and energy conservation measures. Of the potential projects identified, WW-P has selected $30 million in capital improvements for inclusion within the Energy Savings Improvement Program. The other projects will be addressed under other capital projects in the future.

The following pages highlight the energy conservation measures (ECMs) and capital needs identified by WW-P and SE staff and included in the ESIP project. Some of the largest savings opportunities are from HVAC and controls upgrades, LED lighting, and implementation of a solar Power Purchase Agreement (PPA). Schneider Electric has assisted the District in an RFP for a solar PPA. Six (6) proposals were received, with Pfister Energy & Greenskies being selected as the District's PPA providers. Pfister Energy will perform the engineering and installation and Greenskies will provide the financing.

ESIP Highlights:

$1,369,568	Annual energy & operational savings
$2,172,450	Funding from rebates & incentives
$29,648,392	Total Project Cost

For a summary of the energy conservation measures (ECMs) proposed for each building, please see the following graphic.



2.0 Financial Analysis

2.1 Scope Summary

The intent of this project is to maximize savings opportunities, fund critical capital improvements, and achieve the strategic goals of the District. We believe that the following energy conservation measures are the best solution to maximizing savings and meeting the District's needs.

	Energy Conservation Measure (ECM)	Building(s)	Hard Costs	Annual Savings
	Core ECMs			
1	LED Lighting Upgrades - Interior, Exterior, and Sensors	All	$ 4,446,165	$ 342,327
2	Add Emergency Lighting to Generator	MRES	$ 195,860	$ -
3	Air Sealing Improvements	All except WES	$ 354,032	$ 26,466
4	Variable Speed Drives	HSS, DNES, MRES, TCES	$ 176,611	$ 73,616
5	Kitchen Hood Control	All except WES	$ 85,040	$ 14,004
6	Whole School Metering	VES	$ 11,483	$ -
7	School Addition Metering	HSS, CMS, MHES, TCES	$ 48,116	$ -
8	Water Fixture Improvements	All	$ 329,626	$ 43,757
10	Walk in Refrigeration Controls	All except DNES and WES	$ 66,995	$ 7,720
11	Pipe Insulation	All except GMS	$ 105,755	$ 8,675
12	High Efficiency Transformers	All except WES	$ 790,609	$ 46,096
13	Solar Power Purchase Agreement (PPA)	All except CMS, TCES	$ 94,000	$ 311,373
14	Pay for Performance (P4P) Incentives	HSN, HSS, CMS, MRES, TCES, VES	$ 124,430	$ 120,391
15	Equipment Evaluation Study	All except HSN, MRES, WES	$ 103,314	$ -
16	Combined Heat and Power (CHP) System	HSS	$ 590,562	$ 24,616
	Heating, Ventilation, and Air Conditioning (HVAC) Systems			
	High School South			
17	Dedicated Outside Air System w/ Unit Ventilator Replacement	HSS	$ 6,056,868	$ -
18	Chiller Replacements - Main Section	HSS	$ 640,852	$ 2,416
19	Unit Ventilator Replacement - Science Wing	HSS	$ 1,025,398	$ -
20	Unit Ventilator Replacement - 1995 Addition	HSS	$ 223,499	$ -
21	Building Automation System (BAS) Upgrade	HSS	$ 557,448	$ 45,258
22	Replace Air Handling Units Serving Gym	HSS	$ 377,637	$ 150
23	Chiller Replacement - Science Wing	HSS	$ 524,597	$ 2,279
24	Replace Library Split Systems	HSS	$ 419,824	$ -
25	Locker Room Sec. D Unit Ventilator and Fan Coil Replacement	HSS	$ 258,084	
26	Boiler Science Wing	HSS	$ 265,096	$ 4,448
27	Domestic Hot Water Heater Replacement	HSS	$ 51,506	$ 378
	Dutch Neck			
28	Unit Ventilator Replacement	DNES	$ 412,242	$ -
29	Multipurpose Room	DNES	$ 461,277	$ 1,500
30	Replace Units in 300s	DNES	$ 401,539	$ 1,575
31	Replace Units in 401-405	DNES	$ 134,177	$ 1,425
32	Replace Units in Modular Classroom Section	DNES	$ 256,260	$ -
33	Building Automation System (BAS) Upgrade	DNES	$ 490,395	$ 12,462
	Community MS			
34	Replace Two Rooftop Units (RTUs) in 700/800 Wing	CMS	$ 508,847	$ -
35	Boiler Replacement	CMS	$ 419,549	$ 3,689
36	Building Automation System (BAS) Upgrade	CMS	$ 420,802	$ 66,812
	Town Center			
37	Building Automation System (BAS) Upgrade	TCES	$ 868,487	$ 10,761
	Village			
38	Building Automation System (BAS) Upgrade	VES	$ 791,378	$ 35,356
	High School North			
39	HSN Computer Room AC Replacement	HSN	$ 134,301	$ -
	Grover MS			
40	Replace Two (2) Energy Recovery Ventilators (ERVs)	GMS	$ 49,762	
41	Building Automation System (BAS) Upgrade	GMS	$ 26,902	$ -
	Project Summary:		$ 23,299,326	$ 1,207,550

2.2 Financial Summary

The following represents the total, turn-key cost of the Energy Savings Improvement Program based on the scope of work listed on the prior page and Form V from Schneider Electric's RFP Response. The ESIP program with Schneider Electric is a firm fixed price contract. Schneider Electric will serve as the primary contractor, responsible for the execution of all scopes of work under the ESIP program, with the exception of the solar power purchase agreement (PPA).

Category	Cost	Percentage of Hard Costs
Estimated Value of Hard Costs (2):	$ 23,299,326	
Project Service Fees		
Investment Grade Energy Audit	$ 465,987	2.00%
Design Engineering Fees	$ 1,106,718	4.75%
Construction Management & Project Administration	$ 1,281,463	5.50%
System Commissioning	$ 232,993	1.00%
Equipment Initial Training Fees	$ 116,497	0.50%
ESCO Overhead	$ 1,630,953	7.00%
ESCO Profit	$ 1,514,456	6.50%
Project Service Fees Sub Total	$ 3,203,657	13.75%
TOTAL PROJECT COSTS:	$ 29,648,392	27.25%

This program may be funded through a combination of ESIP financing (lease purchase or energy savings obligations) over 15-20 years, rebates and incentives, and capital contribution from WW-P. There are several remaining variables that may alter the scope of this project, including district input, final scope selection, financing term, interest rate, incentives and rebates.

2.3 Cash Flow Analysis

ESCO Name: Schneider Electric

3. Cash Flow Analysis Format:

Total Project Cost:	$29,648,392	Term (Years):	20
Costs of Issuance:	$45,000	Interest Rate:	2.140%
Capital Contribution:	($5,548,392)		
Total Financed:	**$24,145,000**		
Optional M&V Contract (Year 1):	$95,000		

Year	Annual Electric Savings	Annual Natural Gas Savings	Annual Water Savings	Solar Power Purchase Agreement	Annual O&M Savings	Energy Rebates/ Incentives	Annual Service Costs	Total Annual Savings	Projected Payments	Net Cash-Flow to Client	Cumulative Cash Flow
6/30/2021	$151,701	$18,843	$7,906			$406,219		$584,669	$568,565	**$16,104**	
6/30/2022	758,506	94,214	39,531	$311,373	$165,945	882,417		$2,156,985	2,142,180	**14,805**	$30,909
6/30/2023	775,193	96,475	40,480	313,552	165,945	856,534		$2,248,179	2,236,121	**12,058**	42,967
6/30/2024	792,248	98,790	41,451	315,747	165,945	13,641		$1,427,822	1,417,523	**10,299**	53,266
6/30/2025	809,677	101,161	42,446	317,957	165,945	13,641		$1,450,827	1,441,337	**9,490**	62,756
6/30/2026	827,490	103,589	43,465	320,183	165,945			$1,460,672	1,449,135	**11,537**	74,293
6/30/2027	845,695	106,075	44,508	322,424				$1,318,702	1,307,307	**11,396**	85,689
6/30/2028	864,300	108,621	45,576	324,681				$1,343,178	1,332,030	**11,148**	96,837
6/30/2029	883,315	111,228	46,670	326,954				$1,368,167	1,355,844	**12,323**	109,160
6/30/2030	902,748	113,897	47,790	329,243				$1,393,678	1,383,642	**10,036**	119,196
6/30/2031	922,608	116,631	48,937	331,547				$1,419,723	1,410,369	**9,354**	128,550
6/30/2032	942,905	119,430	50,111	333,868				$1,446,315	1,436,027	**10,289**	138,839
6/30/2033	963,649	122,296	51,314	336,205				$1,473,465	1,460,668	**12,798**	151,637
6/30/2034	984,850	125,231	52,546	338,559				$1,501,186	1,489,132	**12,054**	163,691
6/30/2035	1,006,516	128,237	53,807	340,929				$1,529,489	1,516,472	**13,017**	176,708
6/30/2036	1,028,660	131,315	55,098	343,315				$1,558,388	1,547,529	**10,859**	187,567
6/30/2037	1,051,290	134,466	56,421					$1,242,177	1,229,281	**12,897**	200,463
6/30/2038	1,074,419	137,693	57,775					$1,269,887	1,260,313	**9,574**	210,038
6/30/2039	1,098,056	140,998	59,161					$1,298,215	1,285,168	**13,048**	223,085
6/30/2040	1,122,213	144,382	60,581					$1,327,176	1,319,006	**8,170**	231,255
6/30/2041	1,146,902	147,847	62,035					$1,356,784	1,349,285	**7,499**	238,755
Totals	$18,952,941	$2,401,421	$1,007,609	$4,906,537	$829,725	$2,172,450		$30,175,683	$29,936,928	**$238,755**	

2.4 Incentives, Rebates, and Curtailment Services

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

	Smart Start	PJM	P4P	CHP	Total
Install	$ 219,850		$ 165,369	$ 21,000	$ 406,219
Year 1		$ 18,523	$ 828,894	$ 35,000	$ 882,417
Year 2		$ 13,641	$ 828,894	$ 14,000	$ 856,534
Year 3		$ 13,641			$ 13,641
Year 4		$ 13,641			$ 13,641
Total	**$ 219,850**	**$ 59,445**	**$ 1,823,156**	**$ 70,000**	**$ 2,172,450**

All rebates and incentives are subject to program terms, conditions, approvals, and availability of funds.

NJ Clean Energy Program – Pay for Performance (P4P)

The P4P program provides incentives for comprehensive, whole-building energy improvements. This program is administered by TRC, and requires Approved Partners, such as Schneider Electric, to create the Energy Reduction Plan and acquire the incentive on behalf of the District. To learn more about the P4P program, please visit:

NEW JERSEY'S CLEAN ENERGY PROGRAM P4P PAY FOR PERFORMANCE

http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance

For WW-P, P4P represents the most lucrative program available. Schneider Electric will work through the application and approval process on behalf of the District throughout Construction and the first 2 years of the project.

NJ Clean Energy Program – Smart Start

The Smart Start Program provides prescriptive rebates for specific equipment changes, such as lighting upgrades or installation of variable frequency drives (VFDs). To learn more about the Smart Start Program, please visit:

New Jersey SmartStart BUILDINGS®

http://www.njcleanenergy.com/ssb

The New Jersey Clean Energy Program requires that customer choose either the P4P or the Smart Start program. Based upon our analysis, all schools that do not qualify for P4P will utilize the Smart Start program.

NJ Clean Energy Program – Combined Heat and Power:

One of the goals of the State of New Jersey is to enhance energy efficiency through on-site power generation with recovery and productive use of waste heat, and to reduce existing and new demands to the electric power grid. The Board of Public Utilities seeks to accomplish this goal by providing generous financial incentives for Combined Heat & Power (CHP) installations.

WW-P will be able to heat the pool at High School South while also creating electricity to offset the electrical load of the building.

PJM Energy Efficiency Program (PJM EE):

The Energy Efficiency program is designed to provide financial benefit to the consumer for permanent reductions in electrical load. Examples of energy efficiency projects include upgrading to more efficient lighting, or replacing HVAC systems with more efficient ones, or other ECMs that reduce electrical load.

WW-P will see permanent reductions in peak kW, primarily from lighting upgrades. After the installation of this Project, Schneider Electric will work to ensure that these incentives are secured on behalf of WW-P.

PJM Capacity Market Program (Demand Response)

The capacity market program stems from the need for utilities to balance electric supply with electric demand on the grid. Because there is a finite amount of generating capacity, demand response was created to allow consumers to shed demand when needed by PJM. Consumers must work with Curtailment Service Providers (CSPs) to shed electrical load when needed by PJM, in order to generate revenue. The load-shaving can be done through a variety of measures including energy efficiency, on-site generation, or manual shutdown.

Based upon the current conditions of the District’s building automation systems, it has been deemed that demand response may not be an immediate opportunity. However, through the course of the ESIP project and the installation of more sophisticated building automation systems, Schneider Electric will evaluate potential demand revenues.

3.0 Energy Conservation Measures

3.1 ECM Descriptions

1. LED Lighting Upgrades

Interior & Exterior Lighting Upgrades

This section provides a description of existing and proposed lighting systems at the ten schools in WW-P. Throughout the District, most of the lamps being used are 32W T8 lamps, with a single T12 fixture in a storage room in Community Middle School. There are over 100 can lights utilizing LED, metal halide, and CFL lamp technology. In general, lighting will be upgraded to new LED lamps. A description of existing conditions found in each of the schools is provided below.

High School North

- **Classrooms** – Current: 4' Fixtures with 2, 3 or 4 - F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with Tube Light styled 10.5W 4000K LEDs.
- **Hallways** – Current: 4' Fixtures with 2-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with tubular LEDs.
- **Gymnasium** – Current: 4' Fixtures with 6 T5HO lamps.
    1. Proposed: Fixture replacement with 24K Lumen fixture and included wire guard.
- **Aux Gymnasium** – Current: 6 lamp T5HO high bay fixtures.
    1. Proposed: Fixture replacement with 24K Lumen fixture and included wire guard.
- **Wrestling Room & Weight Lifting Rooms** – Current: 4' fixtures with 3 or 4 lamp F32/T8
    1. Proposed: Lamp for lamp replacement with tubular 10.5 W LEDs.
- **Pool –** Current: 85W LED corn cob type LEDs.
    1. No retrofit; fixtures remain as is.
- **Media Center** – Current: lighting setup includes various fixture types including 2x2 Parabolic recessed 2' U-Type lamps, decorative 400 W MH fixtures, 4' strip fixtures, and recessed can lights using 15 W LEDs.
    1. No retrofit; This area is scheduled to be renovated through the referendum scope of work.
- **Auditorium, Cafeteria** – Current: A mix of 2x2 prismatic recessed 2L T8's and can lights with a 250 W quartz lamps along with a smaller quantity of high bay CFL fixtures and LEDs.
    1. Proposed: Lamp for lamp replacement on the 2x2's and a LED replacement for the remainder.
- **Offices** – Current: 4' Fixtures with 2, 3 & 4-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with tubular style LEDs.
- **Bathrooms** – Current: 2' and 4' Fixtures with 2-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with tubular style LEDs.
- **Exterior** – Current: External areas have a variation of HID wall mounted and pole mounted lighting, as well as recessed canopy luminaires.
    1. Proposed: Pole Lights are 150W-250W Metal Halide Fixtures. These will be replaced by 50-70W Pole Mounted LEDs.
    2. Proposed: Wallpacks are 50W-150W HID's. These will be replaced by 11W-37W LEDs.

High School South

- **Classrooms** – Current: 4' Fixtures with 2, 3 or 4 - F32/T8 lamps and a standard ballast. There are HID up-lights as well.

1. Proposed: Lamp for lamp replacement with Tube Light styled 10.5W or 18.5W (in the open classroom areas) 4000K LEDs.
2. Proposed: The HIDs will be replaced with 9000 Lumen, 80W lamp.

- **Hallways** – Current: 2’ & 4' Fixtures with 2-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with tubular LEDs.
- **Gymnasium** – Current: 4' Fixtures with 4 T5HO lamps.
    1. Proposed: Fixture replacement with 18K & 24K Lumen fixture and included wire guard.
- **Aux Gymnasium** – Current: 6 lamp T5HO high bay fixtures.
    1. Proposed: Fixture replacement with 24K Lumen fixture and included wire guard.
- **Wrestling Room & Weight Lifting Rooms** – Current: 4‘ fixtures with 6 lamp T5HO and 9L T8.
    1. Proposed: Fixture replacement with high bay LED and lamp for lamp replacement with tubular LEDs at 10.5 W each.
- **Pool** – Current: 215 W Asymmetric up-light LEDs.
    1. No retrofit; fixtures remain as is.
- **Media Center** – Current: various fixture types including 2x2 Parabolic recessed 2’ U-Type lamps, 4’ 4L with F32WT8, and recessed can lights using 100 W HID.
    1. No retrofit; This area is scheduled to be renovated through the referendum scope of work.
- **Auditorium, Cafeteria** – Current: Mix of xenon 10W decorative in perimeter coves, 250W quartz cans and 60W incandescent lamps for vanities in the dressing rooms.
    1. Proposed: Lamp for lamp replacement for the vanities and the 250 w quartz with dimming capability; xenon lamps will not be replaced.
- **Offices** – Current: 4' Fixtures with 2, 3 & 4-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with tubular style LEDs.
- **Bathrooms** – Current: Primarily 2’ Fixtures with 2-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with tubular style LEDs
- **Exterior** – External Areas have a variety of HID wall mounted and pole mounted lighting, as well as canopy luminaires.
    1. Proposed: Pole Lights are 150W Metal Halide Fixtures. These will be replaced by nominal 50W Pole Mounted LEDs.
    2. Proposed: Wallpacks are 70W-250W HID’s. These will be replaced by 17W-60W LEDs.

Community Middle School

- **Classrooms** – Current lighting setup includes 4' Fixtures with 2-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with Tube Light styled LEDs where the space is not going to be renovated under a separate referendum scope contract.
- **Hallways** – Current lighting setup includes 4' Fixtures with LED’s & 2-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with Tube Light styled LEDs where the space is not going to be renovated under the referendum project
- **Main Gymnasium** - Current lighting setup includes 32W T8 6L high bay.
    1. No Proposed retrofit due to referendum renovation
- **Aux Gymnasium** - Current lighting setup includes 4L F32T8 wrap fixtures.
    1. Proposed retrofit is tubular 10.5W LED lamp for lamp
- **Media Center** – Current lighting setup includes 2’, 3’, & 4' Fixtures with 2-F25 or F32/T8 lamps and a standard ballast.
    1. No Proposed retrofit due to referendum renovation
- **Cafeteria** – Current lighting setup includes 4’ 3L F32T8 and 100 W incandescent can lights

1. Proposed solution is a lamp for lamp replacement with LEDs
- **Offices** – Current lighting setup includes 4' Fixtures with 2 & 3-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with Tube Light styled LEDs where referendum renovation work is not planned
- **Bathrooms** – Current lighting setup includes 4' Fixtures with 2-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with Tube Light styled LEDs
- **Exterior** – External Areas have a variety of HID wall mounted and pole mounted lighting, as well as a series of compact fluorescent surface and recessed canopy luminaires.
    1. All Pole Lights are 175W Metal Halide Fixtures. These will be replaced by Pole Mounted LEDs where referendum work is not planned
    2. Wallpacks are various types of HID and CFL lamps. These will be replaced with LED fixtures where referendum work is not planned

Grover Middle School

- **Classrooms** – Current lighting setup includes 4' Fixtures with 2 & 3-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with Tube Light styled LEDs
- **Hallways** – Current lighting setup includes 4' Fixtures with 2 & 3-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with Tube Light styled LEDs
- **Gymnasium** - Current lighting setup includes 6L high bay 32W T8.
    1. Proposed retrofit is High Bay LEDs
- **Media Center** – Current lighting setup includes 2', 4, 6', 8' fixtures with 2 and up to 6-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with Tube Light styled LEDs
- **Cafeteria** – Current lighting setup includes 2', 4' & 8' F32T8 with 2, 3, & 4 lamps
    1. Proposed solution is a lamp for lamp replacement LEDs
- **Offices** – Current lighting setup includes 4' Fixtures with 3-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with Tube Light styled LEDs
- **Bathrooms** – Current lighting setup includes 4' Fixtures with primarily 2-F32/T8 lamps and a standard ballast.
    1. Proposed solution is a lamp for lamp replacement with Tube Light styled LEDs
- **Exterior** – External Areas have a variation of HID wall mounted and pole mounted lighting, as well as a series of compact fluorescent surface and recessed canopy luminaires.
    1. All Pole Lights are 250W Metal Halide Fixtures. These will be replaced by 10,000 Lumen 72W Pole Mounted LEDs
    2. Wallpacks are variety of wattages and lamp types. These will be replaced by equivalent lumen LEDs

Dutch Neck Elementary School

- **Classrooms** – Current: 4' Fixtures with 2 or 4-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Hallways** – Current: 4' Fixtures with 2 or 4-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Gymnasium** – Current: 4L T5HO high bay fixtures.
    1. Proposed: High bay 18,000 lumen LEDs.
- **Media Center** – Current: 4' Fixtures with 2-F32/T8 lamps and a standard ballast in passageways and prismatic 400W MH in the media center.

1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs in the passageways.
2. No retrofit within the library; Referendum renovation work is planned in this space.

- **Cafeteria** – Current: 3-F32/T8 and some 8' F32/T8.
  1. Proposed solution is a lamp for lamp replacement with LEDs.
- **Offices** – Current: Primarily 4' Fixtures with 2/3/4-F32/T8 lamps and a standard ballast.
  1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Bathrooms** – Current: 4' Fixtures with 2-F32/T8 lamps and a standard ballast.
  1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs where referendum renovation work is not planned.
- **Exterior** – Current: External Areas have a variety of HID wall mounted and pole mounted lighting, as well as a series of compact fluorescent surface and recessed canopy luminaires.
  1. Proposed: All Pole Lights are 250W Metal Halide Fixtures. These will be replaced by 10,000 lumen 72W Pole Mounted LEDs.
  2. Proposed: Wallpacks are a variety of lamp types. These will be replaced by LEDs.

Maurice Hawk Elementary School

- **Classrooms** – Current: 4' & 8'fixtures with 2/3/4-F32/T8 lamps and a standard ballast.
  1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Hallways** – Current: 4' Fixtures with 2 & 4-F32/T8 lamps and a standard ballast.
  1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Gymnasium** – Current: 4L T5HO high bay fixtures.
  1. Proposed: High Bay LEDs with 18,000 lumens and 114W.
- **Media Center** – Current: 4' & 8' Fixtures with 2/4-F32/T8 lamps and a standard ballast.
  1. No retrofit is planned due to referendum renovation.
- **Cafeteria** – Current: 4' 4-F32T8 and T5HO high bay fixtures.
  1. Proposed: Lamp for lamp replacement with 10.5W LEDs.
  2. In the case of T5HO's, no work is planned due to referendum renovation work planned.
- **Offices** – Current: 2', 4', & 8' Fixtures with 2/3/4-F32/T8 lamps and a standard ballast.
  1. Proposed: lamp for lamp replacement with Tube Light styled LEDs with some areas receiving no retrofit due to referendum renovation work.
- **Bathrooms** – Current: 4' Fixtures with 2-F32/T8 lamps and a standard ballast and a majority of LEDs.
  1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs for the 4' fixture.
- **Exterior** – Current: External Areas have a variation of HID wall mounted and pole mounted lighting, as well as a series of compact fluorescent surface and recessed canopy luminaires.
  1. No retrofit; All exterior lights were replaced as part of a district funded project.

Millstone River Elementary School

- **Classrooms** – Current: 4' Fixtures with 2, 3, & 4-F32/T8 lamps and a standard ballast.
  1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Hallways** – Current: 2', 3', 4', & 8' Fixtures with 2/4-F32/T8 lamps and a standard ballast.
  1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Gymnasium** – Current: T5HO 4 lamp fixtures.
  1. Proposed: High Bay, 18,000 lumen, 114 W high bay LEDs.
- **Media Center** – Current: 4' fixtures with 1, 2, or 4-F32/T8 lamps and a standard ballast and a few can lights utilizing 75W incandescent lamps.
  1. No work is planned due to referendum renovation.

- **Auditorium/Stage** – Current: 4L F32T8.
    1. Proposed: Lamp for lamp replacement with LEDs.
- **Offices** – Current: 4' Fixtures with 2/3/4-F32/T8 lamps and a standard ballast.
    1. Proposed lamp for lamp replacement with Tube Light styled LEDs.
- **Bathrooms** – Current: 4' Fixtures with 2-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Exterior** – Current: External Areas are mainly CFL canopy light fixtures, a mix of 32 W and 42 W.
    1. Proposed: Canopy lights will be replaced by 2300 Lumen 22 W fixtures.

Town Center Elementary School

- **Classrooms** – Current: 4' with 2/4-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Hallways** – Current: 8' Fixtures with 4-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement converting to 4' with Tube Light styled LEDs.
- **Gymnasium** – Current: 4L T5HO high bay fixtures.
    1. Proposed: High Bay LEDs with 18,000 lumens and 114W.
- **Media Center** – Current: 4' Fixtures with 3-F32/T8 lamps and a standard ballast.
    1. No retrofit is planned due to referendum renovation.
- **Cafeteria** – Current: 4' 3-F32T8 and 42W CFL can lights.
    1. Proposed: Lamp for lamp replacement with 10.5W LEDs.
    2. Proposed: CFLs will be replaced with a 4,000 lumen 42 W LED.
- **Offices** – Current: 2' & 4' Fixtures with 3-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs with some areas receiving no retrofit due to referendum renovation work.
- **Bathrooms** – Current: 4' Fixtures with 2-F32/T8 lamps and a standard ballast and a majority of LEDs.
    1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs for the 4' fixture.
- **Exterior** – Current: External Areas have a variation of CFL & LED wall mounted and HID pole mounted fixtures. All exterior lights are 20W LED, 26W CFL, & 175W HID.
    1. Proposed: The LEDs will not be replaced, the CFLs will be replaced with 8W LEDs, and the pole mounted fixtures will be replaced with 4,000 lumen, 30W LED.

Village Elementary School

- **Classrooms** – Current: 4' with 3-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Hallways** – Current: 4' & 8' Fixtures with 3/4-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement converting to 4'-converting the 8' to two 4' sections with Tube Light styled LEDs.
- **Gymnasium** – Current: 4L T5HO high bay fixtures.
    1. Proposed: High Bay LEDs with 18,000 lumens and 114W.
- **Media Center** – Current: 4' Fixtures with 3-F32/T8 lamps and a standard ballast.
    1. No retrofit is planned due to referendum renovation.
- **Cafeteria** – Current: 4' 3-F32T8 and 32W CFL can lights and a few quartz flood lights.
    1. Proposed: Lamp for lamp replacement with 10.5W LEDs or in the case of CFL's, a 3,200 lumen 36 W LED; the quartz fixtures will be replaced with a new fixture of 5,600 lumens and 42W.
- **Offices** – Current: 4' Fixtures with 2/3-F32/T8 lamps and a standard ballast.

   1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs with some areas receiving no retrofit due to referendum renovation work.
- **Bathrooms** – Current: 4' Fixtures with 2-F32/T8 lamps and a standard ballast and a majority of LEDs.
   1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs for the 4' fixture.
- **Exterior** – Current: External Areas have a variety of HID, CFL & LED wall mounted and HID pole mounted lighting. Exterior lights are typically 18W LED & 150W HID.
   1. Proposed: The HIDs will be replaced with a LED equivalent and the pole mounted fixtures will be replaced with 10,000 lumen, 72W LED.
   2. Proposed: The poles for the pole lights will be replaced as well due to surface corrosion.

Wicoff Elementary School

- **Classrooms** – Current: 4' with 3-F32/T8 lamps and a standard ballast.
   1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Hallways** – Current: 4' & 8' Fixtures with 3/4-F32/T8 lamps and a standard ballast.
   1. Proposed: Lamp for lamp replacement converting to 4'-converting the 8' to two 4' sections with Tube Light styled LEDs.
- **Gymnasium** – Current: 4L T5HO high bay fixtures.
   1. Proposed: High Bay LEDs with 18,000 lumens and 114W.
- **Media Center** – Current: 4' Fixtures with 3-F32/T8 lamps and a standard ballast.
   1. No retrofit is planned due to referendum renovation.
- **Cafeteria** – Current: 4' 3-F32T8 and 32W CFL can lights and a few quartz flood lights.
   1. Proposed: Lamp for lamp replacement with 10.5W LEDs or in the case of CFLs, a 3,200 lumen 36 W LED; the quartz fixtures will be replaced with a new fixture of 5,600 lumens and 42W.
- **Offices** – Current: 4' Fixtures with 2/3-F32/T8 lamps and a standard ballast.
   1. Proposed Lamp for lamp replacement with Tube Light styled LEDs with some areas receiving no retrofit due to referendum renovation work.
- **Bathrooms** – Current: 4' Fixtures with 2-F32/T8 lamps and a standard ballast and a majority of LEDs.
   1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs for the 4' fixture.
- **Exterior** – Current: External Areas have a variety of HID, CFL & LED wall mounted and HID pole mounted lighting. Exterior lights are typically 18W LED&150W HID.
   1. Proposed: The HIDs will be replaced with a LED equivalent and the pole mounted fixtures will be replaced with 10,000 lumen, 72W LED.

Wicoff Annex (Special Services)

- **Storage Rooms** – Current: Incandescent and CFL Fixtures with 60W and 13W lamps.
   1. Proposed: Retrofit to a 9W LED.
- **Hallways & Common Areas** – Current: 4' 2L-F32/T8 fixtures.
   1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs for the 4' fixture.
- **Kitchen** – Current: 4' 2L-F32/T8 fixtures.
   1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs for the 4' fixture.
- **Offices** – Current lighting setup includes 4' Fixtures with 2-F32/T8 lamps and a standard ballast.
   1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs with some areas receiving no retrofit due to referendum renovation work.
- **Bathrooms** – Current: 4' Fixtures with 2-F32/T8 lamps and a standard ballast and a CFL fixture.
   1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs for the 4' fixture and a LED for the CFL replacement.

- **Exterior** – Current: External Areas have a variety of incandescent and halogen type lamps. Exterior lights are typically 40W, 60W, or 90W.
    1. Proposed: Each fixture will be replaced with 5W, 9W, or 14W LEDs respectively.

Maintenance Building

- **Garage Bays** – Current: 4’ & 8’ wrap and industrial fixtures.
    1. Proposed: Retrofit to a Tube Light styled LEDs for the 4’ fixture and converting the 8’ to two 4’.
- **Offices** – Current: 2’ & 4' Fixtures with 2-F32/T8 lamps and a standard ballast.
    1. Proposed: Lamp for lamp replacement with Tube Light styled LEDs.
- **Exterior** – Current: External Areas have a variety of CFL & HID type lamps. Exterior lights are range from a 42W CFL to a 250W MH.
    1. Proposed: These fixtures will be replaced with LED fixtures to match the lumen output.

For a complete lighting scope of work, please visit the lighting line by line in the Appendix.

Occupancy Sensors

As a result of the varying occupancy load within building spaces, many of the lighting systems operate when no occupants are present. The lack of lighting control results in additional electrical energy consumption and greater burden on space cooling systems. The opportunity to reduce lighting hours of operation while maintaining continuity of service can be achieved through automated lighting controls.

Occupancy sensors are effective in controlling lighting operation in areas with variable occupancy, such as conference rooms and meeting areas, restrooms, corridors, private offices, large open offices, etc. Energy savings are obtained by turning lights off when occupants are not present within the space for a prolonged period of time.

Selecting the appropriate sensor technology, such as ceiling or wall-mounted and single or dual technology occupancy sensors, depends on the specific application. Passive infrared detection works to turn on the light fixtures when motion is detected (using infrared detectors). Dual technology detection turns on the lights when either motion or sound is detected (using a combination of infrared and micro-sonic detectors). The use of dual technology would limit the number of nuisance switching in spaces such as restrooms.

Figure 1. Typical Occupancy Sensors

Occupancy sensors are mounted to easily determine when an individual is either in or out of a space to control lighting.

The following is the total scope of work for occupancy sensors. For more detail, please see the lighting line-by-line in the Appendix.

Abbreviation	Description	Quantity
TBR	Controls installed as part of Renovation	375
PL	Controlled by Previous Line	0
WS	New wall switch occupancy sensor	406
WS2P	New wall switch occupancy sensor, 2 Pole	19
WCM	New ceiling mounted occupancy sensor, wireless	267
WCM2	New ceiling mounted occupancy sensor, wireless, (2) Power Packs	18
WWM	New wall mounted occupancy sensor, wireless	77
WWM2	New wall mounted occupancy sensor, wireless, (2) Power Packs	359
WWM3	New wall mounted occupancy sensor, wireless, (3) Power Packs	52
WWM4	New wall mounted occupancy sensor, wireless, (4) Power Packs	62
2WWM2	(2) New wall mounted occupancy sensor, wireless, (2) Power Packs	24
2WWM3	(2) New wall mounted occupancy sensor, wireless, (3) Power Packs	3

2. Air Sealing Improvements

Overview

This ECM addresses the shell of the building and how well it is keeping conditioned air in and ambient air out. Our onsite testing and analysis of energy consumption indicate there is an opportunity to improve the indoor air quality, occupant comfort, and energy use by upgrading the existing air barrier systems. A tighter Building Envelope will provide the following advantages:

- 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 set point of the conditioned space. 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 “runtime” will increase the operating life of the heating and cooling equipment and increase the performance of new equipment.

Scope

The following is a breakout of the Building Envelope scope by facility:

	HSN	HSS	CMS	GMS	DNES	MHES	MRES	TCES	VES	WES	SS	Maint.	Total
AC Unit Weatherization (Units)												1	**1**
Attic Bypass Air Sealing (SF)												1,350	**1,350**
Attic Flat Insulation (SF)										5,548		1,350	**6,898**
Basement Air Sealing (LF)											147		**147**
Caulking (LF)	3,092		48			85		560					**3,785**
Door Weather Striping - Doubles (Units)	42	39	16	17	10	5	21	19	22	8	1		**200**
Door Weather Stripping - Singles (Units)	8	25	16	12	11	12	8	6	6	5	1	3	**113**
Door Weather Stripping (Units)											1		**1**
Insulation Soffit Baffles (UT)												75	**75**
Overhang Air Sealing (LF)				40									**40**
Overhang Air Sealing (SF)		124				24							**148**
Overhead Door Weather Stripping (Units)												3	**3**
Retrofit Attic Hatch (Units)										1			**1**
Retrofit Pull Down Stairs (Units)												1	**1**
Roll-Up Door Weather Stripping (Units)	2					2							**4**
Roof-Wall Intersection Air Sealing (LF)		1,081	1,824	1,921	40	200	2,192	900	877	74			**9,109**

3. Variable Speed Drives

Overview

Fixed speed fans and pumps supply almost full horsepower and consume nearly maximum energy at all times during operation, regardless of demand. Variable frequency drives (VFDs) regulate the voltage and frequency supply to a motor to allow pumps and fans to modulate their output. By reducing the speed of a motor when temperature or flow requirements are satisfied, dramatic amounts of energy can be saved. Due to the cubic relationship between speed and power, even a 20% reduction in speed can equate to a 50% reduction in the power consumed by a motor. The main selection criteria for VFD applications are the size of the motor, the annual run time, and the amount of mechanical work necessary to take advantage of the variable flow operation afforded by VFDs.

Some of the best opportunities to use VFDs are to control fans in a variable air volume (VAV) application or to control hot or chilled water pumps for pressure control in a variable flow application. In air handlers serving multiple zones, duct and coil modifications may be necessary to maintain proper flows and air temperatures in each zone when converting fixed speed fans to VFD control. In hot water and chilled water systems, piping modifications may be necessary to maintain sufficient pressure at end devices and to maintain minimum flows through equipment when VFDs are used. In either application, VFDs will allow air and water flows to be varied to match the actual loads while saving energy.

Figure 2. Typical Variable Speed Drive

VFDs or variable speed drives come in a variety of motor sizes and applications. These Altivar S-Flex drives by Schneider Electric range in size from 1 horsepower (HP) to 100 HP.

VFDs also provide the benefit of a ‘soft start’ when powering a motor. Without a ‘soft start’, the motor puts out the maximum amount of available torque immediately upon start-up. Particularly in motors that are cycled often, ramping quickly from idle to full torque can be destructive to a motor’s load. Simultaneously, the resulting in-rush current can cause dips in system voltage or even an electrical demand peak in the case of a very large motor or several motors becoming engaged at the same time. A variable frequency drive will gradually increase the speed of a motor at startup to avoid abrupt changes in torque output and to preserve the integrity of the facility’s electrical system’s power quality.

The following highlights the key benefits of this solution:

- *Reduce Energy Costs* – Motor energy is saved through frequency regulation.
- *Advanced Control Strategies* – VFDs allow for energy saving strategies to be implemented in the provision of building heating, cooling, and ventilation.
- *Improve Building Comfort* – Modulation of air and water flow allows for better temperature control, improving occupant comfort.
- *Prolong Equipment Life* – Soft start capabilities reduce wear and damage to motor components, extending useful equipment life.
- *Minimize Demand Peaks* – Ramping of electric systems avoids demand spikes.

Scope

The following list of motors will receive new VFDs that will be incorporated into the new building automation system for variable speed operation:

- High School South – two (2) new 30 HP chilled water pumps
- High School South – two (2) existing 10 HP hot water pumps
- Community Middle School – two (2) 20 HP rooftop unit supply fans
- Community Middle School – two (2) 7.5 HP rooftop unit return fans
- Dutch Neck Elementary School – two (2) existing 7.5 HP hot water pumps
- Town Center Elementary School – two (2) existing 7.5 HP chilled water pumps
- Town Center Elementary School – two (2) existing 15 HP chilled water pumps
- Town Center Elementary School – two (2) existing 15 HP hot water pumps

4. Kitchen Hood Control

Overview

Kitchen exhaust fans pull unwanted, contaminated air out of the kitchen during cooking operations. When there is no cooking, exhaust fans may continue to run if proper control systems are not in place. Manually operated switches rely on staff to turn off and on as needed. Fans may be inadvertently left on over nights or weekends, allowing conditioned air to be exhausted.

By adding the kitchen exhaust hood fan to the building automation system, the kitchen exhaust hood operation can be better managed. A schedule can be implemented to control the run hours of the fan and prevent excessive operation.

Figure 3. Locking Out Kitchen Exhaust Saves Energy

Operating kitchen exhaust only when needed results in significant energy and demand savings at night and on weekends.

The following highlights the key benefits of this solution:

- *Reduce Energy Costs* – Energy will be saved by preventing excess hood operation over nights and weekends.
- *Straightforward* – The schedule will automate the operation of the exhaust hood.

Scope

The existing kitchen exhaust hood at each of the following schools will be added to the new building automation system:

- High School North
- High School South
- Community Middle School
- Grover Middle School
- Dutch Neck Elementary School
- Maurice Hawk Elementary School
- Millstone River Elementary School
- Town Center Elementary School
- Village Elementary School

5. Whole School Metering

Overview

An advanced sub-metering solution is one capable of measuring and recording interval data and communicating the data for integration into the existing building automation system (BAS). The BAS collects the time-differentiated data from numerous meters providing access to usage information and additional features and functionalities related to energy management, procurement, and operations.

This measure involves the turn-key installation of advanced utility metering for the whole building's energy consumption. The new sub-meters will be installed directly in line with the existing applicable utility feeds and interface with the new control systems for integration.

- **Electric** – We propose to install advanced meters on incoming electrical feeds to the buildings to measure electrical energy demand and consumption at the building level.

Figure 4. Sample Screens from Schneider Electric's StruxureWare™

Schneider Electric's StruxureWare™ software as part of a BAS shows continuous, wide-are monitoring, data capture and reporting for power quality and reliability conditions, utility use and energy management.

It is important to understand where the energy usage in the facility goes. Although not directly contributing to savings, this data will enable the energy managers to react to changing energy usage. Specific benefits of installing an advanced electrical metering system include:

- The ability to view real time energy data via the Building Automation System.
  - Electric: power demand in real kilowatts (kW), reactive power (kilovolt-amps reactive or kVAR), or apparent power (kVA) terms; accumulated energy consumption in real kilowatt-hours (kWh), reactive (kVARh), and apparent (kVAh) terms.
- On-board data logging to provide redundancy for a limited number of selected variables in the event of lost communication or power failure.
- Alarming capabilities including phase-loss alarm output.

Scope

A new electric sub-meter will be installed at the main distribution panel for Village Elementary School.

6. School Addition Metering

Overview

The overview of this solution is the same as the whole building metering solution described above, except for this application applies only to new school addition sub-meters. This scope is included as a requirement under the Pay for Performance (P4P) program and will assist in measuring and verifying savings from the ESIP project.

Scope

A new advanced electric sub-meter will be installed at the main distribution panel for each of the new additions at the following schools:

- High School South
- Community Middle School
- Maurice Hawk Elementary School
- Town Center Elementary School

7. Water Fixture Improvements

Overview

The school buildings utilize diaphragm flush valves on the water closets. Most of these valves are designed to flush at least 1.6 with about 1/3 of the total water closets flushing 3.5 gallons per flush (GPF). Urinals are mostly 1 GPF. As a result of Federal Laws enacted in 1996, water closet manufacturers redesigned their china to effectively complete the flush process with 1.6 gallons. This scope includes replacement of the handle assembly and vacuum breaker assembly for both water closets and urinals. In many instances, this measure will result in a savings per flush of over 30 percent.

Lavatory and general use sinks will have a vandal resistant flow control device installed for the appropriate flow rate and pattern along with any required adaptors.

Building	Lavatory Sinks	General Use Sinks	Tank Toilets	Pressure Assist Toilets	Flushometer Toilets	Urinals	Wall Showers	Handheld Showers
High School North	142	7	-	-	125	47	63	12
High School South	91	13	2	-	89	30	62	3
Community MS	59	18	9	-	64	21	12	-
Grover MS	49	55	-	-	65	9	14	-
Dutch Neck ES	39	40	14	1	27	8	-	-
Maurice Hawk ES	27	45	6	-	27	10	-	-
Millstone River (3,4,5)	51	56	-	-	68	16	10	2
Town Center ES	51	34	-	-	53	8	-	-
Village (3,4,5) & Board Office	73	48	-	-	77	15	-	-
Wicoff ES	24	22	-	-	24	5	-	-
Wicoff Annex - Special Services	2	1	-	2	-	-	-	-
Maintenance Bldg	1	2	2	-	-	-	-	-
Total	609	341	33	3	619	169	161	17

Scope

The following water conservation scope will be installed:

Building or Meter	Flushometer Fixtures						Tank Toilets			Sinks		
	Valve Recommissioning	Valve Rebuilding	Valve Replacement	Spud & Flushtube Replacement	Control Stop Modify/Replace	Handle-Mount Hands-Free	System Tuning	Retrofit Upgrade	Convert & Retrofit Upgrade	Vandal Resistant Flow Control	Manual Faucet	Hands-Free Faucet
High School North	-	-	172	111	-	-	-	-	-	149	-	-
High School South	21	-	98	60	-	-	-	2	-	92	-	-
Community MS	-	-	85	48	-	-	1	8	-	77	-	-
Grover MS	-	-	74	49	24	-	-	-	-	104	-	-
Dutch Neck ES	-	-	35	21	-	-	2	12	-	77	-	-
Maurice Hawk ES	-	-	37	21	-	-	1	5	-	68	-	-
Millstone River (3,4,5)	-	-	84	42	-	-	-	-	-	107	-	-
Town Center ES	6	55	-	14	-	-	-	-	-	85	-	-
Village (3,4,5) & Board Office	28	-	57	33	-	-	-	-	-	121	-	-
Wicoff ES	-	-	29	20	-	-	-	-	-	45	-	-
Wicoff Annex - Special Services	-	-	-	-	-	-	-	-	-	3	-	-
Maintenance Bldg	-	-	-	-	-	-	1	1	-	3	-	-
Total	**55**	**55**	**671**	**419**	**24**	**0**	**5**	**28**	**0**	**931**	**0**	**0**

8. Walk-in Refrigeration Controls

Overview

The walk-in coolers and freezers utilize an indoor evaporator, outdoor condensing unit, and electric door heaters to maintain the cooler and freezer temperatures and the door surface temperatures to avoid condensation and ice formation. This measure will install efficient Electronically Commutated Motors (ECM) on the indoor evaporator fans to replace the permanent split capacitor (PSC) motor. The ECM motor can maintain an efficiency of 65-75% versus a PSC motor of 12-45% efficiency. The electric door heaters currently are "on" all the time. This measure will also install a controller that measures the ambient temperature and relative humidity. It performs internal calculations to pulse the electrical power to the heaters such that the surfaces are kept above the temperature where moisture will form on the cooler and freezer door jambs and surrounding surfaces.

Scope

High School North

2 Cooltrol® zones will provide savings by controlling the temperature, evaporator fans and door heaters on the entry doors of a walk-in cooler and freezer.1-Door Freezer will be controlled. One (1) electric defrost will be intelligently controlled. In addition, the motors will also be replaced with EC motors (5 motors total).

High School South

2 Cooltrol® zones will provide savings by controlling the temperature, evaporator fans and door heaters on the entry doors of a walk-in cooler and freezer.1-Door Freezer will be controlled. In addition, the motors will also be replaced with EC motors (5 motors total).

Community Middle School

2 Cooltrol® zones will provide savings by controlling the temperature, evaporator fans and door heaters on the entry doors of a walk-in cooler and freezer.

Grover Middle School

2 Cooltrol® zones will provide savings by controlling the temperature, evaporator fans and door heaters on the entry doors of a walk-in cooler and freezer.1-Door Freezer and 1 door cooler will be controlled. One (1) electric defrost will be intelligently controlled. In addition, the motors will also be replaced with EC motors (6 motors total).

Dutch Neck Elementary Middle School

1 Cooltrol® zones will provide savings by controlling the temperature, evaporator fans and door heaters on the entry doors of a walk-in cooler and freezer.1-Door Freezer will be controlled. This controller can be re-used when the District replaces this freezer.

Maurice Hawk Elementary School

1 Cooltrol® zones will provide savings by controlling the temperature, evaporator fans and door heaters on the entry doors of a walk-in freezer.1-Door Freezer will be controlled. One (1) electric defrost will be intelligently controlled. In addition, the motors will also be replaced with EC motors (2 motors total).

Town Center Elementary School

2 Cooltrol® zones will provide savings by controlling the temperature, evaporator fans and door heaters on the entry doors of a walk-in cooler and freezer.1-Door Freezer and 1 door cooler will be controlled. One (1) electric defrost will be intelligently controlled. In addition, the motors will also be replaced with EC motors (3 motors total).

Village Elementary School

2 Cooltrol® zones will provide savings by controlling the temperature, evaporator fans and door heaters on the entry doors of a walk-in cooler and freezer.1-Door Freezer and 1 door cooler will be controlled. One (1) electric defrost will be intelligently controlled. In addition, the motors will also be replaced with EC motors (3 motors total).

9. Pipe Insulation

Overview

This ECM addresses the mechanical systems within the mechanical room and how well it is keeping the hot water hot and the chilled water cold. Our onsite testing and analysis of energy consumption indicate there is an opportunity to improve the mechanical insulation effectiveness and energy use by insulating sections of piping, valves, pipe specialties, storage tanks, and air separators. More effective insulation systems will provide the following advantages:

- Decreased Contact with Hot Surface - Inadvertent contact with hot mechanical surfaces will be reduced through reduced surface temperature.
- Decreased Energy Consumption – Insulation allows the heating or cooling water to reach the terminal unit HVAC equipment at design temperature thus allowing higher performance. This will decrease the energy consumed and save on energy costs.
- Reduced Maintenance Costs – Reducing the “runtime” will increase the operating life of the heating and cooling equipment and increase the performance of new equipment.

Scope

The following is a breakout of the Mechanical Systems Insulation scope by facility:

Scope	HSN	HSS	CMS	DNES	MHES	MRES	TCES	VES	WES	Total
Balance Valve Insulation (Units)								2		**2**
Ball Valve Insulation (Units)			9					1		**10**
Bonnet Insulation (Units)			12					4		**16**
Butterfly Valve Insulation (Units)		19			4		4			**27**
Check Valve Insulation (Units)							2			**2**
Control Valve Insulation (Units)		1					1	1		**3**
End Cap Insulation (Units)		1	3		5		1			**10**
Flange Insulation (Units)	28	68	43	14	24	16	32	16	19	**260**
Flex Fitting Insulation (UT)	8	6	6	2	4	2	6		6	**40**
Flo-Check Insulation (Units)		8	2							**10**
Gate Valve Insulation (Units)		10	12		3	2				**27**
Pipe Fitting Insulation (Units)	23	6	19			4	3	1		**56**
Pump Insulation (Units)	6	4	6	8	2	3	4	2	4	**39**
Straight Pipe Insulation (LF)	49	3	147			12				**211**
Strainer Insulation (Units)	4	4	1	4	5	2	2	2	4	**28**
Suction Diffuser Insulation (Units)	4	2	5	4	2	2	2		3	**24**
Tank Insulation (Units)		1	1	2	1		1	1		**7**

10. High Efficiency Transformers

Overview

This measure replaces existing secondary transformers with new high efficiency transformers. With the age and condition of many of the electrical transformers, replacement with new equipment is recommended for efficiency improvement as well as reliability and safety. New transformers have lower losses across the transformer core.

Secondary transformers reduce voltage from distribution level, to building level voltage (normally from 480V to 120/208V) to maintain power in the facility. These transformers operate continuously; therefore, utilizing new, high efficiency transformers results in long term, steady energy savings.

Scope

A transformer survey was performed during the investment grade audit and an inventory of existing equipment was compiled. Savings were calculated based on replacing this equipment with higher efficiency transformers.

Figure 5. High Efficiency Transformer

kVA	Existing Quantity	Replacement Quantity
HS North		
15	1	1
30	2	1
75	4	4
150	1	1
HS South		
30	4	4
45	3	2
50	1	1
75	6	5
112.5	3	3
150	2	2
Community MS		
15	3	3
30	1	1
45	7	5
75	2	2
150	1	1
Grover MS		
30	3	3
45	4	4
75	7	6
112.5	1	1
150	6	3
Dutch Neck ES		
75	1	1
Maurice Hawk ES		
45	1	1
Millstone River ES		
25	1	1
45	1	1
50	1	1
75	2	2
112.5	2	2
Town Center ES		
30	3	3
75	2	2
112.5	3	3
150	1	1
Village School		
30	1	1
45	2	2
75	2	2
150	1	1

11. Solar Power Purchase Agreement (PPA)

Overview

This measure will involve the installation of solar panels at each of the schools, delivered through a solar power purchase agreement (PPA). The PPA will allow the District to produce renewable energy on-site with no upfront cost. The PPA will provide a rate change, and these savings will be utilized inside the ESIP to help fund other scope.

Scope

Pfister Energy (Engineer, Procure, and Construct contractor or EPC) and Greenskies (Financier/PPA provider) submitted a joint proposal to the District's request for proposals (RFP) on July 26, 2019. On August 27, 2019, the Pfister/Greenskies team was were selected by the West Windsor-Plainsboro Regional School District as the successful RFP respondent. Below are the projected PV system sizes at each of the schools.

School	Post ESIP Baseline (kWh)	Post Project $ Cost	PV System Size (kW)	Expected PV Output (kWh)	% of Post ESIP Baseline	Post Project Cost for PV Output ($)	Marginal Rate (kWh charges only)	Solar PPA Savings ($)
HS North	2,621,367	$338,262	1,200.00	1,443,554	55%	$98,872	$ 0.068	**$ 98,251**
HS South	2,218,817	$268,016	513.93	629,004	28%	$67,842	$ 0.108	**$ 47,568**
Grover MS	1,389,576	$165,082	759.98	911,698	66%	$85,362	$ 0.094	**$ 59,378**
Dutch Neck ES	558,346	$79,827	104.34	128,600	23%	$14,675	$ 0.114	**$ 9,725**
Maurice Hawk ES	635,361	$81,666	471.00	557,080	88%	$42,225	$ 0.076	**$ 16,536**
Millstone River ES	1,416,332	$183,230	345.58	429,466	30%	$40,282	$ 0.094	**$ 32,478**
Village ES	1,241,874	$145,261	483.59	581,136	47%	$49,871	$ 0.086	**$ 39,498**
Wicoff ES	465,874	$69,093	78.00	92,699	20%	$12,415	$ 0.134	**$ 7,939**
Total	**10,547,546**	**1,330,436**	**3,956.42**	**4,773,238**	**45%**	**411,545**	**$ 0.086**	**311,373**

Savings estimates are calculated by subtracting the PPA rate ($0.032/kWh) from each school's individual rate (roughly $0.10/kWh). This includes kWh charges only; demand savings (kW) have not been calculated.

In addition to facilitating the PPA RFP, Schneider Electric has submitted utility interconnection agreements to the applicable utilities, PSEG and JCP&L.

The following PV locations are not currently included in the Energy Savings Plan savings calculations but may be added to the PPA to provide additional savings.

School	Post ESIP Baseline (kWh)	Post Project $ Cost	PV System Size (kW)	Expected PV Output (kWh)	% of Post ESIP Baseline	Post Project Cost for PV Output ($)	Solar PPA Costs ($)	Marginal Rate (kWh charges only)	Solar PPA Savings ($)
Town Center ES	614,389	$83,911	450.66	541,722	88%	$ 58,302	$ 17,335	$ 0.108	$40,967
HS North - Ground	2,621,367	$338,262	706.32	921,041	70%	$ 99,126	$ 29,473	$ 0.108	$69,653
Village ES - Ground	1,241,874	$145,261	375.84	490,095	80%	$ 48,993	$ 15,683	$ 0.100	$33,310
Total			**1,532.82**	**1,952,859**		**$ 206,422**	**$ 62,491**		**$ 143,930**

12. Pay for Performance (P4P) Incentives

Overview

As described in Section 2.4 of this report, Schneider Electric will secure Pay for Performance Incentives for the following WW-P facilities:

- High School North
- High School South
- Community Middle School
- Maurice Hawk Elementary School
- Village Elementary School

Concurrently to this ESIP project, WW-P is undertaking a $115 M referendum which includes comprehensive upgrades to Heating, Ventilation, and Air Conditioning (HVAC) Equipment and Building Automation Systems (BAS) at High School North, Millstone River Elementary School, and Wicoff Elementary School. Based upon the HVAC/BAS scope performed under the referendum at Millstone River, that school may also qualify for P4P.

Scope

The scope of this ECM is to secure an approved Energy Reduction Plan (ERP) under the P4P program for each of the schools listed above. By combining both ESIP scope and referendum scope under a single ERP, WW-P is able to maximize incentives for upgrades taking place within the schools. Schneider Electric has estimated savings within this ESP for the HVAC/BAS upgrades for High School North and Millstone River Elementary School. The savings at High School North incorporate an outside air adjustment, to take into account the energy penalty associated with increased outside air required by the new systems which will be installed.

13. HVAC System Evaluation

Overview

Retro-commissioning (RCx) in existing buildings is a common energy savings strategy to restore the original intended operating performance and optimize the existing systems that are to remain in the facility. Equipment performance and control sequences naturally degrade over time, and sub-standard performance or even failures of systems and components go unrecognized. The ultimate result is almost universal waste of various kinds, including substantial energy and maintenance cost.

Scope

As part of the Investment Grade Audit (IGA), Schneider Electric performed a detailed HVAC equipment evaluation or point-to-point checkout. The purpose of this evaluation was to identify operations and maintenance issues, comfort issues, and other opportunities which may be rectified via operational or maintenance changes, as opposed to major capital upgrades. This effort was also used to help develop scope for the ESIP program. A copy of this Evaluation can be found in the Appendix of this Report.

14. Combined Heat and Power (CHP)

Overview

Indoor pools provide a benefit to the District and community while consuming a great deal of energy. The High School South Natatorium has a dedicated boiler for maintaining pool water temperature and a dedicated Rooftop unit for removing humidity and reheating the air. The pool unit operates twenty-four hours a day all year long.

Scope

We propose to provide a combined heat and power (CHP) system, to generate power and capture the byproduct heat to use in the pool. A single 35 kW natural gas engine generator will feed power back to the pool area. The installation of a dedicated water loop between the engine and a new pool heat exchanger will provide pool water heating in both winter and summer and an additional level of redundancy.

This CHP system is approximately 88% efficient based on the ratio of input energy to used output energy. As a reference, electricity generated at power plants is typically less than 40% efficient.

15. Building Automation System (BAS) Upgrade

Overview

Updating a control system can greatly increase the efficiency of a building. A Building Automation System (BAS) allows building operators to control equipment from a central location. Individuals will have the ability to identify and diagnose equipment issues without ever having to leave the office. A centralized, building automation system installation will include a combination of the following:

- Installing new direct digital controls (DDC), where applicable,
- Incorporating existing DDC points, and
- Extending DDC to existing pneumatic controls.

With a microprocessor based direct digital control (DDC) system there are many opportunities to optimize building systems without sacrificing occupant comfort or safety. The BAS will allow energy managers to better control their energy use and consumption through the following control and reporting features including:

- Set point control and monitoring,
- Scheduling of equipment,
- Identification and verification of issues with equipment,
- Implementation of advanced control sequences, and
- Trending and reporting features.

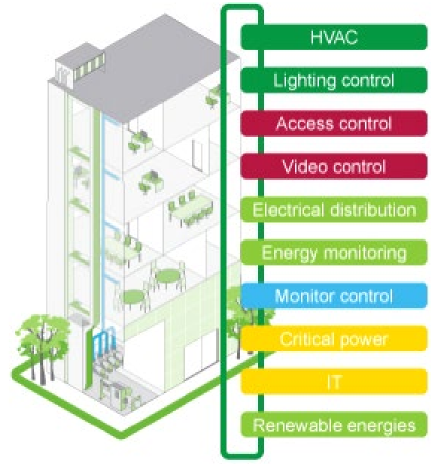


Figure 6. Building Automation System (BAS)

A BAS with new and integrated Direct Digital Controls and graphics equipped user interface workstations allows building personnel to better manage and control energy use.

All direct digital controls will be seamlessly integrated within the overarching BAS. The BAS will facilitate communications between the various systems and provide for a full featured graphical user interface accessible through a PC workstation or remotely via the internet. Through this interface, the facility staff will be able to view all spaces and systems for monitoring and troubleshooting purposes. Floor plan views for each facility will provide a live snapshot of conditions within each space including the current room temperatures, set points and effective occupancy. Detailed equipment graphics pages will display the status and configuration of mechanical equipment operated by DDC systems and all control points on the system will be accessible. Global and individual scheduling will be provided for all systems and all control points can be set up for instantaneous monitoring, trending, or alarming as required.

The following highlights the key benefits of this solution:

- *Reduce Energy Costs* – Control strategies use energy more effectively.
- *Improve Occupant Comfort* – New, calibrated system provide better temperature control.
- *Better Visibility* – Graphics, remote monitoring, and alarms help identify and prevent issues.
- *Enhance System Performance* – EMS will allow for new control strategies to be implemented.
- *Extends Equipment Life* – With reduced run times, equipment wear and tear will be lessened.
- *Reduce Maintenance Costs* – New, standardized control system will require less maintenance and replacement parts are more readily available.

Scope

The following section outlines the existing HVAC systems that will be incorporated into the new BAS. Any new HVAC equipment, meters, or other devices that will be incorporated into the new BAS are outlined in their associated ECM description.

High School South – The existing pneumatic and Novar controls associated with the following existing HVAC equipment will be replaced:

- Thirteen (13) unit ventilators (hot water)
- Twenty-five (25) fan coil units (hot water)
- Four (4) air handling units (DX/hot water)
- One (1) air handling unit (hot water)
- Eight (8) rooftop units (DX/hot water)
- Three (3) rooftop units (DX/Gas Heat)
- Nine (9) ductless mini-splits
- Eight (8) boilers
- Two (2) constant volume hot water pumps
- Three (3) variable volume hot water pumps
- Two (2) chillers
- Three (3) chiller pumps

Additionally, the three (3) existing Trane rooftop unit OEM controllers associated with the Theater and Aux Gym will be integrated into the BAS.

Community Middle School – The existing Novar controls associated with the following existing HVAC equipment will be replaced:

- One (1) rooftop unit
- Forty (40) VAV boxes
- Four (4) unit ventilators (hot water only)
- Twenty-four (24) PTAC's
- Six (6) boilers
- Five (5) hot water pumps

Additionally, the existing JCI controllers associated with the following equipment will be integrated into the BAS:

- Nine (9) VAV air handling units
- One hundred and five (105) VAV boxes
- Two (2) unit ventilators

Grover Middle School – The existing Siemens controllers associated with the following equipment will be integrated into the BAS:

- One hundred and forty-one (141) water source heat pumps
- Sixteen (16) energy recovery units

- Four (4) make-up air units
- Five (5) rooftop units

Dutch Neck Elementary School – The existing controls associated with the following existing HVAC equipment will be replaced:

- Two (2) unit ventilators (4-pipe only)
- One (1) fan coil unit (4-pipe only)
- One (1) heating and ventilation unit (hot water only)
- One (1) cafeteria AHU
- Four (4) boilers
- Four (4) hot water pumps
- One (1) chiller
- One (1) chilled water pump
- One (1) cooling tower
- One (1) condenser water pump

Additionally, the twenty (24) existing VRF units serving the Admin Area, 100 Wing, and 200 Wing will be integrated into the BAS.

Maurice Hawk Elementary School – The JCI and Daikin controls associated with the recent capital improvement project will be integrated into the BAS. The associated HVAC equipment includes:

- Forty-eight (48) VAV boxes (cooling only)
- Two (2) VAV boxes
- One (1) air handling unit
- Three (3) energy recovery units
- One (1) rooftop unit
- Two (2) electric unit heaters
- Four (4) cabinet unit heaters
- Three (3) exhaust fans
- Two (2) split system AC units
- Fifty (50) VRF units

Town Center Elementary School – The existing standalone thermostats and Novar controls associated with the following existing HVAC equipment will be replaced:

- Forty-seven (47) unit ventilators (4-pipe)
- Eleven (11) air handling units (4-pipe)
- Four (4) ductless mini-splits
- Two (2) boilers
- Two (2) hot water pumps
- One (1) chiller
- Four (4) chilled water pumps

- One (1) cooling tower
- Two (2) condenser water pumps

Additionally, the JCI and Daikin controls associated with the recent capital improvement project will be integrated into the BAS. The associated HVAC equipment includes:

- One (1) energy recovery unit
- Eighteen (18) Split System Heat Recovery Units
- Sixteen (16) VAV boxes
- One (1) exhaust fan

Village Elementary School – The existing Novar controls associated with the following existing HVAC equipment will be replaced:

- Fifty-eight (58) unit ventilators (2-pipe)
- Three (3) air handling units (4-pipe)
- One (1) energy recovery unit (4-pipe)
- One (1) VAV air handling unit (4-pipe)
- Twelve (12) VAV boxes
- Two (2) boilers
- Two (2) hot water pumps
- Two (2) dual temp pumps
- One (1) chiller
- One (1) chilled water pump
- One (1) chilled water/condenser water standby pump
- One (1) cooling tower
- One (1) condenser water pump

16. HVAC Upgrades

HVAC: High School South

Overview

High School South consists of multiple additions and renovations since the main building was built in circa 1972. The main building consists of two air cooled chillers and multiple condensing gas fired boilers utilizing a dual temp system for heating and cooling. The Science Wing, built in circa 1998, has its own central plant consisting of two gas fired boilers and one air cooled chiller. The building is zoned for different uses as follows:

Figure 7. Open Classroom with Unit Ventilator Grilles

1. Open classroom – HVAC system consists of dual temp unit ventilators with outside air connected to each unit ventilator. Controls are pneumatic.
2. 1995 Section classrooms – There are six floor mounted unit ventilators using hot water for heating and self-contained DX for cooling.
3. Original gym – HVAC system consists of two floor mounted air handling units utilizing the dual temp system. Controls are pneumatic.
4. Science Wing – HVAC System consists of 4-pipe unit ventilators with pneumatic controls. The boilers are Cleaver Brooks firetubes. The chiller is a Carrier split with two circuits, two air cooled condensers on the roof, and the evaporator and compressors in the boiler room. A Siemens controller monitors and provides alarming capability of the boilers.

Scope

For the overall system, we propose staying with the dual temp system, replacing the unit ventilators but capping the outside air connection. Outside air would instead be provided by a DX cooling/hot water heating Dedicated Outdoor Air System (DOAS) rooftop unit to condition the outside air to reduce the likelihood of higher than desired humidity levels. Outside air from the DOAS units will be ducted to the return air duct of each unit ventilator to ensure adequate outside air is provided to each space. The air-cooled chillers serving the main building would be replaced since they are circa 2005 and have begun to have component failures. Piping is original to the building construction which means it is close to 50 years old. The intent is to replace this piping to reduce the potential for age-related failure.

The 1995 addition unit ventilators will be replaced and remain connected to the main building hot water system and maintain the independence from the main building chilled water system. This will allow the varied usage times they are accustomed to apart from the main chilled water plant.

The Science Wing unit ventilators will be replaced with new units utilizing ECM motors and DDC controls.

For the Main gymnasium, we propose removing (2) AHUs and replacing them with (2) new AHUs utilizing demand-controlled ventilation and reusing the duct distribution system. In the central Lobby, we propose replacing the AHUs with new AHUs.

HVAC: Dutch Neck Elementary School

Overview

Dutch Neck Elementary School consists of multiple additions and renovations since the original building was built in circa 1900. The HVAC system serving the original building consists of an LG Variable Refrigerant Flow (VRF) system in the 100 & 200 wings. Classroom areas have a variety of HVAC systems ranging from 2-pipe and 4-pipe unit ventilators, self-contained vertical units in the 300 wing, packaged terminal air conditioning (PTAC) units in one section of the 400 wing, and hot water unit ventilators with window AC units in another section of the 400 wing. The 100 & 200 classroom sections have rooftop mounted energy recovery system providing tempered outside air to the spaces.

The multi-purpose room has two split-system air conditioning units with integral hot water coils. The Media Center has a dedicated packaged rooftop unit. The boiler and chiller plant are relatively new, utilizing Aerco condensing gas fired boilers and a water-cooled chiller with the cooling tower on the roof. The building is zoned in line with the HVAC system types as noted above.

Scope

We propose a system design maintaining use of the relatively new Aerco boilers and Carrier water-cooled chiller. Our scope will expand the use of the chilled water plant within its capacity limits by adding in Classrooms 15 - 23 along the North side of the corridor. Classrooms in the 300 wing will receive replacements for the Airedale units. Classrooms in the two 400 wings will receive new unit ventilators with split system DX coils and will reconnect to the hot water system where it is currently; The hot water system will be extended to new unit ventilators that will be installed in the section that has PTAC units. Hot water piping will be re-used. The rooftop mounted energy recovery units will be re-commissioned to ensure proper operation.

The LG system will remain and be tied into the BAS system.

The multi-purpose room will have new split system systems installed and tied into the BAS. Hot water will be reconnected to the air handling units.

The Media Center rooftop unit is planned to be replaced under a future school-funded project.

Figure 8. Rooftop ERV

HVAC: Community Middle School

Overview

The Community Middle School HVAC system is largely being replaced under a current referendum project or has been upgraded in recent years. However, the 700/800 section rooftop units are not being replaced. This section was engineered in 1994. It consists of hot water terminal units and rooftop VAV units using inlet guide vanes for VAV functionality. The boiler system contains modular gas fired units dating to circa 1986 and the 700/800 section boilers were added in 1994 when that system was engineered. Cooling is provided by packaged rooftop units.

Figure 9. Section 700/800 Rooftop Unit (RTU)

Scope

The ESIP HVAC scope at CMS is focused on the 700/800 section and the boiler room. The proposed scope will have the rooftop units replaced with VAV cooling only rooftop units. The heating will continue to be provided by the hot water terminal units. Additionally, the boilers will be replaced with Aerco condensing gas-fired boilers.

Figure 10. Modular Boilers

3.2 Optional ECMs

The following opportunities have been identified during the Investment Grade Audit but are not currently included in the Energy Savings Plan.

	Optional ECMs	Building(s)	Hard Costs		Annual Savings	
	High School South					
37	Theater Lighting	HSS	$	496,181	$	2,032
39	***Community MS***					
41	Domestic Hot Water Replacement	CMS	$	79,804	$	127
	Maurice Hawk					
42	Replace UV's with HW & CHW Coils	MHES	$	1,950,364	$	-
43	Replace UV's with DX & HW Coils	MHES	$	66,654	$	-
44	Install 120 ton Chiller	MHES	$	388,470	$	-
45	Replace RTU - Cooling Only	MHES	$	146,319	$	-
46	BAS Upgrade to Common Front End	MHES	$	447,506	$	7,359
	Town Center					
47	Boiler Replacement	TCES	$	275,276	$	3,059
48	Chiller Replacement	TCES	$	640,113	$	1,783
49	Domestic Hot Water Replacement	TCES	$	42,103	$	132
	Village					
50	Boiler Replacement	VES	$	284,190	$	1,948
51	Cooling Tower Replacement	VES	$	255,779	$	12,174
	Grover MS					
52	HVAC System Replacement	GMS	$	2,708,503	$	14,111
53	Domestic Hot Water Replacement	GMS	$	40,617	$	244
54	Theater Lighting	GMS	$	304,324	$	2,000
55	Electric Vehicle Charging Stations	GMS	$	61,165	$	-
	Millstone River					
56	Boiler Replacement	MRES	$	447,677	$	6,882
57	Domestic Hot Water Replacement	MRES	$	65,109	$	337
	High School North					
58	Combined Heat and Power	HSN	$	731,317	$	27,191
60	Theater Lighting	HSN	$	641,728	$	2,888
61	Electric Vehicle Charging Stations	HSN	$	206,313	$	-
	Optional ECMs - Total:		$	10,279,512	$	82,264

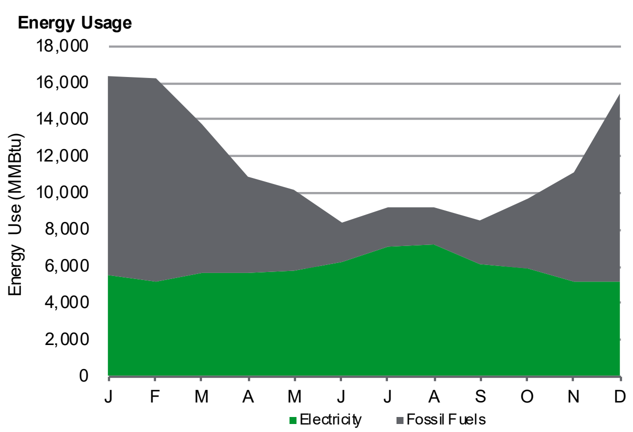
4.0 Energy Savings

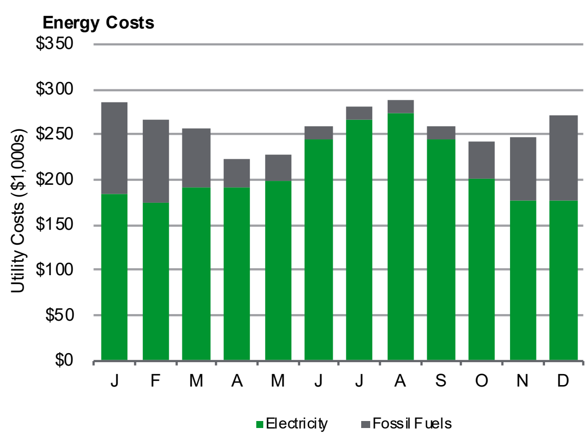
4.1 Baseline Energy Use

This baseline includes all facilities and was created by taking several years of utility data and utilizing the following:

- Prorating the usage into clean monthly bins
- Weather normalizing the baseline to represent a typical meteorological year

	Electricity			Fossil Fuels			Energy Total		
Month	Energy Use	Billed Demand	Cost	Energy Use	Billed Demand	Cost	Energy Use	Billed Demand	Cost
mmm	*kWh*	*kW*	*$*	*MMBtu*	*kBtu/hr*	*$*	*MMBtu*	*kBtu/hr*	*$*
Jan	1,605,994	3,610	$185,208	10,927	610,877	$99,658	16,408	623,199	$284,866
Feb	1,496,516	3,677	$173,710	11,195	385,348	$92,981	16,302	397,896	$266,691
Mar	1,666,037	3,838	$191,755	8,057	227,312	$64,508	13,743	240,411	$256,264
Apr	1,651,615	4,199	$191,286	5,246	0	$32,589	10,883	14,332	$223,874
May	1,689,828	4,678	$198,857	4,449	0	$27,843	10,217	15,966	$226,700
Jun	1,825,888	4,797	$244,337	2,211	0	$14,485	8,443	16,371	$258,821
Jul	2,069,883	4,449	$265,828	2,126	0	$13,978	9,190	15,186	$279,806
Aug	2,109,896	4,671	$273,791	2,064	0	$13,619	9,265	15,942	$287,409
Sep	1,780,722	5,008	$243,994	2,412	0	$15,684	8,490	17,093	$259,678
Oct	1,712,243	4,556	$200,899	3,797	447,070	$41,771	9,641	462,618	$242,670
Nov	1,513,608	3,941	$177,327	5,920	724,838	$69,807	11,086	738,288	$247,133
Dec	1,523,099	3,507	$176,303	10,190	637,745	$95,625	15,388	649,714	$271,927
Year	**20,645,329**	**50,930**	**$2,523,294**	**68,593**	**3,033,190**	**$582,546**	**139,056**	**3,207,015**	**$3,105,839**





Site Name	Community Middle School		
Project square footage	1,478,621		
Total building square footage	141,802	Total Energy Usage Index	121.1
Percentage of Total site area	10%	Total Utility Cost Index	$2.926

Fuel Type	Utility Usage		Utility Demand		Utility Cost	Percentage of Total
Fuel	*Value*		*Value*		*$*	*%*
Electricity	2,707,848	kWh	6,935	kW	$345,067	83%
Natural Gas	7,775	MCF	369,133	kBtu/hr	$69,796	17%
Total	**17,173**	**MMBtu**	**392,801**	**kbtu/hr**	**$ 414,864**	

Site Name	Dutch Neck Elementary School		
Project square footage	1,478,621		
Total building square footage	77,922	Total Energy Usage Index	78.1
Percentage of Total site area	5%	Total Utility Cost Index	$1.863

Fuel Type	Utility Usage		Utility Demand		Utility Cost	Percentage of Total
Fuel	*Value*		*Value*		*$*	*%*
Electricity	871,283	kWh	2,600	kW	$116,895	81%
Natural Gas	3,050	MCF	262,917	kBtu/hr	$28,268	19%
Total	**6,085**	**MMBtu**	**271,793**	**kbtu/hr**	**$ 145,164**	

Site Name	Grover Middle School		
Project square footage	1,478,621		
Total building square footage	176,453	Total Energy Usage Index	49.3
Percentage of Total site area	12%	Total Utility Cost Index	$1.513

Fuel Type	Utility Usage		Utility Demand		Utility Cost	Percentage of Total
Fuel	*Value*		*Value*		*$*	*%*
Electricity	2,218,147	kWh	6,436	kW	$256,134	96%
Natural Gas	1,107	MCF	48,647	kBtu/hr	$10,753	4%
Total	**8,700**	**MMBtu**	**70,612**	**kbtu/hr**	**$ 266,887**	

Site Name	West Windsor High School North		
Project square footage	1,478,621		
Total building square footage	323,931	Total Energy Usage Index	114.9
Percentage of Total site area	22%	Total Utility Cost Index	$2.132

Fuel Type	Utility Usage		Utility Demand		Utility Cost	Percentage of Total
Fuel	*Value*		*Value*		*$*	*%*
Electricity	4,433,857	kWh	8,577	kW	$528,640	77%
Natural Gas	21,647	MCF	666,498	kBtu/hr	$161,993	23%
Total	**37,213**	**MMBtu**	**695,772**	**kbtu/hr**	**$ 690,632**	

Site Name	West Windsor High School South						
Project square footage	1,478,621						
Total building square footage	270,372		Total Energy Usage Index	102.0			
Percentage of Total site area	18%		Total Utility Cost Index	$2.306			
Fuel Type	**Utility Usage**		**Utility Demand**		**Utility Cost**	**Percentage of Total**	
Fuel	*Value*		*Value*		*$*	*%*	
Electricity	4,267,745	kWh	9,468	kW	$508,993	82%	
Natural Gas	12,747	MCF	614,456	kBtu/hr	$114,602	18%	
Total	**27,568**	**MMBtu**	**646,772**	**kbtu/hr**	**$ 623,595**		

Site Name	Maurice Hawk Elementary School						
Project square footage	1,478,621						
Total building square footage	78,860		Total Energy Usage Index	83.6			
Percentage of Total site area	5%		Total Utility Cost Index	$1.768			
Fuel Type	**Utility Usage**		**Utility Demand**		**Utility Cost**	**Percentage of Total**	
Fuel	*Value*		*Value*		*$*	*%*	
Electricity	875,626	kWh	2,789	kW	$100,932	72%	
Natural Gas	3,534	MCF	306,568	kBtu/hr	$38,507	28%	
Total	**6,594**	**MMBtu**	**316,087**	**kbtu/hr**	**$ 139,439**		

Site Name	Millstone River Elementary School						
Project square footage	1,478,621						
Total building square footage	142,300		Total Energy Usage Index	98.0			
Percentage of Total site area	10%		Total Utility Cost Index	$2.085			
Fuel Type	**Utility Usage**		**Utility Demand**		**Utility Cost**	**Percentage of Total**	
Fuel	*Value*		*Value*		*$*	*%*	
Electricity	1,761,652	kWh	4,215	kW	$225,469	76%	
Natural Gas	7,781	MCF	386,862	kBtu/hr	$71,285	24%	
Total	**13,949**	**MMBtu**	**401,248**	**kbtu/hr**	**$ 296,754**		

Site Name	Town Center Elementary School						
Project square footage	1,478,621						
Total building square footage	91,021		Total Energy Usage Index	69.2			
Percentage of Total site area	6%		Total Utility Cost Index	$1.692			
Fuel Type	**Utility Usage**		**Utility Demand**		**Utility Cost**	**Percentage of Total**	
Fuel	*Value*		*Value*		*$*	*%*	
Electricity	961,409	kWh	2,474	kW	$125,609	82%	
Natural Gas	2,960	MCF	156,233	kBtu/hr	$28,398	18%	
Total	**6,301**	**MMBtu**	**164,678**	**kbtu/hr**	**$ 154,007**		

Site Name	**Village Elementary School**		
Project square footage	1,478,621		
Total building square footage	126,053	Total Energy Usage Index	91.5
Percentage of Total site area	9%	Total Utility Cost Index	$2.032

Fuel Type *Fuel*	Utility Usage *Value*		Utility Demand *Value*		Utility Cost *$*	Percentage of Total *%*
Electricity	1,845,531	kWh	4,411	kW	$212,436	83%
Natural Gas	5,138	MCF	168,001	kBtu/hr	$43,709	17%
Total	**11,540**	**MMBtu**	**183,057**	**kbtu/hr**	**$ 256,145**	

Site Name	**Wicoff Elementary School**		
Project square footage	1,478,621		
Total building square footage	47,470	Total Energy Usage Index	62.0
Percentage of Total site area	3%	Total Utility Cost Index	$1.947

Fuel Type *Fuel*	Utility Usage *Value*		Utility Demand *Value*		Utility Cost *$*	Percentage of Total *%*
Electricity	555,028	kWh	2,434	kW	$81,517	88%
Natural Gas	1,030	MCF	53,875	kBtu/hr	$10,906	12%
Total	**2,945**	**MMBtu**	**62,183**	**kbtu/hr**	**$ 92,423**	

Site Name	**Special Services**		
Project square footage	1,478,621		
Total building square footage	2,052	Total Energy Usage Index	119.3
Percentage of Total site area	0%	Total Utility Cost Index	$2.096

Fuel Type *Fuel*	Utility Usage *Value*		Utility Demand *Value*		Utility Cost *$*	Percentage of Total *%*
Electricity	15,678	kWh	86	kW	$2,560	60%
Natural Gas	187	MCF	0	kBtu/hr	$1,742	40%
Total	**245**	**MMBtu**	**293**	**kbtu/hr**	**$ 4,302**	

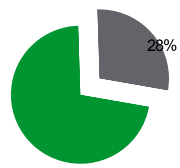
Site Name	**Buildings and Grounds**		
Project square footage	1,478,621		
Total building square footage	385	Total Energy Usage Index	1,932.0
Percentage of Total site area	0%	Total Utility Cost Index	$56.172

Fuel Type *Fuel*	Utility Usage *Value*		Utility Demand *Value*		Utility Cost *$*	Percentage of Total *%*
Electricity	131,525	kWh	504	kW	$19,041	88%
Natural Gas	289	MCF	0	kBtu/hr	$2,586	12%
Total	**744**	**MMBtu**	**1,721**	**kbtu/hr**	**$ 21,626**	

For a month to month baseline for each school, please see Appendix 7.1.

4.2 Energy Savings

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



Energy Cost Savings

Energy and Water Indices	Energy	Demand	Cost	Water	Cost	Total
	kBtu/ft2	*Btu/hr-ft2*	*$/ft2*	*Gal/ft2*	*$/ft2*	*$/ft2*
Baseline	94.0	2168.9	$2.10	18.7	$0.17	$2.27
Post Project	67.0	2121.6	$1.51	15.0	$0.14	$1.65
% Savings	**28.7%**	**2.2%**	**28.3%**	**20.2%**	**14.9%**	**27.3%**

Project Summary

Project	Electricity		Fossil Fuels		Energy	Water	Water	Combined
	Energy Use	Actual Demand	Energy Use	Actual Demand	Total Cost	Energy Use	Total Cost	Total Cost
Phase	*kWh*	*kW*	*MMBtu*	*kBtu/hr*	*$*	*kGal*	*$*	*$*
Baseline	20,645,329	50,930	68,593	3,033,190	$3,105,862	19,226	$171,653	$3,277,515
Post Project	13,569,669	39,897	52,774	3,000,832	$2,227,843	15,349	$146,130	$2,373,973
Projected Savings, Units	**7,075,660**	**11,034**	**15,819**	**32,358**	**$878,019**	**3,877**	**$25,522**	**$903,542**
Projected Savings, %	**34.3%**	**21.7%**	**23.1%**	**1.1%**	**28.3%**	**20.2%**	**14.9%**	**27.6%**

Notes:
DOES NOT INCLUDE SOLAR PPA SAVINGS

To estimate savings from the proposed project, Schneider Electric utilized engineering formulas and energy modeling software. 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 energy simulation software called eQuest. eQuest was developed through funding by the United States Department of Energy (USDOE) and is the preferred tool for energy modeling in the energy performance contracting industry. Additionally, ELEMENT, a proprietary building modeling tool was used to develop baselines and savings for some builds. Using these modeling tool allows for the ability to model existing conditions and proposed retrofits to assess potential energy savings.

Name	Total Savings	Electric Savings	Demand Savings	Electric Cost Savings	Natural Gas Savings	Natural Gas Savings	Water (Including WW) Savings	Water (Including WW) Savings
Community MS	*$*	*kWh*	*kW*	*$*	*MMBtu*	*$*	*kGal*	*$*
1.1 Interior Lighting Improvements	$18,049	159,299	562	$20,923	(476)	-$2,875		
1.2 Exterior Lighting	$3,135	29,131	-	$3,135	-	$0		
1.3 Occupancy Sensor for Lighting	$695	6,333	11	$807	(18)	-$111		
1.6 Air Sealing Improvements	$3,468	3,136	-	$337	457	$3,131		
2.2 BAS Upgrade	$66,812	465,736	3	$49,867	2,783	$16,945		
2.3 Kitchen Hood Controls	$1,299	5,252	-	$565	107	$734		
3.1 Water Fixture Improvements - NG	$1,012	-	-	$0	171	$1,012		
3.5 Walk-in Refrigerator Controls	$554	4,751	7	$554	-	$0		
3.9 Pipe Insulation	$2,188	-		$0	319	$2,188		
4.3 Boiler Replacements	$3,689	(9,016)		-$1,005	763	$4,693		
4.4 High Efficiency Transformers	$6,870	58,893	81	$6,870	-	$0		
3.1 Water Fixture Improvements	$3,587						545	$3,587
Dutch Neck ES	*$*	*kWh*	*kW*	*$*	*MMBtu*	*$*	*kGal*	*$*
1.1 Interior Lighting Improvements	$14,763	110,947	516	$15,408	(88)	-$645		
1.2 Exterior Lighting	$1,736	16,131	-	$1,736	-	$0		
1.3 Occupancy Sensor for Lighting	$1,559	12,962	35	$1,637	(11)	-$78		
1.6 Air Sealing Improvements	$624	2,052	-	$221	60	$404		
2.2 BAS Upgrade	$12,462	76,003	39	$8,247	574	$4,215		
2.3 Kitchen Hood Controls	$918	3,962	-	$426	66	$492		
2.4 Variable Frequency Drives	$3,707	32,211	48	$3,762	(7)	-$55		
3.1 Water Fixture Improvements - NG	$329	-		$0	49	$329		
3.9 Pipe Insulation	$492	-		$0	66	$492		
4.1 HVAC Replacement	$10,018	79,342	77	$9,155	115	$863		
4.4 High Efficiency Transformers	$443	3,850	7	$443	-	$0		
Outdoor Air Adjustment	-$4,949	(20,588)		-$3,543	(196)	-$1,406		
3.1 Water Fixture Improvements	$2,114						321	$2,114
Grover MS	*$*	*kWh*	*kW*	*$*	*MMBtu*	*$*	*kGal*	*$*
1.1 Interior Lighting Improvements	$37,450	319,579	1,062	$37,868	(63)	-$418		
1.2 Exterior Lighting	$7,936	81,705	-	$7,936	-	$0		
1.3 Occupancy Sensor for Lighting	$3,088	25,452	100	$3,114	(4)	-$27		
1.6 Air Sealing Improvements	$6,211	62,326	-	$6,054	23	$157		
2.2 BAS Upgrade	$16,304	163,110	-	$15,843	70	$461		
2.3 Kitchen Hood Controls	$808	8,317	-	$808	-	$0		
3.1 Water Fixture Improvements - NG	$424	-	-	$0	72	$424		
3.5 Walk-in Refrigerator Controls	$1,352	12,775	17	$1,352	-	$0		
4.4 High Efficiency Transformers	$8,713	77,076	123	$8,713	-	$0		
3.1 Water Fixture Improvements	$7,112						1080	$7,112
High School North	*$*	*kWh*	*kW*	*$*	*MMBtu*	*$*	*kGal*	*$*
1.1 Interior Lighting Improvements	$60,112	491,040	1,554	$62,153	(209)	-$2,041		
1.2 Exterior Lighting	$13,786	128,097	-	$13,786	-	$0		
1.3 Occupancy Sensor for Lighting	$942	7,473	38	$999	(8)	-$57		
1.6 Air Sealing Improvements	$2,469	8,219	-	$885	267	$1,584		
2.3 Kitchen Hood Controls	$1,393	5,804	-	$625	130	$769		
3.1 Water Fixture Improvements - NG	$1,277	-	-	$0	191	$1,277		
3.5 Walk-in Refrigerator Controls	$1,266	10,822	15	$1,266				
3.9 Pipe Insulation	$1,253	-	-	$0	211	$1,253		
4.4 High Efficiency Transformers	$4,486	26,493	67	$4,486	-	$0		
Referendum Scope	$157,553	927,607	367	$91,157	12,073	$66,395		
Outdoor Air Adjustment	-$72,991	(116,717)	12	-$22,677	(7,227)	-$50,315		

High School South	$	kWh	kW	$	MMBtu	$	kGal	$
1.1 Interior Lighting Improvements	$60,674	523,580	1,460	$66,405	(870)	-$5,731		
1.2 Exterior Lighting	$10,871	101,010	-	$10,871	-	$0		
1.3 Occupancy Sensor for Lighting	$3,249	33,647	-	$3,621	(57)	-$372		
1.6 Air Sealing Improvements	$3,421	6,969	-	$750	452	$2,671		
2.2 BAS Upgrade	$45,258	258,764	2	$24,818	3,140	$20,441		
2.3 Kitchen Hood Controls	$1,391	5,804	-	$625	130	$766		
2.4 Variable Frequency Drives	$57,278	465,011	766	$55,294	259	$1,984		
3.1 Water Fixture Improvements - NG	$657				111	$657		
3.5 Walk-in Refrigerator Controls	$759	6,356	11	$759	-	$0		
3.9 Pipe Insulation	$1,218	437	-	$47	198	$1,171		
4.1 HVAC Replacement	$18,916	167,420	(99)	$19,618	69	-$701		
4.2 Chiller Replacements	$2,279	16,458	59	$2,279	-	$0		
4.4 High Efficiency Transformers	$13,518	115,893	159	$13,518	-	$0		
4.6 Combined Heat & Power	$24,616	306,600	420	$35,763	(1,914)	-$11,146		
4.7 HVAC System Replacement - 2 Pipe UVs	$8,923	80,281	141	$9,599	(88)	-$676		
3.1 Water Fixture Improvements	$6,184						939	$6,184
Maurice Hawk ES	$	kWh	kW	$	MMBtu	$	kGal	$
1.1 Interior Lighting Improvements	$8,737	97,318	376	$9,708	(146)	-$971		
1.3 Occupancy Sensor for Lighting	$784	7,969	43	$869	(13)	-$84		
1.6 Air Sealing Improvements	$984	2,013	-	$144	127	$840		
2.3 Kitchen Hood Controls	$510	3,102	-	$222	49	$288		
3.1 Water Fixture Improvements - NG	$361	-	-	$0	61	$361		
3.5 Walk-in Refrigerator Controls	$432	5,348	7	$432	-	$0		
3.9 Pipe Insulation	$952	-		$0	144	$952		
4.4 High Efficiency Transformers	$352	4,337	7	$352	-	$0		
3.1 Water Fixture Improvements	$1,179						179	$1,179
Millstone River ES	$	kWh	kW	$	MMBtu	$	kGal	$
1.1 Interior Lighting Improvements	$19,480	160,784	622	$21,320	(278)	-$1,841		
1.2 Exterior Lighting	$4,197	38,998	-	$4,197	-	$0		
1.3 Occupancy Sensor for Lighting	$1,772	14,919	51	$1,934	(24)	-$163		
1.6 Air Sealing Improvements	$3,622	3,393	-	$365	475	$3,257		
2.3 Kitchen Hood Controls	$854	3,479	-	$374	81	$479		
2.4 Variable Frequency Drives	$6,897	63,214	62	$6,897	-	$0		
3.1 Water Fixture Improvements - NG	$603	-	-	$0	102	$603		
3.5 Walk-in Refrigerator Controls	$1,541	13,176	19	$1,541	-	$0		
3.9 Pipe Insulation	$512	-	-	$0	75	$512		
4.4 High Efficiency Transformers	$3,883	33,294	45	$3,883	-	$0		
Referendum Scope	$35,830	268,305		$28,876	1,051	$6,954		
3.1 Water Fixture Improvements	$4,149						630	$4,149

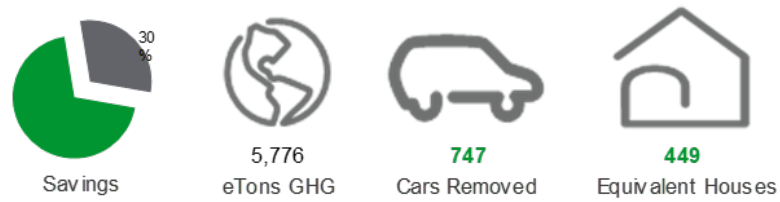
Town Center ES	$	kWh	kW	$	MMBtu	$	kGal	$
1.1 Interior Lighting Improvements	$19,029	166,876	492	$20,980	(295)	-$1,951		
1.2 Exterior Lighting	$1,996	18,542	-	$1,996	-	$0		
1.3 Occupancy Sensor for Lighting	$1,495	13,316	49	$1,698	(31)	-$203		
1.6 Air Sealing Improvements	$2,298	3,933	-	$423	273	$1,875		
2.2 BAS Upgrade	$10,761	54,397	3	$5,574	758	$5,187		
2.3 Kitchen Hood Controls	$604	2,741	-	$295	52	$309		
2.4 Variable Frequency Drives	$5,734	51,905	89	$6,155	(66)	-$421		
3.1 Water Fixture Improvements - NG	$101	-	-	$0	17	$101		
3.5 Walk-in Refrigerator Controls	$949	8,121	11	$949	-	$0		
3.9 Pipe Insulation	$1,023	1,119	-	$120	132	$903		
4.4 High Efficiency Transformers	$4,641	37,803	77	$4,641	-	$0		
3.1 Water Fixture Improvements	$476						72	$476
Village ES	$	kWh	kW	$	MMBtu	$	kGal	$
1.1 Interior Lighting Improvements	$17,825	153,348	619	$19,298	(219)	-$1,473		
1.2 Exterior Lighting	$3,105	31,065	-	$3,105	-	$0		
1.3 Occupancy Sensor for Lighting	$655	5,215	28	$703	(7)	-$47		
1.6 Air Sealing Improvements	$2,069	4,732	-	$473	233	$1,596		
2.2 BAS Upgrade	$35,356	264,925	5	$26,430	1,347	$8,926		
2.3 Kitchen Hood Controls	$1,036	5,252	-	$525	87	$511		
2.4 Variable Frequency Drives	$1,540	16,514	21	$1,785	(36)	-$245		
3.1 Water Fixture Improvements - NG	$237	-	-	$0	40	$237		
3.5 Walk-in Refrigerator Controls	$866	7,906	12	$866	-	$0		
3.9 Pipe Insulation	$669	171	-	$17	95	$652		
4.4 High Efficiency Transformers	$3,190	28,508	53	$3,190	-	$0		
Wicoff ES	$	kWh	kW	$	MMBtu	$	kGal	$
1.1 Interior Lighting Improvements	$8,498	59,437	270	$8,833	(50)	-$335		
1.2 Exterior Lighting	$1,148	9,757	-	$1,148	-	$0		
1.3 Occupancy Sensor for Lighting	$1,270	9,381	41	$1,351	(12)	-$80		
2.3 Kitchen Hood Controls	$190	488	-	$57	23	$133		
3.1 Water Fixture Improvements - NG	$126	-	-	$0	21	$126		
3.9 Pipe Insulation	$368	-	-	$0	54	$368		
3.1 Water Fixture Improvements	$659						100	$659
Special Services	$	kWh	kW	$	MMBtu	$	kGal	$
1.1 Interior Lighting Improvements	$293	2,064	8	$293	-	$0		
1.2 Exterior Lighting	$135	993	3	$135	-	$0		
1.6 Air Sealing Improvements	$260	358	-	$42	32	$218		
Buildings and Grounds	$	kWh	kW	$	MMBtu	$	kGal	$
1.1 Interior Lighting Improvements	$1,030	7,118	29	$1,030	24	$0		
1.2 Exterior Lighting	$486	3,471	12	$486	12	$0		
3.1 Water Fixture Improvements	$63	-	-	$0	-	$0	10	$63
Total	$903,542	7,056,901		$791,592	15,875	$86,428	3,877	$25,522

For detailed savings calculations for each ECM, please see the Appendix 7.1.

4.3 Environmental Impact

The following graphic shows the environmental impact of the project.

Environmental Benefits	
Total Emissions	
Total Energy (MMBtu)	139,056
Total Emission (Tons CO_2e)	19,032
Total Savings (Tons CO_2e)	5,776
Total Savings (Tons NOx)	4
Total Savings (Tons SO_2e)	3



* Emissions factors are derived from EPA eGrids database and represent the State of NJ
Totals include 12 Project Sites and a total of 101 ECMs

Note: The above figures do not include the Solar PPA impact.

5.0 Performance Assurance Support Services (PASS)

The purpose of Performance Assurance Support Services is to measure, verify, and provide the necessary support services to sustain savings over time. Per NJ ESIP law, the PASS Agreement must be a separate contract from the ESIP Construction Contract. This section includes a description of the proposed measurement & verification plan.

5.1 Description of Services

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

Measurement and Verification Services with Savings Reporting (Option C)

The International Performance Measurement & Verification Protocol (IPMVP) was created to determine standards and best practices in the measurement & verification of energy efficiency investments. 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.

Measurement and Verification Services with Savings Reporting (Option A)

The IPMVP Option A, Partial Retrofit Isolation, involves a pre and post measurement of a single variable used to determine energy savings. Option A is a good fit when savings represent a small portion of a building's energy baseline, or when savings for an ECM can be easily isolated from other measures.

Commission and Verify (C&V)

This process is used to qualify and validate the installation, function, operation and performance of ECMs. The protocol consists of a planned process with a deliberate combination of steps which systematically identify, test and challenge various key aspects used to verify the performance objectives of an installed ECM against an established design criterion. Benefits include an improved controls interface, reduced energy demand and consumption, and improve occupancy comfort.

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.

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.

On-site Visits

On-site visits include a review and reporting 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 District's energy and sustainability programs. Resource Advisor combines quality assurance and data capture capabilities of utility information into one energy management solution.

5.2 Measurement & Verification (M&V) Plan

Based upon the scope of this project, we recommend a measurement & verification (M&V) program based upon a blend of Option C and Option A methodology as defined by the International Performance Measurement & Verification Protocol (IPMVP), with other ECMs commissioned and verified by SE staff.

The purpose of the Performance Assurance Support Services (PASS) program is to assist the District in sustaining savings over the long term. The following services are currently proposed. Each year after the initial term, the services can be eliminated or negotiated between SE & WW-P, to ensure the proper level of support and savings verification.

Services Included:	Year 1	Year 2	Year 3
• Commissioning & Verify ECMs • Measurement & Verification of Savings • Financial guarantee • Quarterly Savings Reports • On-site Energy Auditing & Consulting • On-site Training • Resource Advisor with Energy Star Portfolio Manager benchmarking • Monthly Building Automation System Reviews • Remote Energy Management & Technical Support • Complete Pay for Performance (P4P) applications for the third incentive	$95,000	$87,000	$23,000

5.3 Ongoing Maintenance

Under the New Jersey ESIP legislation, all maintenance contracts are required to be procured separately from the ESIP. Schneider Electric will properly commission all equipment, provide training, review manufacturer maintenance requirements, and provide an owner's manual to ensure proper maintenance of the equipment.

6.0 Implementation

6.1 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.

6.2 Assessment of Risks

This assessment of risks is meant to provide WW-P 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 WW-P 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 set-points and occupied times, energy savings associated with the building automation system, variable frequency drives (VFDs), and HVAC upgrades could be affected.
- Hot water pump variable frequency drives (VFDs), and control valve upgrades must not have the VFD overridden to manual position for extended periods of time. While this is allowable and expected for maintenance or emergency work, the VFDs must be reset to maintain energy savings.
- Building Automation System sequences of operation must not be over-ridden or changed permanently. Overrides are permitted for maintenance or special occasions but must be reset to maintain energy savings.
- The Walk-in Cooler and Freezer Controls must not be overridden or changed permanently to maintain energy savings.
- Water consuming fixtures must be maintained to maintain the water and energy savings. Replacement parts need to be of similar flow characteristics to maintain water and energy savings.
- Lighting systems will require maintenance as they age. Replacement parts need to be of similar energy efficiency to maintain savings.

7.0 Appendices

7.1 Savings Calculations & Documentation

Below is a high-level summary of how savings were calculated for each measure included in this report. For further documentation of savings calculations, please see the following pages.

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, 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 tools and approaches used for calculating savings.

ECM Name	Analysis Tool
Building Management System (BMS) Upgrades	eQuest/ELEMENT
LED Lighting – Interior	eQuest/ELEMENT
LED Lighting – Exterior	eQuest/ELEMENT
Occupancy Sensors for Lighting Control	eQuest/ELEMENT
Air Sealing Improvements	Spreadsheet Calculations (with BIN Data)
Water Fixture Improvements	Spreadsheet Calculations
Cooling Tower Deduct Meter	Spreadsheet Calculations
Walk-in Refrigeration Controls	Spreadsheet Calculations
High Efficiency Transformers	Spreadsheet Calculations
Boiler Replacements	eQuest/ELEMENT
RTU Replacements	eQuest/ELEMENT
Variable Speed Drives	eQuest/ELEMENT
Combined Heat and Power	Spreadsheet Calculations
Solar Power Purchase Agreement	Spreadsheet calculations
Kitchen Hood Controls	Spreadsheet calculations

Savings Methods – Spreadsheet Calculations

Schneider Electric utilizes a mixture of spreadsheet calculations and basic formula calculation tools. eCalc 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. Below is an example of an eCalc spreadsheet for calculating kitchen hood controls improvement savings.

eCalcs: Energy Calculation Suite — Life Is On Schneider Electric

WWPRSD - Grover MS

Kitchen Hood Controls

Building Data

Building Name	Grover MS
Weather City	NJ, Trenton

Fan Calculations

Exhaust Fans - Baseline

Fan Name	Motor HP	LF %	Motor Eff %	Oper Hr/yr	Total CFM	Fan kW	Fan kWh/yr
6	0.5	70%	80.0%	5,450	4,550	0.3	1,778
						0.0	0
						0.0	0
						0.0	0
						0.0	0
						0.0	0
						0.0	0
				Total	4,550	0.3	1,778

Make Up Air Fans - Baseline

Fan Name	Motor HP	LF %	Motor Eff %	Oper Hr/yr	Total CFM	Fan kW	Fan kWh/yr
7	0.25	70%	80.0%	5,450	3,350	0.2	889
						0.0	0
						0.0	0
						0.0	0
						0.0	0
						0.0	0
						0.0	0
				Total	3,350	0.2	889

Exhaust Fans - Post Project

	Fan kW	Hours %	Oper Hr/yr	Speed %	Power %	VFD Eff %	Fan kWh/yr
Run 8 hours or	0.3	67%	3,650	100%	100%	100%	1,191
		0%	0	90%	75%	97%	0
		0%	0	80%	55%	97%	0
		0%	0	70%	38%	97%	0
		0%	0	60%	25%	97%	0
		0%	0	50%	15%	97%	0
		0%	0	40%	8%	97%	0
		0%	0	30%	4%	97%	0
		0%	0	20%	1%	97%	0
		0%	0	10%	0%	97%	0
		33%	1,799	0%	0%	97%	0
		100%	5,450				1,191

Make Up Air Fans - Post Project

Fan kW	Hours %	Oper Hr/yr	Speed %	Power %	VFD Eff %	Fan kWh/yr
0.2	67%	3,650	100%	100%	100%	595
	0%	0	100%	100%	97%	0
	0%	0	100%	100%	97%	0
	0%	0	95%	87%	97%	0
	0%	0	81%	58%	97%	0
	0%	0	68%	35%	97%	0
	0%	0	54%	19%	97%	0
	0%	0	41%	9%	97%	0
	0%	0	27%	3%	97%	0
	0%	0	14%	0%	97%	0
	33%	1,799	0%	0%	97%	0
	100%	5,450				595

Heating and Cooling Calculations

Flow Rates and Temperature Setpoints

	Make Up	
Average Existing	3,350	cfm
Average Proposed	2,244	cfm
Cooling		
Cooling Available	Yes	
Cooling Lockout	55.0	oF
Space Cooling Set Point	75.0	oF
Space Relative Humidity	100%	%
Space Enthalpy Set Point	38.7	Btu/lb
Cooling Efficiency	0.88	kW/Ton
Heating		
Heating Available	Yes	
Heating Lockout	50.0	oF
Space Heating Set Point	68.0	oF
Heating Efficiency	330%	%

Savings Summary

Type	Savings	Units	Utility Type
Fan	881	kWh	Electricity
Cooling	680	kWh	Electricity
Heating	6,757	kWh	Electricity

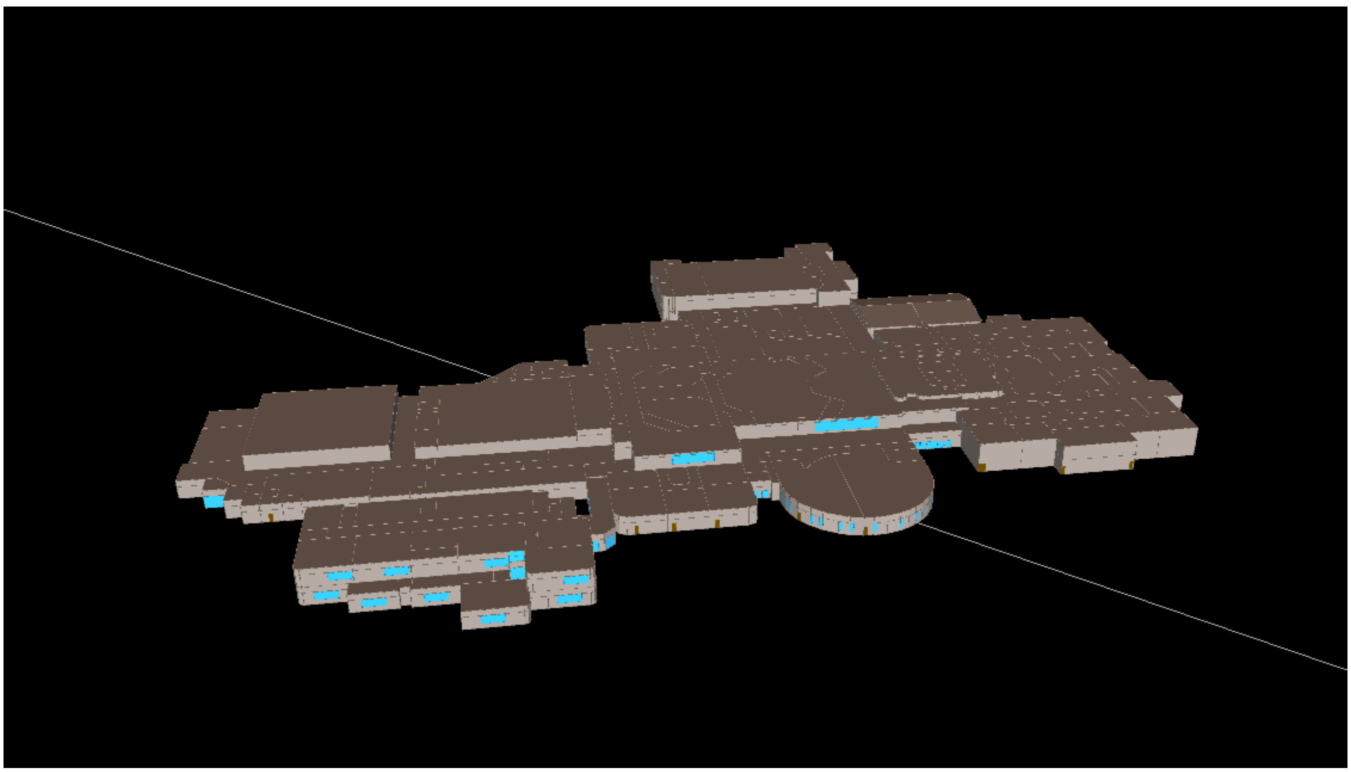
Weather Bin Data (Schedule: Schedule1)

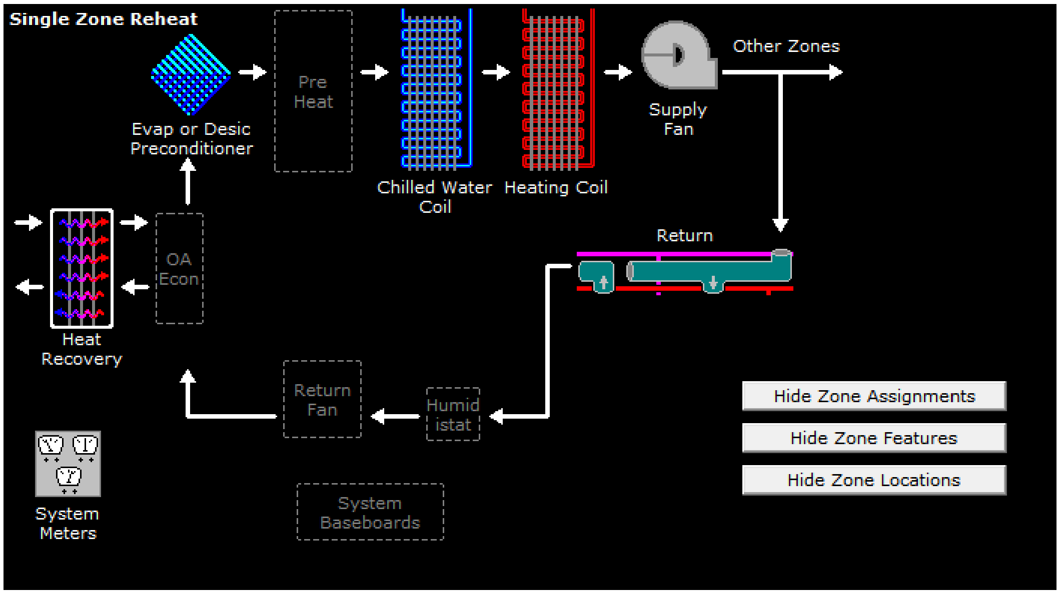
Ref	DB Range oF	DB Temp oF	MCWB oF	Enthalpy Btu/lb	Occ Hrs hrs/yr	HVAC Saving Loads: Cooling Loads kBtu	HVAC Saving Loads: Heating Loads kBtu	Energy Savings: Cooling Savings kWh/yr	Energy Savings: Heating Savings kWh/yr
1	1.5 to 5.5	3.5	3.1	1.7	6	0	77	0	41
2	5.5 to 9.5	7.5	7.0	2.9	16	0	72	0	103
3	9.5 to 13.5	11.5	10.0	3.8	58	0	68	0	348
4	13.5 to 17.5	15.5	13.8	5.0	65	0	63	0	362
5	17.5 to 21.5	19.5	17.2	6.1	80	0	58	0	412
6	21.5 to 25.5	23.5	21.0	7.5	135	0	53	0	637
7	25.5 to 29.5	27.5	24.1	8.6	174	0	48	0	748
8	29.5 to 33.5	31.5	27.6	9.9	151	0	44	0	585
9	33.5 to 37.5	35.5	31.1	11.4	227	0	39	0	783
10	37.5 to 41.5	39.5	35.0	13.0	326	0	34	0	986
11	41.5 to 45.5	43.5	39.1	14.9	344	0	29	0	894
12	45.5 to 49.5	47.5	42.3	16.4	395	0	24	0	859
13	49.5 to 53.5	51.5	45.8	18.2	301	0	0	0	0
14	53.5 to 57.5	55.5	50.4	20.7	529	0	0	0	0
15	57.5 to 61.5	59.5	54.9	23.3	263	0	0	0	0
16	61.5 to 65.5	63.5	58.1	25.4	346	0	0	0	0
17	65.5 to 69.5	67.5	61.1	27.4	276	0	0	0	0
18	69.5 to 73.5	71.5	64.8	30.2	402	0	0	0	0
19	73.5 to 77.5	75.5	66.6	31.6	490	1	0	21	0
20	77.5 to 81.5	79.5	69.0	33.5	335	5	0	132	0
21	81.5 to 85.5	83.5	70.5	34.7	242	10	0	180	0
22	85.5 to 89.5	87.5	72.7	36.7	119	15	0	130	0
23	89.5 to 93.5	91.5	73.7	37.6	148	20	0	214	0
24	93.5 to 97.5	95.5	75.2	39.0	22	2	0	3	0
25	97.5 to 101.5	99.5	77.4	41.1	-	12	0	0	0
				Total	5,450	64	609	680	6,757

Savings Methods – eQuest

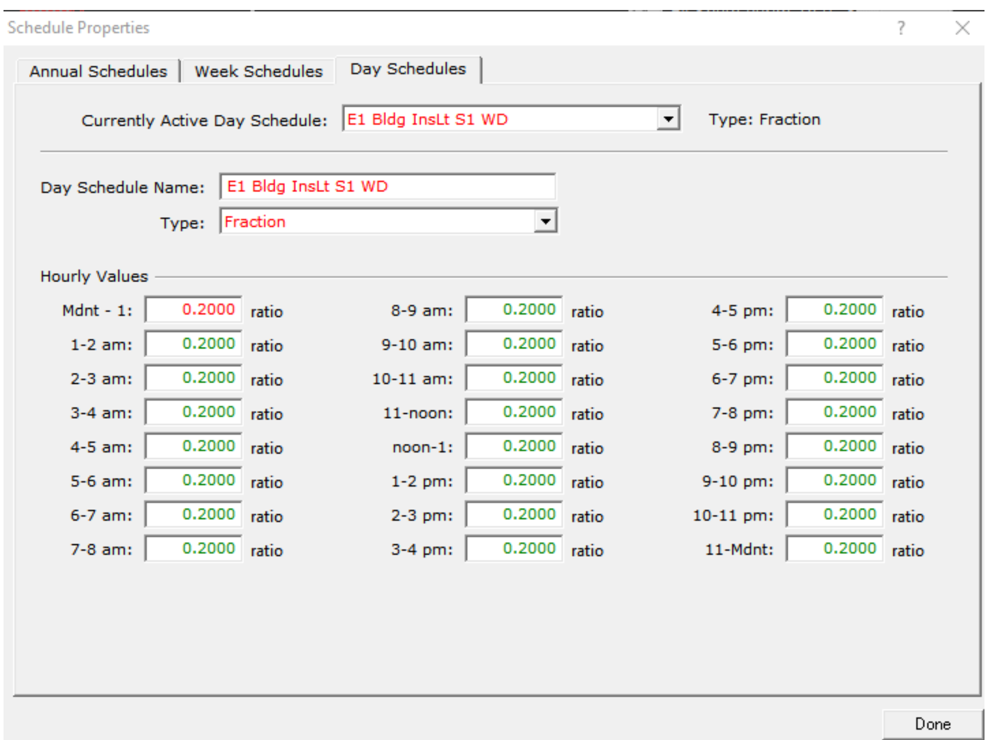
To estimate savings for key buildings, Schneider Electric modeled energy use of buildings using eQuest. eQuest was developed through funding by the United States Department of Energy (USDOE) and is used as the preferred tool for energy modeling in the industry. This modeling tool provides the unique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

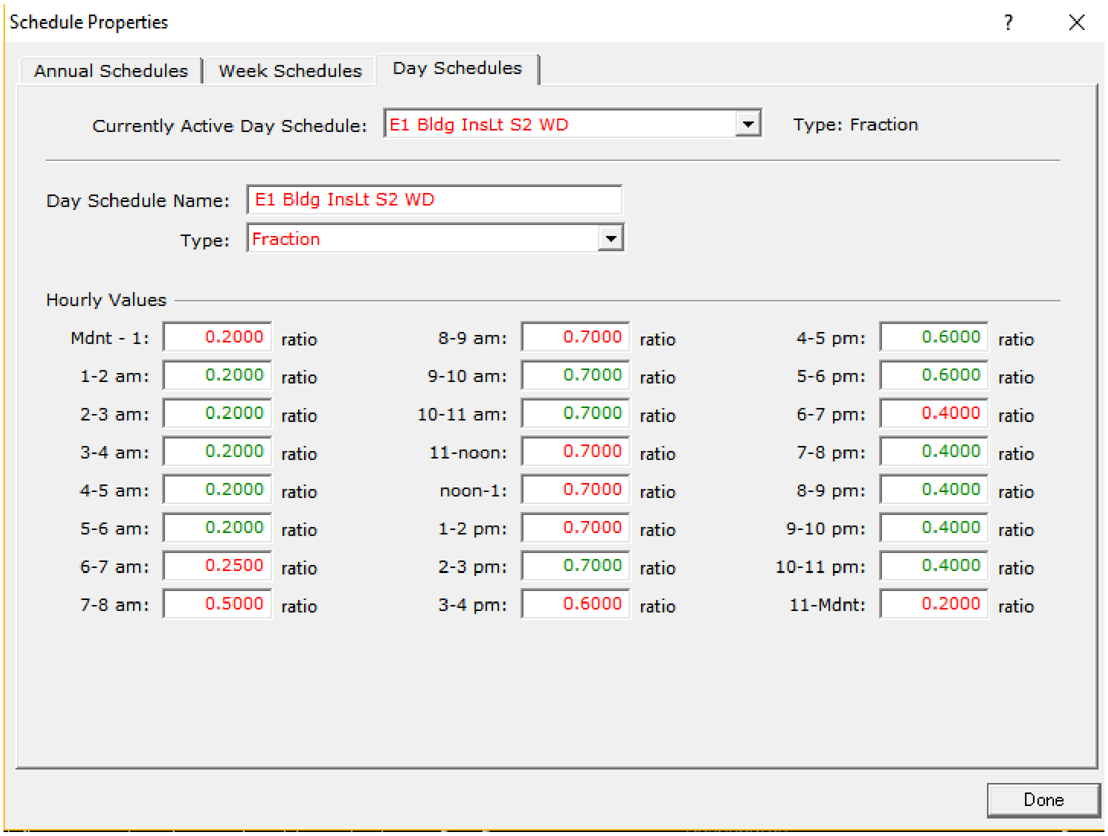
Spaces are defined by their construction to determine thermal conductivity and mass for heat loss/gain calculations. Also included are ventilation rates, lighting, equipment, and occupant loads and schedules. Individual spaces or groups of spaces are assigned to thermal zones that are served by an air 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 High School South.





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 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 set-points. 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 West Windsor High School South.

eQuestrian

PC18P0019 - WWP RSD - High School South - Baseline

Baseline | ECM01 | ECM02 | ECM03 | ECM04 | ECM05 | ECM06 | ECM07 | ECM08 | ECM09 | ECM10

Update Results

Energy Modeling Summary

Ref File Last Saved	9/26/2019 13:53
Ref File Last Imported	9/26/2019 14:18
Hourly Last Saved	9/26/2019 13:53
Hourly Last Imported	9/26/2019 14:18

Baseline Comments

Provide key assumptions made to calibrate energy baseline.

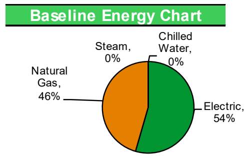
Compress

Decompress

Baseline Energy

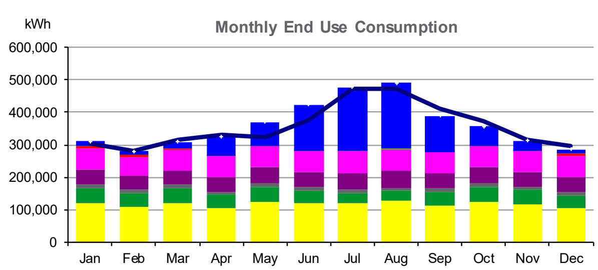
Fuel	Pre	Units	EUI
Electric	4,335,472	kWh	54.7
Electric	10,433	kW	-
Natural Gas	123,668	Therm	45.7
Chilled Water	-	Ton-hrs	-
Steam	-	klb	-
Total	27,163,756	kBtu	100.5

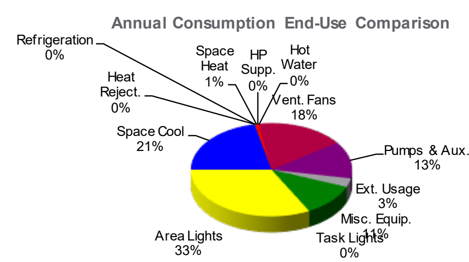
Baseline Energy Chart



Electric Energy Data

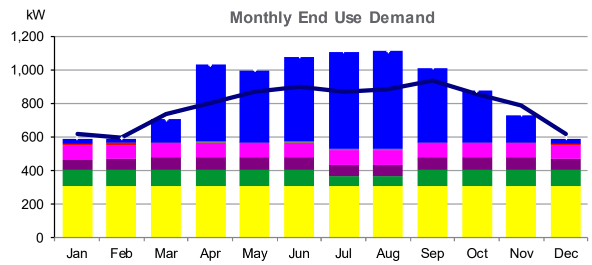
Electric Consumption														kWh
1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	1
Space Cool	12,961	11,945	18,322	60,366	73,584	143,593	196,152	203,597	111,093	60,643	31,032	14,098	937,384	Space Cool
Heat Reject.	8	8	17	175	155	582	993	901	253	99	18	9	3,219	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	7,716	6,382	4,102	2,086	836	7	0	0	175	1,096	2,703	6,021	31,125	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	64,774	58,505	64,774	62,969	65,216	64,154	66,541	66,638	63,657	65,035	62,684	64,774	769,721	Vent. Fans
Pumps & Aux.	45,875	41,291	42,124	44,903	46,893	45,805	51,903	52,327	47,340	46,972	44,722	46,286	556,441	Pumps & Aux.
Ext. Usage	11,047	9,978	11,047	10,691	11,047	10,691	11,047	11,047	10,691	11,047	10,691	11,047	130,070	Ext. Usage
Misc. Equip.	46,021	41,608	46,021	39,085	47,287	39,567	28,605	29,469	41,223	47,287	44,108	38,426	488,705	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	122,153	110,418	122,153	106,632	124,832	120,028	122,153	127,511	114,669	124,832	117,348	106,078	1,418,807	Area Lights
Total	310,554	280,136	308,559	326,908	369,849	424,426	477,394	491,489	389,101	357,011	313,306	286,739	4,335,472	Total Model
Utility Baseline	302,935	281,339	315,980	331,875	323,762	375,911	473,811	471,372	411,255	373,623	317,553	298,448	4,277,862	Utility Baseline
Error	3%	0%	-2%	-1%	14%	13%	1%	4%	-5%	-4%	-1%	-4%	1%	

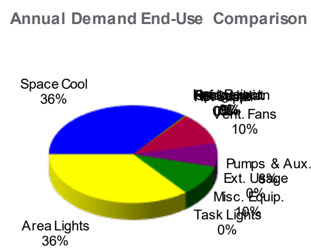




Electric Demand Data

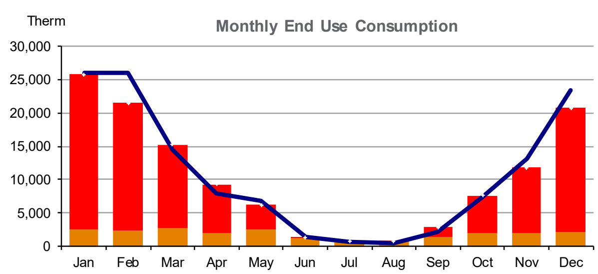
Electric Demand														kW
1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	1
Space Cool	32	24	142	459	428	506	577	583	443	309	169	26	3,699	Space Cool
Heat Reject.	0	0	0	6	4	5	7	7	4	1	0	0	34	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	4	11	2	0	0	0	0	0	0	0	0	8	25	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	0	0	0	0	0	0	0	0	0	0	0	0	0	Hot Water
Vent. Fans	87	87	87	90	91	91	90	90	91	90	87	87	1,070	Vent. Fans
Pumps & Aux.	62	63	71	70	70	70	70	70	70	70	71	63	822	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	96	96	96	96	96	96	54	54	96	96	96	96	1,063	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	310	310	310	310	310	310	310	310	310	310	310	310	3,720	Area Lights
Total	**591**	**590**	**707**	**1,030**	**999**	**1,079**	**1,108**	**1,115**	**1,014**	**877**	**733**	**590**	**10,433**	Total Model
Utility Baseline	618	595	740	808	869	898	869	883	939	854	787	615	9,475	Utility Baseline
Error	-4%	-1%	-4%	28%	15%	20%	27%	26%	8%	3%	-7%	-4%	10%	

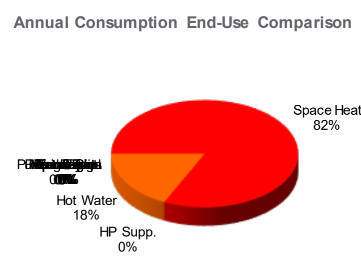




Natural Gas Energy Data

Natural Gas Consumption														Therm
1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	100
Space Cool	0	0	0	0	0	0	0	0	0	0	0	0	0	Space Cool
Heat Reject.	0	0	0	0	0	0	0	0	0	0	0	0	0	Heat Reject.
Refrigeration	0	0	0	0	0	0	0	0	0	0	0	0	0	Refrigeration
Space Heat	23,278	19,091	12,607	7,248	3,781	136	11	6	1,433	5,616	9,771	18,575	101,553	Space Heat
HP Supp.	0	0	0	0	0	0	0	0	0	0	0	0	0	HP Supp.
Hot Water	2,510	2,376	2,633	2,029	2,461	1,138	690	691	1,385	1,992	1,998	2,213	22,115	Hot Water
Vent. Fans	0	0	0	0	0	0	0	0	0	0	0	0	0	Vent. Fans
Pumps & Aux.	0	0	0	0	0	0	0	0	0	0	0	0	0	Pumps & Aux.
Ext. Usage	0	0	0	0	0	0	0	0	0	0	0	0	0	Ext. Usage
Misc. Equip.	0	0	0	0	0	0	0	0	0	0	0	0	0	Misc. Equip.
Task Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Task Lights
Area Lights	0	0	0	0	0	0	0	0	0	0	0	0	0	Area Lights
Total	**25,788**	**21,467**	**15,240**	**9,277**	**6,242**	**1,274**	**701**	**697**	**2,817**	**7,608**	**11,769**	**20,789**	**123,668**	Total Model
Utility Baseline	26,045	26,007	14,466	7,891	6,801	1,379	666	562	2,241	7,327	13,235	23,401	130,022	Utility Baseline
Error	-1%	-17%	5%	18%	-8%	-8%	5%	24%	26%	4%	-11%	-11%	-5%	





Savings Methods – ELEMENT

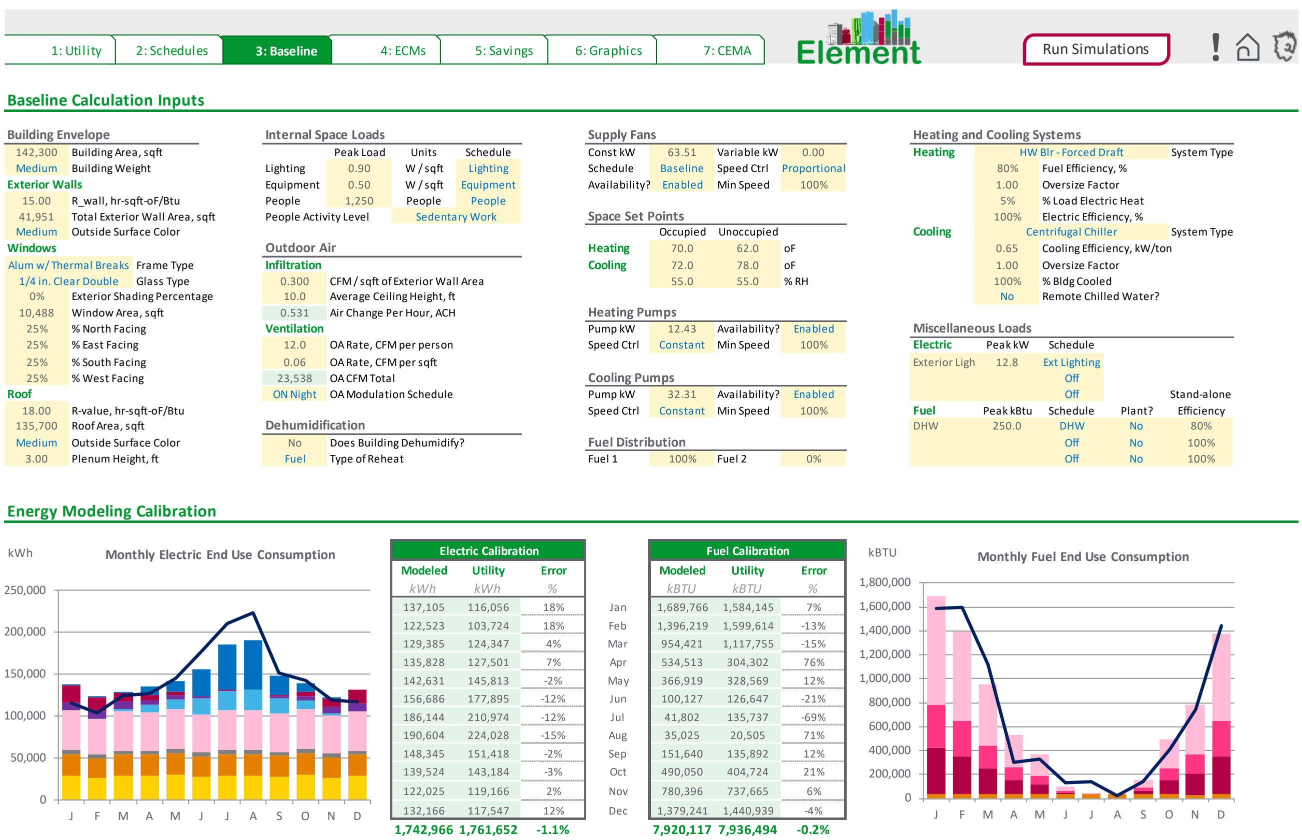
The ELEMENT tool was developed to provide transparency into the end use breakdown of energy consumption for each fuel type. The simplified building inputs and schedules are used in a powerful hourly load analysis to provide quick building calibrations. Energy saving scenarios can be run quickly to see the financial impact to the overall project and generate useful graphs for visualization and reports.

Introduction

ELEMENT is Schneider Electric's proprietary Microsoft Excel based spreadsheet calculation tool used for simulating building energy consumption. Its purpose is to allow a user with prior knowledge of a facility and its energy using equipment to simulate energy consumption, compare the outputs to historical utility data of the facility, breakout the calibrated baseline into its end use components and determine the energy savings of Energy Conservation Measures (ECMs).

The tool uses a variety of Excel functions and custom generated algorithms written in Visual Basic for Applications (VBA) to quickly simulate the energy consumption of a simple to moderately complex building. Heating and cooling loads are determined on an hourly basis (8,760 hours per year) using TMY2 or TMY3 weather data and the building definitions specified by the user. Loads are generated by the user inputs and key building variables are defined and adjusted to calibrate and predict energy impacts.

On the following page is an example of an Element model for Millstone River Elementary School. The element model below was used to predict savings for modified BAS scheduling as well as other ECMs.



Baseline Calculation Inputs

Building Envelope

142,300	Building Area, sqft
Medium	Building Weight
Exterior Walls	
15.00	R_wall, hr-sqft-oF/Btu
41,951	Total Exterior Wall Area, sqft
Medium	Outside Surface Color
Windows	
Alum w/ Thermal Breaks	Frame Type
1/4 in. Clear Double	Glass Type
0%	Exterior Shading Percentage
10,488	Window Area, sqft
25%	% North Facing
25%	% East Facing
25%	% South Facing
25%	% West Facing
Roof	
18.00	R-value, hr-sqft-oF/Btu
135,700	Roof Area, sqft
Medium	Outside Surface Color
3.00	Plenum Height, ft

Internal Space Loads

	Peak Load	Units	Schedule
Lighting	0.90	W / sqft	Lighting
Equipment	0.50	W / sqft	Equipment
People	1,250	People	People
People Activity Level		Sedentary Work	

Outdoor Air

Infiltration	
0.300	CFM / sqft of Exterior Wall Area
10.0	Average Ceiling Height, ft
0.531	Air Change Per Hour, ACH
Ventilation	
12.0	OA Rate, CFM per person
0.06	OA Rate, CFM per sqft
23,538	OA CFM Total
ON Night	OA Modulation Schedule

Dehumidification

No	Does Building Dehumidify?
Fuel	Type of Reheat

Supply Fans

Const kW	63.51	Variable kW	0.00
Schedule	Baseline	Speed Ctrl	Proportional
Availability?	Enabled	Min Speed	100%

Space Set Points

	Occupied	Unoccupied	
Heating	70.0	62.0	oF
Cooling	72.0	78.0	oF
	55.0	55.0	% RH

Heating Pumps

Pump kW	12.43	Availability?	Enabled
Speed Ctrl	Constant	Min Speed	100%

Cooling Pumps

Pump kW	32.31	Availability?	Enabled
Speed Ctrl	Constant	Min Speed	100%

Fuel Distribution

Fuel 1	100%	Fuel 2	0%

Heating and Cooling Systems

Heating	HW Blr - Forced Draft	System Type
	80%	Fuel Efficiency, %
	1.00	Oversize Factor
	5%	% Load Electric Heat
	100%	Electric Efficiency, %
Cooling	Centrifugal Chiller	System Type
	0.65	Cooling Efficiency, kW/ton
	1.00	Oversize Factor
	100%	% Bldg Cooled
	No	Remote Chilled Water?

Miscellaneous Loads

Electric	Peak kW	Schedule		
Exterior Ligh	12.8	Ext Lighting		
		Off		
		Off		Stand-alone
Fuel	Peak kBtu	Schedule	Plant?	Efficiency
DHW	250.0	DHW	No	80%
		Off	No	100%
		Off	No	100%

Energy Modeling Calibration

Electric Calibration				Fuel Calibration		
Modeled	Utility	Error		Modeled	Utility	Error
kWh	kWh	%		kBTU	kBTU	%
137,105	116,056	18%	Jan	1,689,766	1,584,145	7%
122,523	103,724	18%	Feb	1,396,219	1,599,614	-13%
129,385	124,347	4%	Mar	954,421	1,117,755	-15%
135,828	127,501	7%	Apr	534,513	304,302	76%
142,631	145,813	-2%	May	366,919	328,569	12%
156,686	177,895	-12%	Jun	100,127	126,647	-21%
186,144	210,974	-12%	Jul	41,802	135,737	-69%
190,604	224,028	-15%	Aug	35,025	20,505	71%
148,345	151,418	-2%	Sep	151,640	135,892	12%
139,524	143,184	-3%	Oct	490,050	404,724	21%
122,025	119,166	2%	Nov	780,396	737,665	6%
132,166	117,547	12%	Dec	1,379,241	1,440,939	-4%
1,742,966	**1,761,652**	**-1.1%**		**7,920,117**	**7,936,494**	**-0.2%**

Baseline Breakout Analysis

Electric Consumption

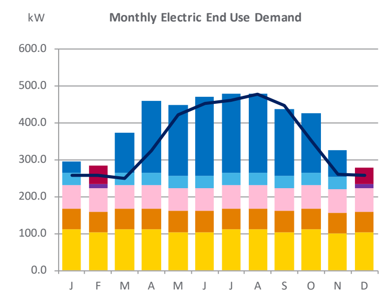
	Internal Loads		Miscellaneous Loads			Fans and Pumps			Heating and Cooling			
	Lighting	Equipment	xterior Lighti	0	0	Fans	Clg Pumps	Htg Pumps	Heating	Cooling	Dehumid	Reheat
	19.6%	17.5%	3.3%	0.0%	0.0%	31.9%	7.0%	3.5%	5.3%	11.9%	0.0%	0.0%
Month	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
1	29,254	25,963	4,813	0	0	47,254	162	9,183	20,417	59	0	0
2	26,510	23,494	4,347	0	0	42,681	485	8,164	16,812	29	0	0
3	28,574	25,625	4,813	0	0	47,254	2,714	8,202	11,251	953	0	0
4	28,793	25,365	4,657	0	0	45,730	8,885	5,530	6,069	10,799	0	0
5	29,934	26,301	4,813	0	0	47,254	12,084	4,598	3,971	13,677	0	0
6	27,433	24,689	4,657	0	0	45,730	19,547	1,429	792	32,409	0	0
7	29,254	25,963	4,813	0	0	47,254	23,650	149	79	54,983	0	0
8	29,254	25,963	4,813	0	0	47,254	24,038	0	0	59,282	0	0
9	28,113	25,027	4,657	0	0	45,730	17,899	2,063	1,402	23,454	0	0
10	29,934	26,301	4,813	0	0	47,254	10,662	5,145	5,512	9,903	0	0
11	26,753	24,351	4,657	0	0	45,730	2,229	8,090	9,105	1,110	0	0
12	28,574	25,625	4,813	0	0	47,254	162	9,183	16,556	0	0	0
	342,377	**304,664**	**56,664**	**0**	**0**	**556,383**	**122,517**	**61,736**	**91,966**	**206,659**	**0**	**0**

Fuel Consumption

	Miscellaneous Loads			Heating			
	DHW	0	0	Envelope	Infiltration	Ventilation	Reheat
	5.2%	0.0%	0.0%	22.5%	20.5%	51.9%	0.0%
Month	kBtu	kBtu	kBtu	kBtu	kBtu	kBtu	kBtu
1	35,025	0	0	384,093	362,822	907,826	0
2	31,800	0	0	319,291	295,817	749,311	0
3	33,750	0	0	215,454	191,599	513,619	0
4	34,800	0	0	119,946	106,991	272,776	0
5	36,300	0	0	81,808	70,774	178,037	0
6	32,250	0	0	16,752	13,998	37,127	0
7	35,025	0	0	1,700	1,416	3,660	0
8	35,025	0	0	0	0	0	0
9	33,525	0	0	29,350	24,731	64,034	0
10	36,300	0	0	114,368	98,992	240,390	0
11	30,975	0	0	179,631	160,877	408,913	0
12	33,750	0	0	316,163	293,129	736,199	0
	408,525	**0**	**0**	**1,778,556**	**1,621,145**	**4,111,892**	**0**

Electric Demand

	Internal Loads		Miscellaneous Loads			Fans and Pumps			Heating and Cooling			
	Lighting	Equipment	xterior Lighti	0	0	Fans	Clg Pumps	Htg Pumps	Heating	Cooling	Dehumid	Reheat
	27.0%	14.4%	0.0%	0.0%	0.0%	16.0%	6.8%	0.5%	1.9%	33.4%	0.0%	0.0%
Month	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW
1	111.4	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	30.4	0.0	0.0
2	102.5	56.9	0.0	0.0	0.0	63.5	0.0	12.4	49.6	0.0	0.0	0.0
3	111.4	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	108.6	0.0	0.0
4	111.4	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	195.2	0.0	0.0
5	103.7	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	193.1	0.0	0.0
6	103.7	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	215.4	0.0	0.0
7	111.4	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	215.4	0.0	0.0
8	111.4	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	215.4	0.0	0.0
9	103.7	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	181.1	0.0	0.0
10	111.4	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	162.2	0.0	0.0
11	99.9	56.9	0.0	0.0	0.0	63.5	32.3	0.0	0.0	72.0	0.0	0.0
12	102.5	56.9	0.0	0.0	0.0	63.5	0.0	12.4	43.0	0.0	0.0	0.0
	1,285	**683**	**0**	**0**	**0**	**762**	**323**	**25**	**93**	**1,589**	**0**	**0**



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 sequentially, building upon each other. This results in more accurate estimate of savings than if each ECM were run in comparison to the baseline.

ECMs outside of Energy Model

Some ECMs because of their scope, impact, and nature do not fit well within the energy models. For example, savings from water fixture replacements cannot be calculated in the eQuest or ELEMENT modeling software. When this is the case, in-house built tools are used to accurately estimate savings.

Savings Methodology by ECM

Below are the Energy Conservation Measures that are being implemented at WW-P as part of this project.

Building Automation System (BAS) Upgrades

Schneider Electric estimated savings by utilizing eQuest. Using a parametric run, a change was made to the model to reflect new setback and setup temperature schedules. Setups and setbacks are proposed to reduce the energy used by empty spaces after normal school hours.

Applicable To
High School South
Community Middle School
Grover Middle School
Dutch Neck Elementary School
Town Center Elementary School
Village Elementary School

LED Lighting — Interior

Spreadsheet calculations were utilized to accurately define the savings for this measure. Pre and post lighting wattages were compared as well as burn hours. Projected savings were also run through eQuest models for each school to ensure correctness and compliance.

Applicable To
High School North
High School South
Community Middle School
Grover Middle School
Dutch Neck Elementary School
Maurice Hawk Elementary School
Millstone River Elementary School
Town Center Elementary School
Village Elementary School

Wicoff Elementary School
Special Services Building
Buildings & Grounds Building
Maintenance Building

LED Lighting – Exterior

Spreadsheet calculations were utilized to accurately define the savings for this measure.

Applicable To
High School North
High School South
Community Middle School
Grover Middle School
Dutch Neck Elementary School
Millstone River Elementary School
Town Center Elementary School
Village Elementary School
Wicoff Elementary School
Special Services Building
Maintenance Building

Occupancy Sensors for Lighting Control

Spreadsheet calculations were utilized to accurately define the savings for this measure. Pre and post burn hours were derived from on-site data collection. Projected savings were also run through eQuest models for each school to ensure correctness and compliance.

Applicable To
School North
High School South
Community Middle School

Grover Middle School
Dutch Neck Elementary School
Maurice Hawk Elementary School
Millstone River Elementary School
Town Center Elementary School
Village Elementary School
Wicoff Elementary School
Special Services Building
Buildings & Grounds Building
Maintenance Building

Air Sealing Improvements

Schneider Electric uses typical meteorological year (TMY) weather data, draft pressure, internal space temperatures (both occupied and unoccupied), and crack size to conduct savings calculations. Schneider Electric follows ASTM E1186-03 Standard Practices for air leakage in building envelope. ASHRAE Fundamentals 16.23-48 was used to calculate the flow rate and crack method for all envelope calculations.

Applicable To
High School North
High School South
Community Middle School
Grover Middle School
Dutch Neck Elementary School
Maurice Hawk Elementary School
Millstone River Elementary School
Town Center Elementary School
Village Elementary School
Special Services Building
Maintenance Building

Kitchen Hood Control

Savings can be achieved from this ECM by reducing run time for kitchen hoods through scheduling. The kitchen hoods can also be monitored via the building automation system.

Applicable To
High School North
High School South
Community Middle School
Grover Middle School
Dutch Neck Elementary School
Maurice Hawk Elementary School
Millstone River Elementary School
Town Center Elementary School
Village Elementary School

Variable Frequency Drives

Significant energy savings can be achieved by converting a constant volume system to variable volume with the use of VFDs.

Applicable To
West Windsor-Plainsboro High School South
Dutch Neck Elementary School
Millstone River Elementary School
Town Center Elementary School

Water Conservation

Schneider Electric used excel spreadsheets to compare pre and post flow rates to generate water savings.

Applicable To
High School North
School South
Community Middle School
Grover Middle School
Dutch Neck Elementary School
Maurice Hawk Elementary School
Millstone River Elementary School
Town Center Elementary School
Village Elementary School
Wicoff Elementary School
Special Services Building

Walk-In Refrigeration Controls

Schneider Electric partnered with National Resource Management, Inc to generate savings for the walk-in freezer and refrigerator retrofits. Spreadsheet based calculations were used by NRM to generate kWh savings, which were reviewed by Schneider Electric.

Applicable To
High School South
Community Middle School
Grover Middle School
Maurice Hawk Elementary School
Millstone River Elementary School
Town Center Elementary School
Village Elementary School

Pipe Insulation

Un-insulated pipes can unnecessarily overheat conditioned spaces as well as the unconditioned, unexcavated spaces, resulting in a loss of energy throughout. Spreadsheet calculations were used to calculate savings for pipe insulation.

Applicable To
High School North
High School South
Community Middle School
Dutch Neck Elementary School
Maurice Hawk Elementary School
Millstone River Elementary School
Town Center Elementary School
Village Elementary School
Wicoff Elementary School

High Efficiency Transformers

Schneider Electric partnered with Powersmiths to determine savings for this measure. Spreadsheet based calculations were used by Powersmiths to generate kWh savings, which were reviewed by Schneider Electric.

Applicable To
High School North
High School South
Community Middle School
Grover Middle School
Dutch Neck Elementary School
Maurice Hawk Elementary School
Millstone River Elementary School
Town Center Elementary School
Village Elementary School

HVAC Upgrades

Schneider Electric generated savings for this measure internally using eQuest modelling software. Several of these systems will incorporate measures to control outdoor air and recover energy. The savings calculations were then thoroughly reviewed for accuracy and correctness.

Applicable To
High School South
Community Middle School
Dutch Neck Elementary School

Chiller/Cooling Tower Replacement

This measure will replace antiquated chillers with new, higher efficiency systems to improve the overall performance of the cooling plant.

Applicable To
High School South

Boiler Replacement

The existing hot water boiler plant is nearing the end of its useful life and would benefit from replacement with new, high efficiency boilers sized with overall operating efficiency in mind.

Applicable To
Community Middle School

Combined Heat and Power

Combined heat and power (CHP) systems can generate both heating energy as well as electrical power. Such systems can significantly reduce electric load of a building on the grid. The Pool boiler at the High School will be incorporated into such a system. The savings for this measure were calculated and reviewed internally.

Applicable To
High School South

The CHP will be used for heating the pool water only and not the rest of the building. The pool being in an indoor controlled environment has very little variation in heating requirement annually. Pool occupancy has minimal impact on the heating requirement of the pool water as the pool water will be maintained 24/7. Therefore, the evaporation/water cooling rate will be constant in all seasons.

As such, the overall run hours will likely be close to 8760 with 60 hours removed for maintenance downtime which has been incorporated into the summer months.

Solar Power Purchase Agreement (PPA)

Energy savings for the solar PPA were calculated in Excel by comparing the current electric consumption charges with the targeted PPA rate, and multiplying the difference by the anticipated production of the solar PV system.

$$Savings\ (\$) = PPA\ production\ (kWh) * \left(existing\ consumption\ only\ charges\ \left(\frac{\$}{kWh}\right) - New\ Solar\ PPA\ Rate\ \left(\frac{\$}{kWh}\right)\right)$$

Applicable To
High School North
High School South
Grover Middle School
Dutch Neck Elementary School
Maurice Hawk Elementary School
Millstone River Elementary School
Village Elementary School
Wicoff Elementary School

Please see Appendix 7.1 for additional savings calculation documentation.

7.2 Sample School Calendar

WEST WINDSOR-PLAINSBORO REGIONAL SCHOOL DISTRICT
2019-2020 SCHOOL YEAR CALENDAR

SEPTEMBER 2019

M	T	W	Th	F
2	3	4	**5**	6
9	10	11	12	13
16	17	18	19	20
23	24	25	26	27
30				

FEBRUARY 2020

M	T	W	Th	F
3	4	5	6	7
10	11	12	13	14
17	18	19	20	21
24	25	26	27	28

COLOR CODES

Red	Schools Closed
Blue	Emergency Closing Day
Yellow	Early Dismissal: Conferences
Green	Early Dismissal Day K-12
Purple	Professional Development Day
Orange	PD Day. NEW Teachers Only

OCTOBER 2019

M	T	W	Th	F
	1	2	3	4
7	8	9	10	11
14	15	16	17	18
21	22	23	24	25
28	29	30	31	

MARCH 2020

M	T	W	Th	F
2	3	4	5	6
9	10	11	12	13
16	17	18	19	20
23	24	25	26	27
30	31			

FALL 2019

8/26-8/29	Professional Development Days. NEW TEACHERS ONLY
9/2	Labor Day. Schools Closed.
9/3-9/4	PD Days for Staff
9/5	First Day of School
9/30	Schools Closed
10/9	Schools Closed
10/17-18	Early Dismissal K-8: Conferences
10/21-22	Early Dismissal K-5. Conferences
11/7-11/8	Schools Closed
11/27	Early Dismissal K-12
11/28-11/29	Schools Closed. Thanksgiving Recess

NOVEMBER 2019

M	T	W	Th	F
				1
4	5	6	7	8
11	12	13	14	15
18	19	20	21	22
25	26	27	28	29

APRIL 2020

M	T	W	Th	F
		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
27	28	29	30	

WINTER 2019-2020

12/20	Early Dismissal K-12. Winter Recess
12/23-12/31	Schools Closed. Winter Recess
1/1	Schools Closed. Winter Recess
1/16-1/17	Early Dismissal K-5 Parent-Teacher Conferences
1/20	Schools Closed
2/10-2/11	Early Dismissal 6-8. Parent-Teacher Conferences
2/14	Schools Closed. PD Day
2/17	Schools Closed

DECEMBER 2019

M	T	W	Th	F
2	3	4	5	6
9	10	11	12	13
16	17	18	19	20
23	24	25	26	27
30	31			

MAY 2020

M	T	W	Th	F
				1
4	5	6	7	8
11	12	13	14	15
18	19	20	21	22
25	26	27	28	29

SPRING 2020

4/3	Early Dismissal K-5. Parent-Teacher Conferences
4/8-4/9	Emergency Closing Days
4/10	Schools Closed. Spring Recess
4/13-4/17	Schools Closed. Spring Recess
5/25	Schools Closed.
5/26	Emergency Closing Day
6/19	Last Day of School. Early Dismissal K-12. High School Graduation
6/22	Professional Development Day. NEW TEACHERS ONLY

JANUARY 2020

M	T	W	Th	F
		1	2	3
6	7	8	9	10
13	14	15	16	17
20	21	22	23	24
27	28	29	30	31

JUNE 2020

M	T	W	Th	F
1	2	3	4	5
8	9	10	11	12
15	16	17	18	19
22	23	24	25	26
29	30			

EMERGENCY CLOSING DAYS

Days Used	Schools Will Be Open On:
1	April 8, 2020
2	April 9, 2020
3	May 26, 2020
4	-------

Note: If we have no emergency closing days, schools are closed on April 8, April 9, and May 26, 2020.

BOARD APPROVAL: November 28, 2017

7.3 HVAC System Evaluation Reports

Please see the following pages for copies of HVAC System Evaluation Reports for the following schools:

1. HSS
2. Dutch Neck
3. Maurice Hawk
4. Community MS
5. Town Center
6. Village
7. Grover MS

7.4 Solar Proposal & Preliminary Panel Layouts

Please see the following pages for excerpts from the winning PPA RFP response along with preliminary solar design layouts.

7.5 Lighting Line by Line

Please see lighting line by lines attached.

7.6 Combined Heat & Power (CHP): Sample Specification

Please see the following pages.

7.7 Water Conservation: Sample Submittal

Please see the following pages.

7.8 Local Government Energy Audit (LGEA)

Please see the following pages for a copy of the Local Government Energy Audit (LGEA).

7.9 Third Party Review & Approval Report

Please see the following pages for a copy of the Third-Party Review Report.

WEST WINDSOR - PLAINSBORO BOARD OF EDUCATION - THIRD PARTY ENERGY SAVINGS PLAN REVIEW

November 12, 2019

Final Revised November 25, 2019

Prepared by: DLB Associates
(dlb # 15051)

WEST WINDSOR - PLAINSBORO BOARD OF EDUCATION - THIRD PARTY ENERGY SAVINGS PLAN REVIEW

Table of Contents

SECTION 1: EXECUTIVE SUMMARY

WEST WINDSOR - PLAINSBORO BOARD OF EDUCATION - THIRD PARTY ENERGY SAVINGS PLAN REVIEW

1.1 Executive Summary

1.1.1 Overview

DLB Associates has been commissioned by the West Windsor - Plainsboro Board of Education to provide a Third-Party Review of an Energy Savings Plan (ESP) for conformance with State requirements for ten (10) of the Board's facilities. State requirements are set forth in P.L. 2009, Chapter 4, "Energy Savings Improvement Program" and Local Finance Notices 2009-11 and 2011-17. Amendments to P.L. 2009, Chapter 4, are included in P.L. 2012, Chapter 55.

DLB's review includes an analysis of the Energy Savings Plan for conformance with the New Jersey Board of Public Utilities (BPU) Standards and for verification that all required sections were submitted in the ESP Report. A review of the calculations methodology and plan savings as specified by the BPU protocol also was performed.

This report includes the summary and conclusions of DLB's Third-Party Review of the submitted Energy Savings Plan prepared by Schneider Electric and dated October 24, 2019.

1.1.2 Energy Savings Plan Review

The ESP appears to be complete and contains the required components. DLB has indicated items for further review and expect that the comments can be incorporated without affecting the ESP results significantly.

1.1.3 Energy Savings Calculations Review

The review of the energy savings calculations included within the ESP concluded that the calculations were performed in accordance with industry standard practice and utilizing the intent of the BPU protocol. Spreadsheet analyses were used to calculate Energy Conservation Measure (ECM) savings. The equations used to determine savings follow the protocol's calculation methods for energy efficient construction, but DLB recommends a few areas be clarified as identified in this report.

1.1.4 Conclusion

Both the ESP and the associated calculations appear to be completed with satisfactory effort and in accordance with P.L. 2012, Chapter 55, Amendments to "Energy Savings Improvement Program" and Local Finance Notices 2009-11 and 2011-17. A few calculations and concepts should be verified as indicated within the body of this report and revisions should be reviewed and addressed prior to adoption by the West Windsor - Plainsboro Board of Education. Overall, DLB comments should have a low impact on the predicted savings.

DLB comments have been addressed in the attached Appendix by Schneider Electric, sent to DLB November 20, 2019, and have been incorporated into the revised ESP. The Energy Savings Plan is ready for review and adoption by the West Windsor-Plainsboro Board of Education.

We have reviewed the revised West Windsor-Plainsboro Board of Education Energy Savings Plan dated November 20, 2019, as submitted by Schneider Electric in accordance with P.L. 2012, c. 55 (2009 c.4.).

WEST WINDSOR - PLAINSBORO BOARD OF EDUCATION - THIRD PARTY ENERGY SAVINGS PLAN REVIEW

According to this legislation, an independent third party must review the plan and certify that the plan savings were properly calculated pursuant to the Board of Public Utilities protocols and / or the International Performance Measurement and Verification Protocol.

As a qualified New Jersey licensed engineer and in accordance with good engineering principles, we have reviewed each calculation outlined in the plan along with the associated energy conservation measure described. Our review indicates that the plan was established and compiled with sound measurement and verification protocols and in compliance with established standards set by the NJBPU.

SECTION 2: ENERGY SAVINGS PLAN REVIEW

WEST WINDSOR - PLAINSBORO BOARD OF EDUCATION - THIRD PARTY ENERGY SAVINGS PLAN REVIEW

2.1 Executive Summary

2.1.1 Energy Savings Plan Overview

The ESP reviewed by DLB Associates was prepared by Schneider Electric and dated October 24, 2019. The ESP Report includes an analysis for the following ten (10) facilities:

FACILITY INFORMATION	
Building Name	**Street Address**
High School North	90 Grovers Mill Road Plainsboro, New Jersey 08536
High School South	346 Clarksville Road West Windsor Township, New Jersey 08550
Community Middle School	95 Grovers Mill Road Plainsboro, New Jersey 08536
Thomas Grover Middle School	10 Southfield Road West Windsor, New Jersey 08550
Dutch Neck Elementary School	392 Village Road East West Windsor, New Jersey 08550
Maurice Hawk Elementary School	303-305 Clarksville Road West Windsor, New Jersey 08550
Millstone River Elementary School	75 Grovers Mill Road Plainsboro, New Jersey 08536
Town Center Elementary School	700 Wyndhurst Drive Plainsboro, New Jersey 08536
Village Elementary School	601 New Village Road West Windsor, New Jersey 08550
Wicoff Elementary School	510 Plainsboro Road Plainsboro, New Jersey 08536

SECTION 3: ENERGY SAVINGS PLAN REVIEW

3.1 Energy Savings Plan Review

3.1.1 Plan Components – Required By P.L. 2012, C.55

The Energy Savings Plan is the core of the Energy Savings Implementation Program (ESIP) process. Planned ECMs are described and the cost calculations supporting how the plan will pay for itself in reduced energy costs are provided. Under the law, the ESP must address the following elements:

- Energy audit results
- Energy conservation measure descriptions
- Greenhouse gas reduction calculations based on energy savings
- Design and compliance issue identification and identification of who will provide these services
- Risk assessment for the successful implementation of the plan
- Identification of eligibility, costs and revenues for demand response and curtailable service activities
- Schedules showing calculations of all costs of implementing the proposed energy conservation measures and the projected energy savings
- Maintenance requirements necessary to ensure continued energy savings
- Description and cost estimates for energy services company (ESCO) savings guarantee

3.1.2 Plan Components – Submitted Plan Review

The submitted ESP, dated October 24, 2019, is the basis for the Third-Party Review. The table below lists the required elements of the ESP as required by the law, whether the items were addressed satisfactorily in the ESP, and any associated comments.

ENERGY SAVINGS PLAN COMPONENT REVIEW			
Plan Component	**Included In Plan**	**Location In Plan**	**Comments**
Energy Audit Results	Yes	Entire Plan	See Below
ECM Descriptions	Yes	Section 3, Pages 11 – 43	See Section 4 of this Report
Greenhouse Gas Calculations	Yes	Section 4.3	See Section 4.1.6 of this Report
Design and Compliance Issues	Yes	Section 6, Pages 55	None
Implementation Risk Assessment	Yes	Section 6, Page 55	None
Demand Response Program / Curtailable Energy Services	Yes	Section 2.4, Page 10	None
Implementation Costs	Yes	Section 2, Page 6-8	See Section 4.1.5 of this Report
Projected Energy Savings	Yes	Section 2, Page 6	See Section 4 of this Report
Maintenance Requirements	Yes	Section 5.3, Page 54	Could be expanded to include recommended maintenance impacts
Savings Guarantee Information	No	Not found	None
Measurement and Verification Plan	Yes	Section 5.2, Pages 54	None

SECTION 4: ENERGY SAVINGS CALCULATIONS REVIEW

4.1 Energy Savings Calculations Review

4.1.1 Methodology of Submitted Calculations

The Energy Savings Improvement Plan included calculations that utilized BPU-acceptable equations and spreadsheet analyses.

The seventeen (17) ECMs analyzed and accepted in the base project include:

1. LED Lighting Upgrades
2. Air Sealing Improvements
3. Variable Speed Drives
4. Kitchen Hood Control
5. Whole School Metering
6. School Addition Metering
7. Water Fixture Improvements
8. Cooling Tower Submeters
9. Walk-in Refrigeration Controls
10. Pipe Insulation
11. High Efficiency Transformers
12. Solar Power Purchase Agreement (PPA)
13. Pay for Performance (P4P) Incentives
14. HVAC System Evaluation
15. Combined Heat and Power (CHP)
16. Building Automation System (BAS) Upgrade
17. HVAC Upgrades

4.1.2 General Calculation Quality

The quality of the energy savings calculations is satisfactory and representative sample sets were checked for accuracy. Spreadsheet analyses were provided by Schneider Electric as separate appendix files and have been spot-checked by DLB.

The approach and equations used were summarized broadly in the body of the report with no results given in the ECM description sections. References for equations were listed for some ECMs in the report body. The report body could be expanded to include more details on methodology and results for clarity, but they are included in the Appendix sections.

DLB notes the following comments for the overall report:

1. Any ECMs which propose to modify temperature setpoints or operation schedules of any equipment, including, but not limited to, HVAC equipment, equipment connected to plug load control devices, walk-in freezers or coolers or computing equipment, should be confirmed with the District to ensure there will be no detrimental operations impacts.
2. The total kWh and therm savings for the project should be verified and updated for consistency throughout the report.
3. eQuest was noted as being used to calculate savings for certain ECMs and it is suggested that the eQuest baseline variables and model results are included for these ECMs to back up savings calculations.

4.1.3 Mechanical and Electrical Energy Conservation Measures

ECMs were evaluated using spreadsheet analyses. The ECMs submitted agree with Standard Industry Practice and BPU protocol requirements.

DLB notes the following possible issues with the ECM analysis:

ECM 2 – Air Sealing Improvements (All except WES)

1. It appears that the calculations in Appendix 7.1.2 is only for NBSD but this ECM is for all facilities. Make sure the final report includes separate calculations for each facility that would match up to the savings in section 4.2.
2. Verify temperature settings with operations – think the settings noted here are different than those noted on the one eQuest baseline sheet included in the report.

ECM 3 – Variable Speed Drives (HSS, DNES, MRES, TCES)

1. Annual Electric Savings (kWh/yr) calculations are not shown. Clarify if this was modeled in eQuest or Excel Calculations and provide data to support savings.

2. It appears VFDs are to be installed on VAVs, CVs, Hot Water Pumps, and Chilled Water Pumps. Please confirm that the equipment / system being retrofitted will work with VFDs or if replacement with inverter duty motors is included in the cost for this ECM.

ECM 4 – Kitchen Hood Control (All except WES)

1. It appears that the calculations in Appendix 7.1.2 is only for HSS but this ECM is for all facilities. Make sure the final report includes separate calculations for each facility that would match up to the savings in section 4.2.
2. Is there a current procedure present for hood control or are the fans turned on in the beginning of the day and turned off at the end of the day?
3. It seems the information provided on page 22 of ESP does not match page 68; change to match.
4. Note if this ECM includes any modifications to the volume of kitchen Make Up Air supplied to the kitchen areas to accommodate reduction in exhaust

ECM 5 – Whole School Metering (VES)

1. Confirm that this is only Electric Utility Metering and does not include Natural Gas or Water utility metering.
2. Are there any annual subscriptions or proprietary software associated with this Metering system and If so, are these also included in the costs?

ECM 6 – School Addition Metering (HSS, CMS, MHES, TCES)

1. Confirm that this is only Electric Utility Metering and does not include Natural Gas or Water utility metering.

ECM 7 – Water Fixture Improvements (All)

1. Confirm that total savings for this measure is estimated at ~ $ 43,000 and the total water utility costs for the district is ~ $ 173,000, which is over 20% savings.
2. It appears that lavatory sinks were estimated at 0.37 GPM which is more aggressive than the suggested BPU Protocol 0.5 GPM for public restrooms.
3. 3.05 GPF pre-retrofit flow rate for toilets seems to indicate older style fixtures. Has it been confirmed that these fixtures are compatible with new valves or valve refurbishment and would not have to be replaced to accommodate lower flow rates?

ECM 8 – Cooling Tower Submeters (DNES, TCES, VES)

1. Has it been confirmed with the local utility that they will allow reduction in utility cost for this metering?
2. There were no calculations included for this ECM. We suggest either Excel Calculations or eQuest modeling data be included to back up the savings.

ECM 9 – Walk-in Refrigeration Controls (All except DNES and WES)

1. Baseline electric consumption values are provided for each type of unit, but no explanation of how these were determined is provided. DLB suggests providing a calculation or description stating how these values were obtained.
2. The calculations seem to calculate savings by applying a general 46% savings factor to the baseline consumption. Additional detail should be included to define how this savings factor is derived.
3. It appears that the calculations in Appendix 7.1.2 is only for HSS but this ECM is for multiple facilities. Make sure the final report includes separate calculations for each facility that would match up to the savings in section 4.2.

ECM 10 – Pipe Insulation (All except GMS)

1. The Appendix includes insulation thicknesses for each pipe to be repaired but it is unclear how this relates to the chart included in the ESIP. It may be beneficial to add some additional detail. The piping systems are indicated; however, system operating temperatures are not shown. The temperatures should be included to confirm insulation thicknesses.
2. Calculations use 5110 hours for heating. Confirm these operating hours with the school facility personnel.
3. Additional supporting data should be provided for this ECM, including information on the heat loss coefficients, the fluid and ambient temperature assumptions, and heating equipment efficiencies assumed.
4. It appears that the calculations in Appendix 7.1.2 is only for HSS but this ECM is for multiple facilities. Make sure the final report includes separate calculations for each facility that would match up to the savings in section 4.2.

ECM 11 – High Efficiency Transformers (All except WES)

1. It would be beneficial to define where the "Baseline Transformer Losses" are based on. Not sure if these are manufacturer published data or field measured.
2. The age of the existing transformers to be replaced should be included in the report.
3. It appears that the savings do not match the P4P typical annual loss table for transformers; from the Appendix a 75 kVa is listed as 6,010 kWh savings and the P4P table uses 4,600 for pre TP-1. Double check these if the transformer savings is being used for P4P incentives.
4. Would be good to verify what incentive / rebates are tied to this Transformer Upgrade ECM.

ECM 12 – Solar Power Purchase Agreement (All except CMS, TCES)

1. DLB recommends noting some of the PPA agreement requirements for reference such as: panel warranty, panel removal terms, any specific insurance provisions or site licensure or access requirements.
2. If the new solar panels are proposed to be installed on sections of the roof of various buildings of various ages and roof materials, we suggest clarification be added on who would be responsible for any structural modifications required to support the weight of the new solar panels, and if applicable, include the associated costs in the financial analysis.
3. It is unclear if maintenance access was taken into account in the general panel layout which should be considered for any roof top equipment.
4. Also, it may be worthwhile to highlight any system downtime incorporated in the estimated production values. From what we have seen, some PPA vendors note this in their contracts and we have seen downtimes that stretch for months which would affect savings.
5. Are any of the proposed solar array sizes close to or higher than 80% of building usage / service sizes?
6. Appendix includes solar PPA resolution and projected PV sizes for each school but it does not contain information of where this data was obtained, BPU protocols recombed PV Watts.

ECM 13 – Pay For Improvement (P4P) Incentives (HSN, HSS, CMS, MHES, VES)

1. Has initial eligibility (Incentive 0 applications) been submitted for P4P to confirm base eligibility for these schools?
2. The table in 2.1 shows $124,430 for this ECM as a Hard Cost; what does this cost represent?
3. Table in 2.4 lists dollar amounts anticipated for all three incentives. Please provide written explanation or example calculations to support those and verify that that ECMs being applied to these do not overlap.
4. Are there calculations / measurements indicating buildings' eligibility (200kW peak demand, 15% source energy savings) for this incentive available? It may be worthwhile to illustrate how close the proposed ECMS are to the 15% threshold.

ECM 14 – Equipment Evaluation Study (All except HSN, MRES, WES)

1. Confirm there was no Retro-Commissioning (no work from this effort to adjust or maintenance to do list) to optimize or restore performance of any systems.
2. There is no energy savings noted for this effort and we want to confirm this is a capital improvement project as well.

ECM 15 – Combined Heat and Power (HSS)

1. ESP calls for the installation of a Yanmar CP35D1 CHP. It may be beneficial to include the equipment information on this unit to further detail performance and operational requirements of the system.
2. It appears that eQuest was used to develop savings for this ECM. It is recommended to include the baseline and individual runs for these calculations in the Appendix sections.
3. Please confirm that maintenance costs / contract is included in overall cost for this ECM. CHP systems have a very rigorous maintenance schedule.
4. It may be beneficial to note the total expected operating hours that the CHP Plant is planned to be run and verify with the BOE personnel. It appears from the description tis will be run 100% of the time for the entire year.
5. Since this is integral to the payment terms, it may be beneficial to confirm with the facility personnel that there is enough space at the site for the CHP system and the connections to the existing heating hot water system. Also, the installation location should be reviewed to ensure there will not be any noise issues with running 24/7.

ECM 16 – BAS Upgrade To Common Front End (HSS, DNES, CMS, TCES, VES, GMS)

1. ECM description includes central boiler plant, terminal units and common area AHU units for most of the schools. Clarify if any Exhaust Fans are included in the DDC control scope (if applicable).
2. There are no calculations included for this ECM and methodology or calculations should be included in the report or Appendix to define these values. If these were eQuest runs, the individual baseline and ECM output sheets could be included.
3. The savings for Community MS appears to be ~ 20% of its overall energy use; the savings value for this one should be confirmed.
4. Number of the descriptions note existing pneumatic control systems that typically require complete rewiring and device replacement such as in High School South. We wanted to verify that complete system replacement was covered in the scope in these facilities.

ECM 17 – HVAC Upgrades (High School south, Dutch Neck, Community MS)

1. Confirming that these are BOE driven Capital Improvement projects. The payback all of these replacements are beyond the overall Energy Savings Plan timeframe.
2. A slight energy savings was noted for some of these HVAC improvements such as chiller replacement and boiler replacement which is expected, and savings methodology or calculations should be included in the report or Appendix files to define these values.
3. Were maintained savings taken into account for the preplacement of older equipment?

4.1.4 Lighting Energy Conservation Measures

Lighting improvement savings calculations were performed in a satisfactory manner using a spreadsheet analysis and reviewed in a spot-check fashion.

DLB notes the following potential issues with the lighting ECM analysis:

ECM 1 – Comprehensive LED Lighting Upgrades (District Wide)

1. It may be beneficial to include details on the recommended model for the replacement lamp – not sure if lamp or line voltage upgrade kits are being proposed.
2. If line voltage upgrade kits, we would suggest model information is included to make sure the recommended retrofit maintains the UL listing of the light fixtures.
3. For lamp replacement projects, is a maintenance savings taken into account for extended life?
4. The quantity of fixtures being replaced should be identical and should be checked. In the "Lighting Line by Line" Table there appears to be a few locations where the quantity numbers differ, such as in a Private Office (ID#3228) (9 vs. 5), but these may relate to lamps not fixtures.
5. Please identify reduction in hours for some areas, such as "Weight Room 506" (4000 vs 3200), that appear in the "Lighting Line by Line" Table.
6. Please identify source of "Current Hours." It appears that offices use 3,300 and classrooms use 2,000 operational hours, which differs from the suggested hours of operation in the BPU protocol.
7. The energy savings calculations do not appear to utilize the Iterative Factor (IF) used in the BPU Protocols.
8. Confirm that the lighting upgrade also includes lighting control upgrades.

4.1.5 Financial Calculations

The financial calculations included within the ESP incorporate a 2.3% interest rate for the loan and the BPU-required 2.2% electric and 2.4% natural gas and fuel oil utility escalation.

The recommended plan includes thirty-one (31) ECMs and is analyzed over a 20-year financing term.

DLB notes the following potential issues with the financial calculations:

1. Cash Flow Form shown on page 8 of the report shows an installation year savings of ~ $ 177, 000 and a total year 1 savings of ~ $ 1,174,000. The total savings shown in the cost summary on page 6 is ~ $ 1,174,000. This initial savings and savings values should be reviewed and coordinated or an explanation added to define the lower installation year savings value.
2. Cash Flow Form shown on page 8 includes a total of $ 387,674 Energy Rebates / Incentives to be received in installation year. Confirm the schedule; some of these rebates are issued after ECMs are installed which may be in year 1.

3. LFN 2009-11 requires that any capital improvements be paid through other appropriations (i.e., bonds or capital improvement funds), not energy savings obligations. DLB recommends confirming that any capital improvements are planned to be funded appropriately.

4.1.6 Greenhouse Gas Calculations

Greenhouse Gas Calculations are provided and the factors used to calculate savings are clearly called out in the report. The factors should be revised to meet the current BPU guidelines, shown on page 13 of the protocol:

- 1,374 lbs. CO_2 per MWh saved
- 1.11 lbs. NO_x per MWh saved
- 0.98 lbs. SO_2 per MWh saved
- 11.7 lbs. CO_2 per therm saved
- 0.0092 lbs. NO_x per therm saved

SECTION 5: REVIEW DISCLAIMER

5.1 Review Disclaimer

DLB Associates, as part of the Third-Party Review services, is providing our professional opinion in the evaluation of the energy savings calculations, ESP, and any other supporting documentation provided.

This evaluation is not a guarantee that the savings and assumptions stated are valid. DLB Associates will not be responsible for any failure in achieving the predicted energy and cost savings detailed.

Our intention is to complete our due diligence in verifying the energy savings calculations in accordance with the BPU protocols; however, it is impractical to review all inputs in detail. As a result, bottom line numbers and a limited number of parameters have been verified to conclude validity of savings.

SECTION 6: ATTACHMENT

WEST WINDSOR - PLAINSBORO BOARD OF EDUCATION - THIRD PARTY ENERGY SAVINGS PLAN REVIEW

November 12, 2019

November 20, 2019: SE Responses

Prepared by: DLB Associates
(dlb # 15051)

3.1.2 Plan Components – Submitted Plan Review

The submitted ESP, dated October 24, 2019, is the basis for the Third-Party Review. The table below lists the required elements of the ESP as required by the law, whether the items were addressed satisfactorily in the ESP, and any associated comments.

ENERGY SAVINGS PLAN COMPONENT REVIEW			
Plan Component	**Included In Plan**	**Location In Plan**	**Comments**
Energy Audit Results	Yes	Entire Plan	See Below
ECM Descriptions	Yes	Section 3, Pages 11 – 43	See Section 4 of this Report
Greenhouse Gas Calculations	Yes	Section 4.3	See Section 4.1.6 of this Report
Design and Compliance Issues	Yes	Section 6, Pages 55	None
Implementation Risk Assessment	Yes	Section 6, Page 55	None
Demand Response Program / Curtailable Energy Services	Yes	Section 2.4, Page 10	None
Implementation Costs	Yes	Section 2, Page 6-8	See Section 4.1.5 of this Report
Projected Energy Savings	Yes	Section 2, Page 6	See Section 4 of this Report
Maintenance Requirements	Yes	Section 5.3, Page 54	Could be expanded to include recommended maintenance impacts
Savings Guarantee Information	No	Not found	None
Measurement and Verification Plan	Yes	Section 5.2, Pages 54	None

The savings guarantee information can be found in Section 5.2, pages 54. It has been clarified that the PASS plan includes the financial guarantee.

4.1.2 General Calculation Quality

The quality of the energy savings calculations is satisfactory and representative sample sets were checked for accuracy. Spreadsheet analyses were provided by Schneider Electric as separate appendix files and have been spot-checked by DLB.

The approach and equations used were summarized broadly in the body of the report with no results given in the ECM description sections. References for equations were listed for some ECMs in the report body. The report body could be expanded to include more details on methodology and results for clarity, but they are included in the Appendix sections.

DLB notes the following comments for the overall report:

1. Any ECMs which propose to modify temperature setpoints or operation schedules of any equipment, including, but not limited to, HVAC equipment, equipment connected to plug load control devices, walk-in freezers or coolers or computing equipment, should be confirmed with the District to ensure there will be no detrimental operations impacts.

   Our “Standards of Comfort” and “Key Operating Strategies” have been included in the appendices, and have also been reviewed and discussed with the District.

2. The total kWh and therm savings for the project should be verified and updated for consistency throughout the report.

   KWh and therm savings appear to be consistent. Please specify where if you find an error.

3. eQuest was noted as being used to calculate savings for certain ECMs and it is suggested that the eQuest baseline variables and model results are included for these ECMs to back up savings calculations.

   eQuest generated results are consolidated and presented through our ‘eQuestrian’ excel tool. The baseline as well as all applicable ECMs that were run through eQuest are included in the appendices.

4.1.3 Mechanical and Electrical Energy Conservation Measures

ECMs were evaluated using spreadsheet analyses. The ECMs submitted agree with Standard Industry Practice and BPU protocol requirements.

DLB notes the following possible issues with the ECM analysis:

ECM 2 – Air Sealing Improvements (All except WES)

1. It appears that the calculations in Appendix 7.1.2 is only for NBSD but this ECM is for all facilities. Make sure the final report includes separate calculations for each facility that would match up to the savings in section 4.2.

   The typo (NBSD) has been corrected and calculations for applicable facilities have been included in the appendices.

2. Verify temperature settings with operations – think the settings noted here are different than those noted on the one eQuest baseline sheet included in the report.

   The settings noted in the tool here are estimated to be close to what the final post project settings would be overall. The overall values were chosen to be similar to what the rest of ECMs were modelled at within eQuest or ELEMENT.

ECM 3 – Variable Speed Drives (HSS, DNES, MRES, TCES)

1. Annual Electric Savings (kWh/yr) calculations are not shown. Clarify if this was modeled in eQuest or Excel Calculations and provide data to support savings.

   Calculations for applicable facilities have been included in the appendices for this ECM. Savings were calculated in eQuest for this ECM.

2. It appears VFDs are to be installed on VAVs, CVs, Hot Water Pumps, and Chilled Water Pumps. Please confirm that the equipment / system being retrofitted will work with VFDs or if replacement with inverter duty motors is included in the cost for this ECM.

   Confirmed. The systems are being retrofitted to accept a VFD control scheme or an inverter duty motor is being installed.

ECM 4 – Kitchen Hood Control (All except WES)

1. It appears that the calculations in Appendix 7.1.2 is only for HSS but this ECM is for all facilities. Make sure the final report includes separate calculations for each facility that would match up to the savings in section 4.2.

   Calculations for all applicable facilities have now been included in the appendices.

2. Is there a current procedure present for hood control or are the fans turned on in the beginning of the day and turned off at the end of the day?

   This has been discussed with the District and the current procedure is mixed. Some fans are turned on in the beginning of the day and turned off at the end of the day. However, observations during the investment grade audit confirmed that some fans were running overnight.

3. It seems the information provided on page 22 of ESP does not match page 68; change to match.

   The information on page 22 is correct; the description on page 68 has been corrected.

4. Note if this ECM includes any modifications to the volume of kitchen Make Up Air supplied to the kitchen areas to accommodate reduction in exhaust

   This ECM does not incorporate any modification to the volume of make up air.

ECM 5 – Whole School Metering (VES)

1. Confirm that this is only Electric Utility Metering and does not include Natural Gas or Water utility metering.

   Correct; it is only electric.

2. Are there any annual subscriptions or proprietary software associated with this Metering system and If so, are these also included in the costs?

   No, there are not any annual subscriptions or proprietary software. This meter will be tied into the Building Automation System.

ECM 6 – School Addition Metering (HSS, CMS, MHES, TCES)

1. Confirm that this is only Electric Utility Metering and does not include Natural Gas or Water utility metering.

   Correct; it is only electric.

ECM 7 – Water Fixture Improvements (All)

1. Confirm that total savings for this measure is estimated at ~ $ 43,000 and the total water utility costs for the district is ~ $ 173,000, which is over 20% savings.

   Savings are in line with what is expected from the individual sites given the number of occupants and expected usage of water. Savings of this degree are expected due to old high flow fixtures and faucets that are being replaced with newer and much more efficient ones.

2. It appears that lavatory sinks were estimated at 0.37 GPM which is more aggressive than the suggested BPU Protocol 0.5 GPM for public restrooms.

   We have had success with using the lower flow rate aerators, while maintaining acceptable flow and hand washing times. Please see the sample submittal in the appendix for various aerator options.

3. 3.05 GPF pre-retrofit flow rate for toilets seems to indicate older style fixtures. Has it been confirmed that these fixtures are compatible with new valves or valve refurbishment and would not have to be replaced to accommodate lower flow rates?

   Yes. All fixtures have been confirmed to be compatible with suggested valves and valve refurbishment.

ECM 8 – Cooling Tower Submeters (DNES, TCES, VES)

1. Has it been confirmed with the local utility that they will allow reduction in utility cost for this metering?

   Through further outreach to the sewer utilities and analysis of sewer bills that were not available at the outset of the IGA, we have decided to remove this ECM from the project.

2. There were no calculations included for this ECM. We suggest either Excel Calculations or eQuest modeling data be included to back up the savings.

   N/A – See response above.

ECM 9 – Walk-in Refrigeration Controls (All except DNES and WES)

1. Baseline electric consumption values are provided for each type of unit, but no explanation of how these were determined is provided. DLB suggests providing a calculation or description stating how these values were obtained.

   Updated calculations for applicable facilities have been included in the appendices which show how the baselines were developed.

2. The calculations seem to calculate savings by applying a general 46% savings factor to the baseline consumption. Additional detail should be included to define how this savings factor is derived.

   Please see comment above.

3. It appears that the calculations in Appendix 7.1.2 is only for HSS but this ECM is for multiple facilities. Make sure the final report includes separate calculations for each facility that would match up to the savings in section 4.2.

   Updated calculations for applicable facilities have been included in the appendices which show how the savings were developed.

ECM 10 – Pipe Insulation (All except GMS)

1. The Appendix includes insulation thicknesses for each pipe to be repaired but it is unclear how this relates to the chart included in the ESIP. It may be beneficial to add some additional detail. The piping systems are indicated; however, system operating temperatures are not shown. The temperatures should be included to confirm insulation thicknesses.

   Relevant calculations have been provided in the appendices as “Pipe Insulation Supporting Data – all sites.”

2. Calculations use 5110 hours for heating. Confirm these operating hours with the school facility personnel.

   This has been confirmed with the District.

3. Additional supporting data should be provided for this ECM, including information on the heat loss coefficients, the fluid and ambient temperature assumptions, and heating equipment efficiencies assumed.

   See Comment 10.1 above.

4. It appears that the calculations in Appendix 7.1.2 is only for HSS but this ECM is for multiple facilities. Make sure the final report includes separate calculations for each facility that would match up to the savings in section 4.2.

   Calculations for applicable facilities have been included in the appendices which show how the savings were developed.

ECM 11 – High Efficiency Transformers (All except WES)

1. It would be beneficial to define where the “Baseline Transformer Losses” are based on. Not sure if these are manufacturer published data or field measured.

The baseline transformer losses are based on a combination of actual measurement data from West Windsor Plainsboro schools and historical data from previous field measurement data of other locations.

2. The age of the existing transformers to be replaced should be included in the report.

   The age of existing transformers is not currently available, but the age of transformers should generally reflect the age of the buildings:

High School North	1997
High School South	1982, 1991
Community MS	1988
Thomas Grover MS	1999
Dutch Neck ES	1925
Maurice Hawk ES	1985
Millstone River ES	1990
Town Center ES	2002
Village ES	1995, 2015
Wicoff ES	1918, 1959

3. It appears that the savings do not match the P4P typical annual loss table for transformers; from the Appendix a 75 kVa is listed as 6,010 kWh savings and the P4P table uses 4,600 for pre TP-1. Double check these if the transformer savings is being used for P4P incentives.

   The current numbers are incredibly close to NEMA suggested numbers and will likely be higher due to the difference in equipment selection. We have had our savings reviewed and approved by TRC for prior P4P Energy Reduction Plans (ERPs).

4. Would be good to verify what incentive / rebates are tied to this Transformer Upgrade ECM.

   This will require creation of ERP tables to accurately determine the expected P4P incentive associated with this measure, which is not feasible at this time.

ECM 12 – Solar Power Purchase Agreement (All except CMS, TCES)

1. DLB recommends noting some of the PPA agreement requirements for reference such as: panel warranty, panel removal terms, any specific insurance provisions or site licensure or access requirements.

   Because this is a PPA, the panel warranty should not have a direct effect on the District. However, all of these items have been specified through a combination of the PPA RFP, and the PPA template provided by Greenskies, the District's selected PPA provider. Both the RFP and the template contract can be found in the appendices, and both have been reviewed, negotiated, and approved by the District and its attorney. Please see the appendix for a copy of the PPA template.

2. If the new solar panels are proposed to be installed on sections of the roof of various buildings of various ages and roof materials, we suggest clarification be added on who would be responsible for any structural modifications required to support the weight of the new solar panels, and if applicable, include the associated costs in the financial analysis.

Pursuant to the RFP and the PPA, the District would be responsible for any structural modifications required to support the solar panels. Or, the designs will be modified to avoid any areas where this may be an issue.

3. It is unclear if maintenance access was taken into account in the general panel layout which should be considered for any roof top equipment.

   Yes, it was taken into consideration. Panel layouts have been reviewed and approved by WW-P administration and facilities team.

4. Also, it may be worthwhile to highlight any system downtime incorporated in the estimated production values. From what we have seen, some PPA vendors note this in their contracts and we have seen downtimes that stretch for months which would affect savings.

   The PPA contract does have lost production language. Please refer to the PPA contract for more information.

5. Are any of the proposed solar array sizes close to or higher than 80% of building usage / service sizes?

   Please see the table below. Only one facility exceeds 80% of the projected kWh baseline (after other ECMs), Maurice Hawk ES. However, this school received a significant building addition during 2018-2019. The energy baseline used was prior to the addition, so the solar will be well below 80% of the actual building's annual kWh usage.

School	% of Post ESIP Baseline
HS North	55%
HS South	28%
Grover MS	66%
Dutch Neck ES	23%
Maurice Hawk ES	88%
Millstone River ES	30%
Village ES	47%
Wicoff ES	20%
Total	**45%**

6. Appendix includes solar PPA resolution and projected PV sizes for each school but it does not contain information of where this data was obtained, BPU protocols recombed PV Watts.

   The data was obtained from the District's PPA provider, Greenskies. Greenskies utilizes PVWatts for production estimates.

ECM 13 – Pay For Improvement (P4P) Incentives (HSN, HSS, CMS, MHES, VES)

1. Has initial eligibility (Incentive 0 applications) been submitted for P4P to confirm base eligibility for these schools?

No, Incentive 0 applications have not yet been submitted, but they will be submitted before the end of the year. We have reviewed all sites and confirmed eligibility.

2. The table in 2.1 shows $124,430 for this ECM as a Hard Cost; what does this cost represent?

   This cost represents internal SE labor required specifically for the P4P process: energy modeling, revisions with TRC, application processing, etc.

3. Table in 2.4 lists dollar amounts anticipated for all three incentives. Please provide written explanation or example calculations to support those and verify that that ECMs being applied to these do not overlap.

   Please see in the appendices folder, "Expected P4P Incentives" file. Based upon the final scope of work selected by the District, P4P estimates have been revised, and have increased slightly.

4. Are there calculations / measurements indicating buildings' eligibility (200kW peak demand, 15% source energy savings) for this incentive available? It may be worthwhile to illustrate how close the proposed ECMS are to the 15% threshold.

   Please see the file mentioned in 13.3 above. All facilities that are included are over 200kw peak demand and exceed the 15% savings threshold.

ECM 14 – Equipment Evaluation Study (All except HSN, MRES, WES)

1. Confirm there was no Retro-Commissioning (no work from this effort to adjust or maintenance to do list) to optimize or restore performance of any systems.

   This was conducted to evaluate the current state of the equipment to aid in modeling and scope development, as well as provide an equipment deficiency report for the District to take action on.

2. There is no energy savings noted for this effort and we want to confirm this is a capital improvement project as well.

   Correct. There are no direct energy savings for this effort. The study was completed for purposes noted above. There is a capital contribution agreed upon with the District.

ECM 15 – Combined Heat and Power (HSS)

1. ESP calls for the installation of a Yanmar CP35D1 CHP. It may be beneficial to include the equipment information on this unit to further detail performance and operational requirements of the system.

   WE have included the Yanmar spec sheet in the appendices. We will coordinate operational requirements with PSE&G.

2. It appears that eQuest was used to develop savings for this ECM. It is recommended to include the baseline and individual runs for these calculations in the Appendix sections.

   The savings were determined using eQuest hourly data post project. This ECM was not run through eQuest in itself. Instead, the hourly data from the last ECM run was used to create the sheet that was shared. The sheet incorporates the necessary formulae to determine the expected savings.

3. Please confirm that maintenance costs / contract is included in overall cost for this ECM. CHP systems have a very rigorous maintenance schedule.

   According to Yanmar, the system has a planned maintenance schedule of 60 hours every 7500-8000 hours. The cost of maintenance is not included in the cost of the ECM.

4. It may be beneficial to note the total expected operating hours that the CHP Plant is planned to be run and verify with the BOE personnel. It appears from the description this will be run 100% of the time for the entire year.

   It is anticipated to operate 8700 hours per year. We have allowed 60 hours for planned maintenance and unexpected downtime

5. Since this is integral to the payment terms, it may be beneficial to confirm with the facility personnel that there is enough space at the site for the CHP system and the connections to the existing heating hot water system. Also, the installation location should be reviewed to ensure there will not be any noise issues with running 24/7.

   This has been discussed with the school. Outdoor space is available near the natatorium and connections to the hot water system have been incorporated into the overall costs.

ECM 16 – BAS Upgrade To Common Front End (HSS, DNES, CMS, TCES, VES, GMS)

1. ECM description includes central boiler plant, terminal units and common area AHU units for most of the schools. Clarify if any Exhaust Fans are included in the DDC control scope (if applicable).

   Please see the following for a school by school description of exhaust fan (EF) control:

   - HSS - We will be controlling any general EF's that are presently controlled by the Novar BAS.
   - CMS - In the areas where we are integrating the existing JCI BAS, there are presently no EF's controlled by the system. In the area where we are replacing the Novar BAS, there are presently no EF's controlled by the system.
   - GMS - We are integrating the existing Siemens BAS and there are presently no EF's controlled by the system.
   - DNES - We will be controlling any general EF's that are presently controlled by the Novar BAS.
   - MHES - We will be controlling the new EF's associated with the Capital Improvement Project. The rest of the building is excluded from this ECM.
   - TCES - We will be controlling any general EF's that are presently controlled by the Novar BAS and the new EF associated with the Capital Improvement Project.
   - VES - We will be controlling any general EF's that are presently controlled by the Novar BAS.

2. There are no calculations included for this ECM and methodology or calculations should be included in the report or Appendix to define these values. If these were eQuest runs, the individual baseline and ECM output sheets could be included.

Calculations for applicable facilities have been included in the appendices. The savings were calculated in eQuest.

3. The savings for Community MS appears to be ~ 20% of its overall energy use; the savings value for this one should be confirmed.

   Savings are expected to be high for this location due to the systems running virtually 24/7 at occupied temperatures. By following the schedules and expected temperatures in the Standards of comfort, a substantial amount of savings is to be expected.

4. Number of the descriptions note existing pneumatic control systems that typically require complete rewiring and device replacement such as in High School South. We wanted to verify that complete system replacement was covered in the scope in these facilities.

   Yes, we accounted for new DDC control devices and wiring for all systems that currently have pneumatic controls.

ECM 17 – HVAC Upgrades (High School south, Dutch Neck, Community MS)

1. Confirming that these are BOE driven Capital Improvement projects. The payback all of these replacements are beyond the overall Energy Savings Plan timeframe.

   Yes, these are the primary capital projects that the District would like to accomplish through the ESIP program.

2. A slight energy savings was noted for some of these HVAC improvements such as chiller replacement and boiler replacement which is expected, and savings methodology or calculations should be included in the report or Appendix files to define these values.

   Calculations for applicable facilities have been included in the appendices. The savings were calculated in eQuest.

3. Were maintained savings taken into account for the preplacement of older equipment?

   Yes, some maintenance savings for HAC upgrades were taken into account.

4.1.4 Lighting Energy Conservation Measures

Lighting improvement savings calculations were performed in a satisfactory manner using a spreadsheet analysis and reviewed in a spot-check fashion.

DLB notes the following potential issues with the lighting ECM analysis:

ECM 1 – Comprehensive LED Lighting Upgrades (District Wide)

1. It may be beneficial to include details on the recommended model for the replacement lamp – not sure if lamp or line voltage upgrade kits are being proposed.

   Please see the file in the appendices entitled, “7.5 Lighting Line by Line – Legend.”

2. If line voltage upgrade kits, we would suggest model information is included to make sure the recommended retrofit maintains the UL listing of the light fixtures.

   Please review the comment above. UL listing will be maintained.

3. For lamp replacement projects, is a maintenance savings taken into account for extended life?

   Yes, some maintenance savings were taking into account for 5 years.

4. The quantity of fixtures being replaced should be identical and should be checked. In the “Lighting Line by Line” Table there appears to be a few locations where the quantity numbers differ, such as in a Private Office (ID#3228) (9 vs. 5), but these may relate to lamps not fixtures.

   This indication in the LxL is work completed via a separate project completed by the District. For this specific example, the lighting line by line captures the new fixtures specified by the District’s architect. In this case, the number of fixtures was changed from 9 to 5, and was not included in the ESIP project, as shown in the ECM description, “No Action - To Be Renovated - LED 2'x4' Troffer 55W.”

5. Please identify reduction in hours for some areas, such as “Weight Room 506” (4000 vs 3200), that appear in the “Lighting Line by Line” Table.

   The reduction is based on using an occupancy sensor installed in the ESIP. Reduction is based on our experience in similar occupancies on other projects.

6. Please identify source of “Current Hours.” It appears that offices use 3,300 and classrooms use 2,000 operational hours, which differs from the suggested hours of operation in the BPU protocol.

   These figures are based on observation and discussions with District staff.

7. The energy savings calculations do not appear to utilize the Iterative Factor (IF) used in the BPU Protocols.

   The ECMs are run through eQuest to accurately determine the final savings impact. Each ECM run is run iteratively and takes into account the effect of the previous ECM run on the total energy use.

8. Confirm that the lighting upgrade also includes lighting control upgrades.

   Occupancy sensors are part of the project and that is where the reduction in operating hours is achieved. Specifically, the following number of sensors will be installed:

Abbreviation	Description	Quantity
TBR	Controls installed as part of Renovation	375
PL	Controlled by Previous Line	0
WS	New wall switch occupancy sensor	406
WS2P	New wall switch occupancy sensor, 2 Pole	19
WCM	New ceiling mounted occupancy sensor, wireless	267
WCM2	New ceiling mounted occupancy sensor, wireless, (2) Power Packs	18
WWM	New wall mounted occupancy sensor, wireless	77
WWM2	New wall mounted occupancy sensor, wireless, (2) Power Packs	359
WWM3	New wall mounted occupancy sensor, wireless, (3) Power Packs	52
WWM4	New wall mounted occupancy sensor, wireless, (4) Power Packs	62
2WWM2	(2) New wall mounted occupancy sensor, wireless, (2) Power Packs	24
2WWM3	(2) New wall mounted occupancy sensor, wireless, (3) Power Packs	3
	Total	1662

4.1.5 Financial Calculations

The financial calculations included within the ESP incorporate a 2.3% interest rate for the loan and the BPU-required 2.2% electric and 2.4% natural gas and fuel oil utility escalation.

The recommended plan includes thirty-one (31) ECMs and is analyzed over a 20-year financing term.

DLB notes the following potential issues with the financial calculations:

1. Cash Flow Form shown on page 8 of the report shows an installation year savings of ~ $ 177, 000 and a total year 1 savings of ~ $ 1,174,000. The total savings shown in the cost summary on page 6 is ~ $ 1,174,000. This initial savings and savings values should be reviewed and coordinated or an explanation added to define the lower installation year savings value.

   DAN: The lower installation year savings value is based on a conservative estimate (20%) of savings during the installation period, to provide an adequate buffer for financing payments in the first few years of the ESIP program.

2. Cash Flow Form shown on page 8 includes a total of $ 387,674 Energy Rebates / Incentives to be received in installation year. Confirm the schedule; some of these rebates are issued after ECMs are installed which may be in year 1.

   The rebates & incentives for the installation period represent the $/SF Incentive 1 payment for P4P and SmartStart incentives for the lighting. We have reviewed the schedule, and these should be achievable based on the financing schedule put together by the District's Financial Advisor.

3. LFN 2009-11 requires that any capital improvements be paid through other appropriations (i.e., bonds or capital improvement funds), not energy savings obligations. DLB recommends confirming that any capital improvements are planned to be funded appropriately.

   Capital improvements funds are being utilized through the District's capital reserve account to accomplish the primary capital needs within the ESIP program.

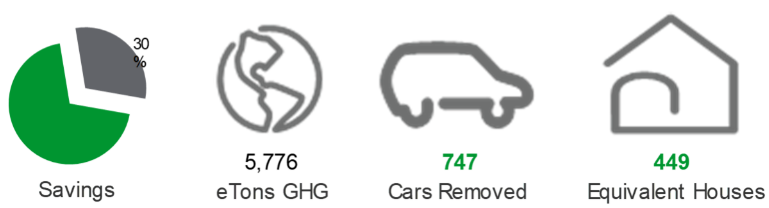
4.1.6 Greenhouse Gas Calculations

Greenhouse Gas Calculations are provided and the factors used to calculate savings are clearly called out in the report. The factors should be revised to meet the current BPU guidelines, shown on page 13 of the protocol:

- 1,374 lbs. CO_2 per MWh saved
- 1.11 lbs. NO_x per MWh saved
- 0.98 lbs. SO_2 per MWh saved
- 11.7 lbs. CO_2 per therm saved
- 0.0092 lbs. NO_x per therm saved

The greenhouse gas calculations have been updated using the emissions factors above:

Environmental Benefits	
Total Emissions	
Total Energy (MMBtu)	139,056
Total Emission (Tons CO_2e)	19,032
Total Savings (Tons CO_2e)	5,776
Total Savings (Tons NOx)	4
Total Savings (Tons SO_2e)	3



* Emissions factors are derived from EPA eGrids database and represent the State of NJ
Totals include 12 Project Sites and a total of 101 ECMs

7.10 Board of Public Utilities (BPU) Approval

Please see the following pages for a copy of the BPU letter of approval.