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March 10, 2010

Local Government Energy Program
Energy Audit Report
FINAL; May 20, 2010

Frankford Township School

Branchville, NJ 07826

Project Number: LGEA52

TABLE OF CONTENTS

INTRODUCTION

On February 11th, 2010 Steven Winter Associates, Inc. (SWA) performed an energy audit and assessment for the Frankford Township School building. The building is located at 2 Pines Rd, Branchville, NJ 07826, in Sussex County. The current conditions and energy-related information were collected in order to analyze and facilitate the implementation of energy conservation measures for the building.

The one story Frankford Township School building was originally built in 1950, with additions constructed in 1958, 1968, and 1974. The building houses the Frankford Elementary and Middle School, grades one through eight. The building consists of approximately 90,000 square feet of conditioned spaces. The building includes classrooms, administrative offices, cafeteria, a library, music room, home economics room, a computer lab, an all purpose room, and boiler rooms. The building is occupied on weekdays with 630 students from 8am to 4pm and 105 faculty / staff employees from 6am to 11pm, September through mid-June.

The goal of this Local Government Energy Audit (LGEA) is to provide sufficient information to the Frankford Township School Board of Education to make decisions regarding the implementation of the most appropriate and most cost effective energy conservation measures for the Frankford Township School building.

Launched in 2008, the LGEA Program provides subsidized energy audits for municipal and local government-owned facilities, including offices, courtrooms, town halls, police and fire stations, sanitation buildings, transportation structures, schools and community centers. The Program will subsidize 75% of the cost of the audit. If the net cost of the installed measures recommended by the audit exceeds the remaining cost of the audit, then that additional 25% will also be paid by the program. The Board of Public Utilities (BPUs) Office of Clean Energy has assigned TRC Energy Services to administer the Program.

EXECUTIVE SUMMARY

The energy audit performed by Steven Winter Associates (SWA) encompasses the Frankford Township School building located at 2 Pines Rd, Branchville, NJ 07826. The one story Frankford Township School building was originally built in 1950, with additions constructed in 1958, 1968, and 1974. The building consists of approximately 90,000 square feet of conditioned spaces. The building includes both the elementary and middle school.

Based on the field visits performed by the SWA staff on February 11th and the results of a comprehensive energy analysis, this report describes the site's current conditions and recommendations for improvements. Suggestions for measures related to energy conservation and improved comfort are provided in the scope of work. Energy and resource savings are estimated for each measure that results in a reduction of heating and cooling energy use.

From April 2008 to March 2009 the Frankford Township School building consumed 590,800 kWh or $98,277 worth of electricity at an approximate rate of $0.166/kWh and 41,458 gallons (58,041 therms) or $86,354 worth of fuel oil #2 at an approximate rate of $2.083/gallon ($1.488/therm). The joint energy consumption for the building, including both electricity and fuel oil #2, was 7,820MMBtu of energy that cost a total of $184,631.

SWA has entered energy information about the Frankford Township School building in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. The building received a score of 59 when compared to similar school buildings. Buildings achieving an Energy Star rating of 75 are eligible to apply for the Energy Star award and receive the Energy Star plaque to convey superior performance. These ratings also greatly help when applying for Leadership in Energy and Environmental Design (LEED) building certification through the United States Green Building Council (USGBC). SWA encourages the Board of Education to continue entering utility data in *Energy Star Portfolio Manager* in order to track weather normalized source energy use over time.

The Site Energy Use Intensity is 86.0 kBtu/ft^{2}yr compared to the national average of a school building consuming 94.0 kBtu/ft^{2}yr. Implementing the recommendations included in this report will reduce the building energy consumption by approximately 14.5 kBtu/ft^{2}yr. There may be energy procurement opportunities for the Frankford Township School to reduce annual utility costs, which are $6,703 higher, when compared to the average estimated NJ commercial utility rates.

Based on the assessment of the Frankford Township School building, SWA has separated the recommendations into three categories (See Section 4 for more details). These are summarized as follows:

Category I Recommendations: Capital Improvement Measures

- Insulate exterior walls
- Replace wood doors in classrooms
- Replace 1972 roof section
- Replace single pane windows
- Upgrade building per ADA requirements
- Replace unit ventilators
- Replace (2) H&V units serving the Large Gym and Multipurpose Room
- Replace (1) H&V units serving the Small Gym

- In lieu of DX cooling systems recommended above, add chilled water cooling system
- In lieu of DX cooling systems recommended above, add conventional water source heat pumps
- In lieu of chilled water or DX cooling systems recommended above, add geothermal cooling and heating system
- Upgrade Building Management System (BMS)
- Replace common area heating equipment
- Replace window air conditioners
- Upgrade electric service
- Provide code minimum ventilation air to all rooms lacking adequate ventilation
- Consider replacement of the 1968 Bally walk-in cooler/freezer
- Consider replacement of the reach-in milk cooler in cafeteria
- Install premium motors when replacements are required

Category II Recommendations: Operations and Maintenance

- Correctly install fiberglass batt attic insulation (air seal prior to installation)
- Inspect and replace gasketing around door into the walk-in refrigeration boxes in the Kitchen and outside.
- Water levels in the expansion tanks and the integrity of the tank bladder should be checked to confirm proper operation.
- Use Energy Star labeled appliances
- Maintain roofs
- Maintain downspouts
- Provide weather stripping / air sealing
- Preventative exterior wall maintenance
- Use smart power electric strips
- Create an energy educational program

Category III Recommendations: Energy Conservation Measures - Upgrades with associated energy savings

At this time, SWA highly recommends a total of **8** Energy Conservation Measures (ECMs) for the Frankford Township School building that are summarized in Table 1. The total investment cost for these ECMs is **$23,977**. SWA estimates a first year savings of **$9,188** with a simple payback of **2.6 years**. SWA estimates that implementing the highly recommended ECMs will reduce the carbon footprint of the Frankford Township School building by **76,353 lbs of CO_2**, which is equivalent to removing approximately 6 cars from the roads each year or avoiding the need of 186 trees to absorb the annual CO_2 generated. SWA also recommends **3** ECMs with payback greater than 5 years summarized in table 2, which result in a first year savings of **$905**. SWA also recommends **7** Over 10 year Payback and End of Life Cycle ECMs with a total first year savings of **$33,295** that are summarized in Table 3.

Institutional buildings with an average annual peak demand over 200 kW (Frankford Township School peak demand is about 206 kW) are eligible to participate in the NJ Clean Energy Pay for Performance program. Incentives for electricity and fuel oil #2 savings will be paid based on actual savings, provided that the minimum performance threshold of 15% savings has been achieved. To participate, select a Program Partner from an approved partner list and submit Application Package with your Partner's assistance. Reducing 15% of the energy use at Frankford Township School will be challenging without undertaking significant investment.

There are various incentives that Township of Lower could apply for that could also help lower the cost of installing the ECMs. SWA recommends that the Frankford Township School apply for the NJ SmartStart program through the New Jersey Office of Clean Energy. This incentive can help provide technical assistance for the building in the implementation phase of any energy conservation project.

A new NJ Clean Power program, Direct Install, could also assist to cover 80% of the capital investment. SWA strongly encourages that the Frankford Township School proceeds to move forward with the Direct Install program in order to offset the cost of the recommended lighting measures.

Renewable ECMs require application approval and negotiations with the utility and proof of performance. There is also a utility-sponsored loan program through JCP&L that would allow the building to pay for the installation of the PV system through a loan issued by the utility.

The following tables summarize the proposed Energy Conservation Measures (ECMs) and their economic relevance. In order to clearly present the overall energy opportunities for the building and ease the decision and choice of which ECM to implement, SWA calculated each ECM independently and did not incorporate slight/potential overlaps between some of the summarized ECMs (i.e. lighting change influence on heating/cooling).

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
Table 1 - Highly Recommended 0-5 Year Payback ECMs																			
2	Install 3 Drinks vending machine misers	www.usatech.com and established costs	$ 837	$ -	$ 837	4,316	1.4	-	0	$ -	$ 699	12	$ 8,390	1.2	902	75	112	$ 8,500	5,913
3.4	11 New motion sensors to be installed with incentives	RS Means, lit search	$ 2,420	$ 220	$ 2,200	5,902	1.2	N/A	0	$ -	$ 956	15	$ 14,342	2.3	552	37	43	$ 9,051	8,086
4.1	Replace (2) 7.5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	$ 1,112	$ 162	$ 950	2,173	0.5	-	0	$ -	$ 361	20	$ 7,214	2.6	659	33	38	$ 4,417	2,977
3.3	88 New occupancy sensors to be installed with incentives	RS Means, lit search	$ 19,360	$ 1,760	$ 17,600	40,404	8.4	N/A	2	$ -	$ 6,545	15	$ 98,182	2.7	458	31	37	$ 59,421	55,354
4.4	Replace (2) 3 Hp domestic hot water pump motor with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	$ 714	$ 108	$ 606	1,113	0.2	-	-	$ -	$ 185	20	$ 3,695	3.3	510	25	30	$ 2,143	1,525
1	Replace old refrigerator with 18 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	$ 750	$ -	$ 750	1,200	0.1	-	-	$ -	$ 199	12	$ 804	3.8	7	1	1	$ (83)	501
5.1	Replace Cooler Evap Fan Motor with Premium Efficiency Motor	Manufacturer's Operations Data, DOE International Motor Master Savings analysis	$ 500	$ -	$ 500	800	0.2	-	-	$ -	$ 133	20	$ 2,656	3.8	431	22	26	$ 1,476	1,096
4.2	Replace (2) 2 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	$ 642	$ 108	$ 534	658	0.1	-	-	$ -	$ 109	20	$ 2,185	4.9	309	15	20	$ 1,091	901
	TOTALS		**$ 26,335**	**$ 2,358**	**$ 23,977**	**56,566**	**12.1**	**0**	**2.0**	**$ -**	**$ 9,188**		**$ 137,469**	**2.6**				**$ 86,016**	**76,353**

Assumptions: Discount Rate: 3.2% per DOE FEMP; Energy Price Escalation Rate: 0% per DOE FEMP Guidelines

Table 2 - Recommended 5-10 Year Payback ECMs																				
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
5.2	Replace Freezer Evap Fan Motor with Premium Efficiency Motor	Manufacturer's Operations Data, DOE International Motor Master Savings analysis	$ 500	$ -	$ 500	600	0	0	0.0	$ -	$ 100	20	1,992	5.0	298	15	19	$ 982	822
4.3	Replace (2) 1.5 Hp domestic hot water pump motor with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	$ 606	$ 90	$ 516	584	0	0	0.0	$ -	$ 97	20	1,939	5.3	276	14	18	$ 926	800
11	Demand Control Ventilation for Cafeteria & MP Room AHUs	RS Means Cost Data & Similar Projects	$ 6,000	$ -	$ 6,000	680	0	400	0.5	$ -	$ 708	15	10,620	8.5	77	5	8	$ 2,452	5612
	TOTALS		**$ 7,106**	**$ 90**	**$ 7,016**	**1864**	**0.3**	**400**	**0.5**	**$ -**	**$ 905**		**14,551**	**7.8**				**$ 4,360**	**7,234**

Table 3 - Recommended Over 10 Year Payback and End of Life Cycle ECMs																				
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
7a	Cost to replace boilers with modulating high efficiency oil-fired boilers	Similar Projects	$ 170,000	$ -	$ 170,000	-	-	9,000	10	$ 1,820	$ 15,210	25	$ 334,755	11.2	124	5	7	$ 94,857	105,300
3.1	823 New T8 fixtures to be installed with incentives	RS Means, lit search	$ 154,183	$ 24,690	$ 129,493	21,529	4.5	-	1	$ 6,995	$ 10,482	15	$ 157,236	12.4	21	1	3	$ (6,146)	29,495
8a	Replace (1) packaged 6-ton electric cooling rooftop HVAC unit with high efficiency unit	similar projects	$ 16,000	$ 438	$ 15,562	1,750	0.4	-	-	$ 900	$ 1,191	15	$ 4,358	13.1	15	1	2	$ (1,350)	2,398
6	Utilize tank type domestic water heater instead of boilers	Similar Projects	$ 16,000	$ -	$ 16,000	-	-	790	1	$ -	$ 1,175	15	$ 17,630	13.6	10	1	1	$ (1,969)	9,243
10a	Replace reach-in stainless steel refrigerator with 42 cu ft Energy Star refrig	Energy Star purchasing and procurement site, similar projectsefficiency unit	$ 13,000	$ -	$ 13,000	4,130	0.9	-	-	$ -	$ 644	12	$ 7,731	20.2	(41)	(3)	(7)	$ (6,587)	5,658
3.2	8 New pulse start metal halide fixtures to be installed with incentives	RS Means, lit search	$ 5,798	$ 200	$ 5,598	1,739	0.4	-	0	$ (51)	$ 231	15	$ 3,465	24.2	38	3	(5)	$ (2,879)	2,382
9a	Replace 40 exhaust fans with premium efficiency units	similar projects, DOE Motor Master International	$ 128,000	$ -	$ 128,000	7,000	1.5	-	0	$ 3,200	$ 4,362	10	$ 11,620	29.3	(66)	(7)	N/A	$ (90,791)	9,590
	TOTALS		**$ 502,981**	**$25,328**	**$ 477,653**	**36,148**	**7.6**	**9,790**	**12**	**$12,864**	**$ 33,295**		**$ 536,795**					**$ (14,866)**	**164,066**

Table 4 - Renewable Energy ECMs																				
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
12	Install 151.2 kW PV rooftop system with incentives	similar projects	$ 1,171,800	$ -	$ 1,171,800	161,025	151.0	N/A	6.1	0	$ 123,345	25	$ 668,254	9.5	92.5	3.7	8.2	$ 552,593	220,604
12a	Install 49.7 kW PV rooftop system with incentives	similar projects	$ 385,175	$49,700	$ 335,475	53,920	50.0	N/A	2.0	0	$ 41,303	25	$ 223,768	8.1	654	26.2	43.8	$1,598,883	73,870

1. HISTORIC ENERGY CONSUMPTION

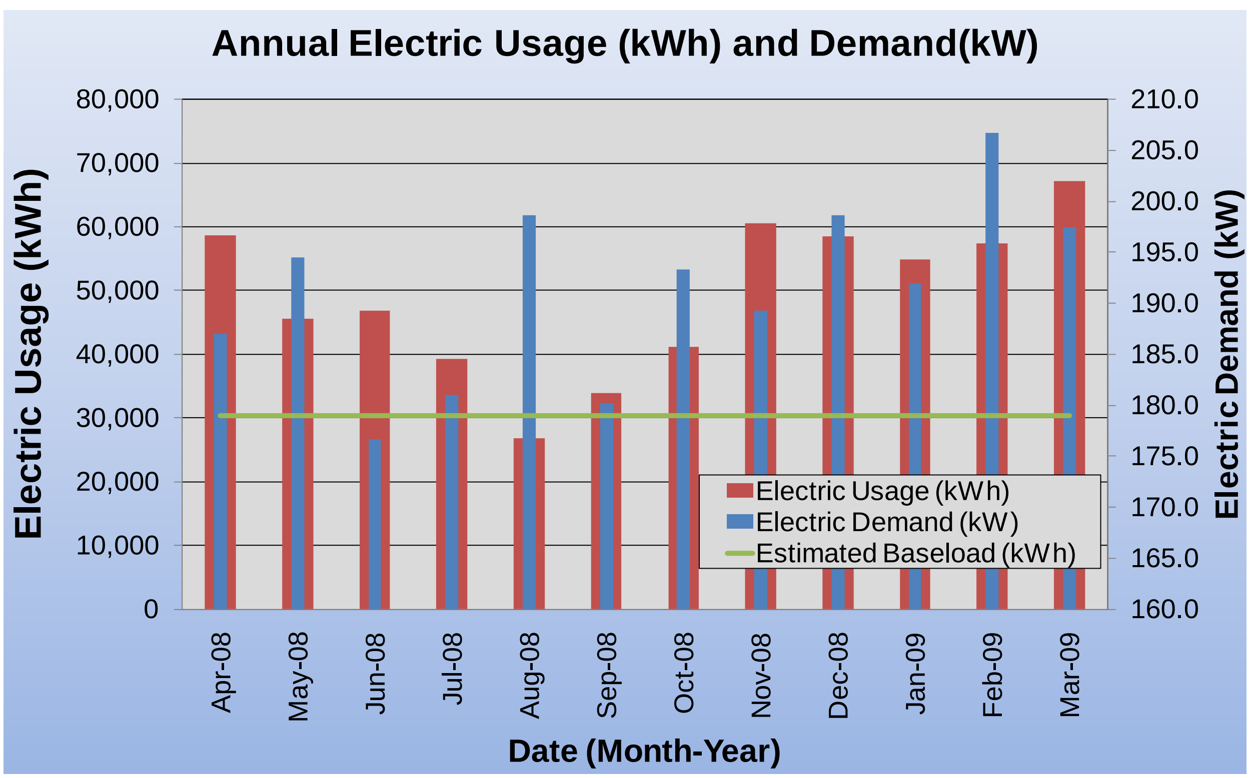
1.1. Energy usage and cost analysis

SWA analyzed utility bills from April 2008 through March 2009 that were received from the BOE and the oil company supplying the Frankford Township School building fuel oil #2.

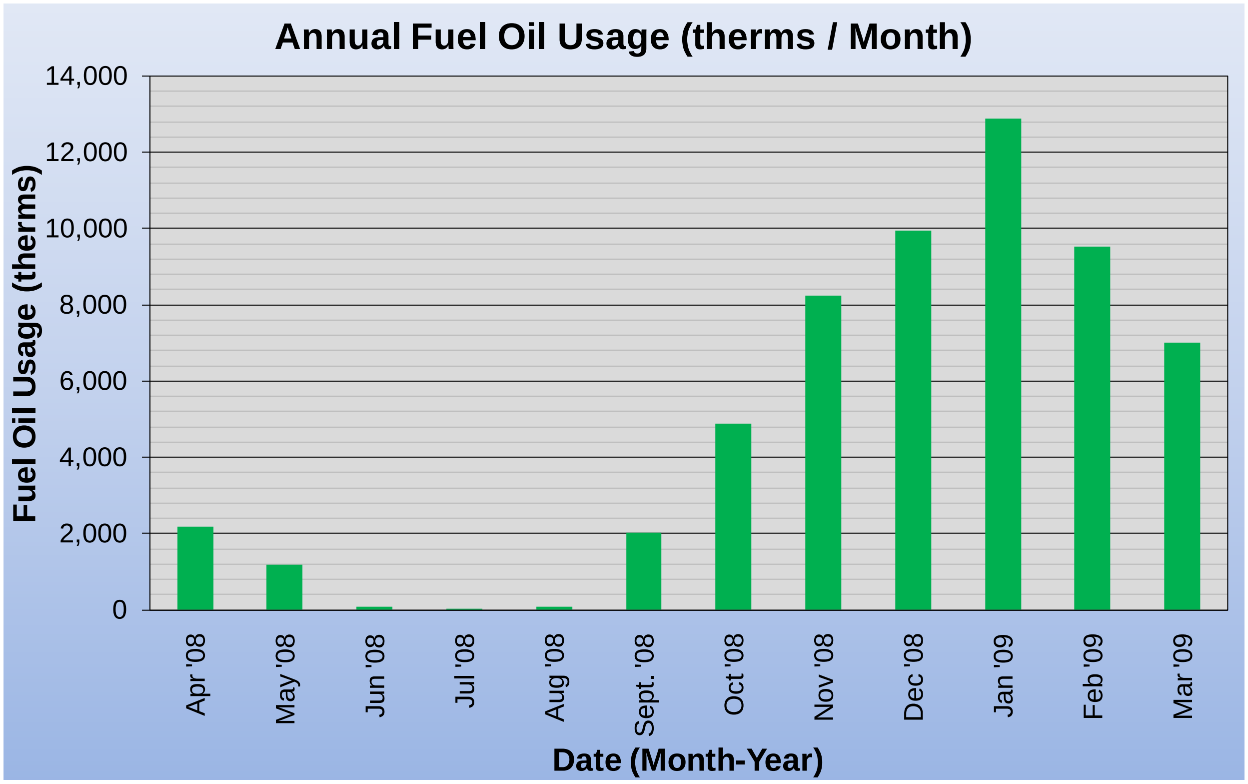
Electricity - The Frankford Township School building is currently served by one electric meter. The Frankford Township School building currently buys electricity from JCP&L at **an average rate of $0.166/kWh** based on 12 months of utility bills from April 2008 to March 2009. The Frankford Township School building purchased **approximately 590,800 kWh or $98,277 worth of electricity** in the previous year. The average monthly demand was 191 kW.

Fuel oil #2 - The Frankford Township Frankford Township School building is currently receiving deliveries for fuel oil #2. The Frankford Township School building currently buys fuel oil #2 from Finch Fuel Oil at **an average aggregated rate of $2.083/gallon or $1.488/therm** based on 12 months of oil receipts for April 2008 to March 2009. The Frankford Township Frankford Township School building purchased **approximately 41,458 gallons (58,041 therms) or $86,354 worth of fuel oil #2** in the previous year.

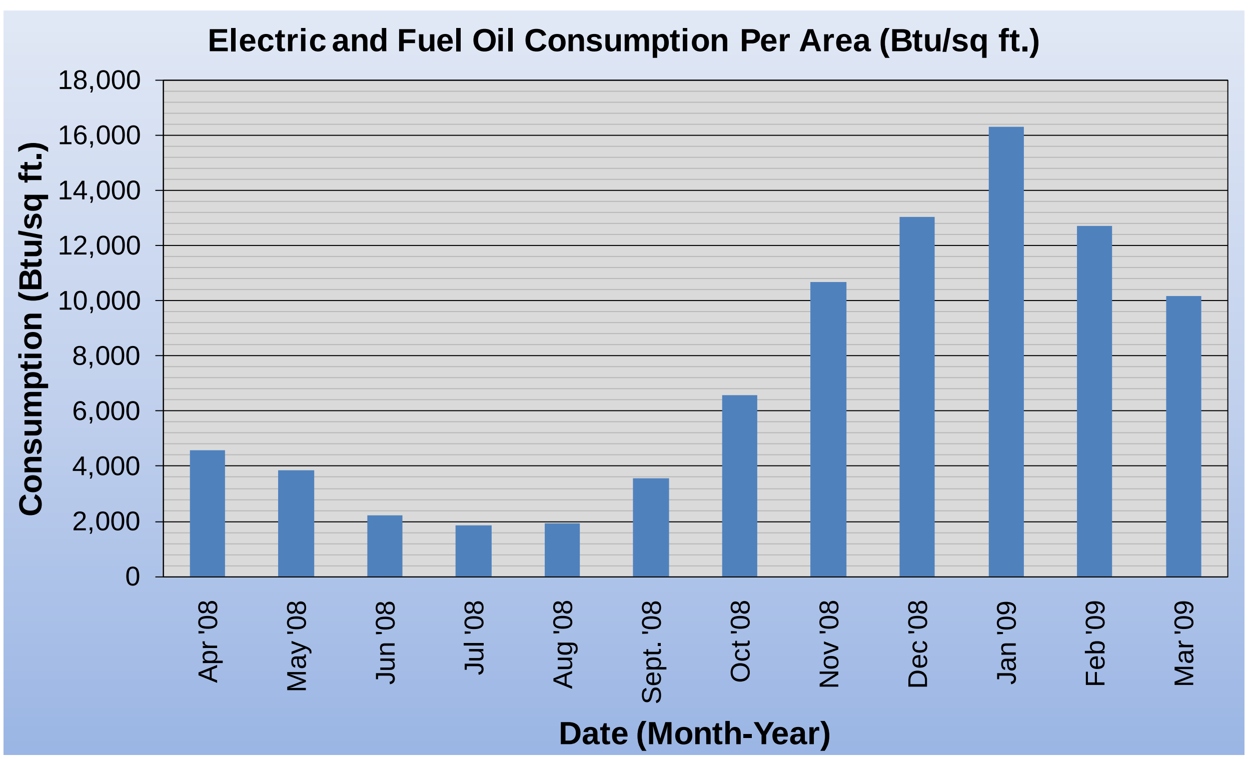
The following chart shows electricity use for the Frankford Township School building based on utility bills for the 12 month period of April 2008 to March 2009.



The following chart shows the fuel oil #2 estimated energy used for the Frankford Township School building based on receipts for the 12 month period of April 2008 to March 2009. SWA estimated the monthly energy use based on HDD and assumed 1,230 therms used for DHW:

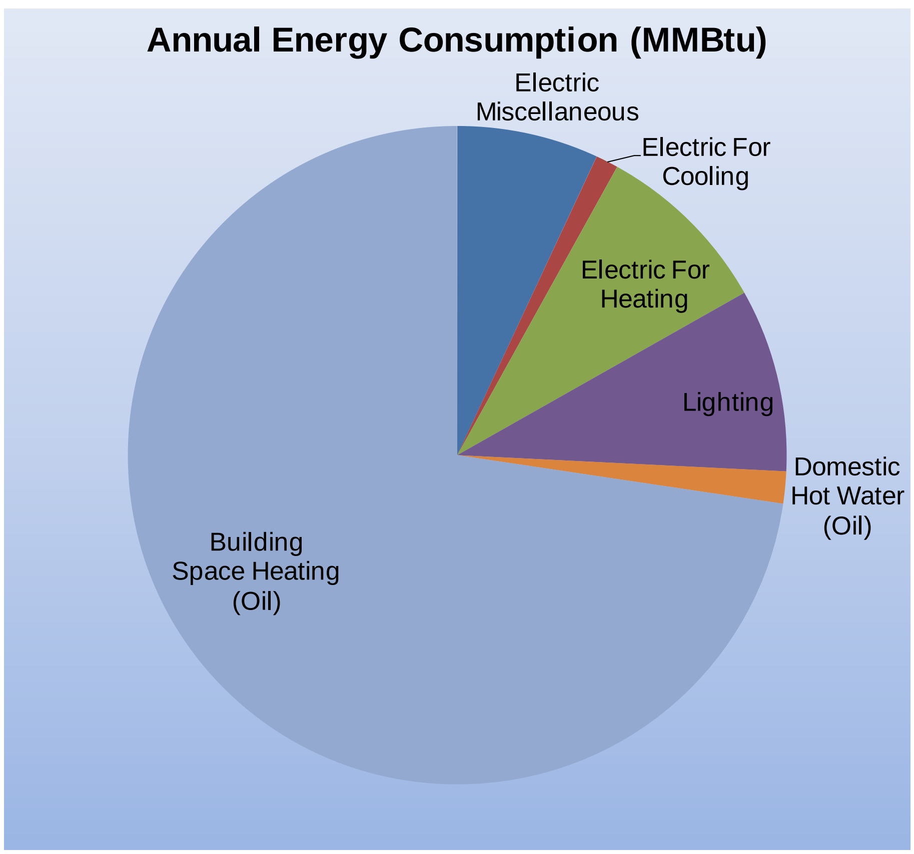


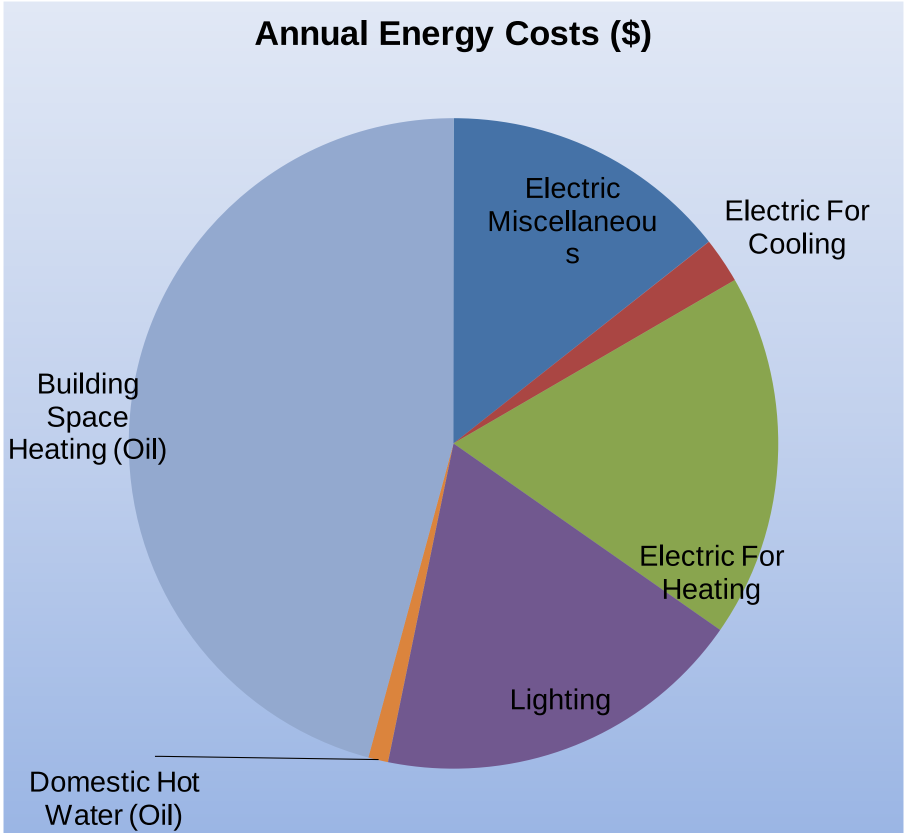
The following chart shows combined fuel oil #2 and electric consumption in Btu/sq ft for the Frankford Township School building based on utility bills and oil receipts for the 12 month period of April 2008 to March 2009.



The following table and pie chart show energy use for the Frankford Township School building based on utility bills for the 12 month period of April 2008 to March 2009. Note electrical cost at $49/MMBtu of energy is more than 3.2 times as expensive to use as fuel oil #2 at $15/MMBtu.

Annual Energy Consumption / Costs					
	MMBtu	**% MMBtu**	**$**	**% $**	**$/MMBtu**
Electric Miscellaneous	544	7%	$26,503	14%	49
Electric For Cooling	86	1%	$4,205	2%	49
Electric For Heating	685	9%	$33,389	18%	49
Lighting	701	9%	$34,180	19%	49
Domestic Hot Water (Oil)	123	2%	$1,824	1%	15
Building Space Heating	5,681	73%	$84,529	46%	15
Totals	7,820	100%	$184,631	100%	
Total Electric Usage	2,016	26%	$98,277	53%	49
Total Oil Usage	5,804	74%	$86,354	47%	15
Totals	7,820	100%	$184,631	100%	





1.2. Utility rate

The Frankford Township School building currently purchases electricity from its utility at a general service market rate for electricity use (kWh) with a separate (kW) demand charge. The Frankford Township School building currently pays an average rate of approximately $0.166/kWh based on the 12 months of utility bills of April 2008 to March 2009.

The Frankford Township School building currently purchases fuel oil #2 supplied by Finch Fuel Oil at the prevailing market rates for fuel oil #2. The average aggregated rate (supply and transport) for the oil is approximately $2.083/gallon ($1.48/therm) based on 12 months of fuel oil bills for April 2008 to March 2009.

1.3. Energy benchmarking

SWA has entered energy information about the Frankford Township School building in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. The building received a score of 59 when compared to other school buildings of its kind. Buildings achieving an Energy Star rating of 75 or higher, and professionally verified to meet current indoor environmental standards, are eligible to apply for the Energy Star award and receive the Energy Star plaque that conveys superior energy performance to students, parents, taxpayers, and employees. These ratings also greatly help when applying for Leadership in Energy and Environmental Design (LEED) building certification to the United States Green Building Council (USGBC).

The Site Energy Use Intensity is 86.0 kBtu/sqft compared to the national average intensity of school buildings consuming 94.0 kBtu/sqft. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 2.0 kBtu/sqft with an additional 12.5 kBtu/sqft from the other recommended measures. Additionally, the building can offset 6.1 kBtu/sqft from installing a 151.2 kW PV rooftop system. These recommendations could account for at least 20.6 kBtu/sq ft yr reduction, which when implemented would make the building energy consumption even lower.

SWA has created the Portfolio Manager site information for Frankford Township School Board of Education. Access is also allowed to TRC. This information can be accessed at the following: https://www.energystar.gov/istar/pmpam/ with the following:

Username: FrankfordTwpSchool
Password: FRANKFORDSCHOOL

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Frankford Township School District - Township School

Building ID: 2051577
For 12-month Period Ending: March 31, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: March 02, 2010

Facility
Frankford Township School District - Township School
2 Pines Road
Branchville, NJ 07826

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1950
Gross Floor Area (ft²): 90,000

Energy Performance Rating[2] (1-100) 59

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	2,015,810
Fuel Oil (No. 2) (kBtu)	5,749,831
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	7,765,641
Energy Intensity[5]	
Site (kBtu/ft²/yr)	86
Source (kBtu/ft²/yr)	139
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	730
Electric Distribution Utility	
FirstEnergy - Jersey Central Power & Lt Co	
National Average Comparison	
National Average Site EUI	94
National Average Source EUI	152
% Difference from National Average Source EUI	-8%
Building Type	K-12 School

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[6] for Indoor Environmental Conditions:

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
N/A

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, PE facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The one story Frankford Township School building was originally built in 1950, with additions constructed in 1958, 1968, and 1974. The building consists of approximately 90,000 square feet of conditioned spaces. The building includes classrooms, administrative offices, cafeteria, a library, music room, home economics room, a computer lab, an all purpose room, and boiler rooms.

2.2. Building occupancy profiles

The building houses the Frankford Elementary and Middle School, grades one through eight. The building is occupied on weekdays with 630 students from 8am to 4pm and 105 faculty / staff employees. The building remains unoccupied over the weekend. There is a scheduled two-week summer program that runs irregularly.

2.3. Building envelope

2.3.1. Exterior Walls

The exterior wall assemblies consist of a brick veneer (with EIFS above certain windows), aluminum framed window wall panels with certain sections containing 2x6 wood framed walls or with CMU (Concrete Masonry Unit) walls. Interior wall finishes are a mixture of lath and plaster, tile, painted CMU and gypsum wall board. During the next major renovation, SWA recommends insulating the exterior walls to the current local building code by adhering 2” polyiso boards (Polyisocyanurate) together with furring strips and gypsum wall boards to the inside of the painted CMU walls.

Exterior wall assembly (portion of Elementary School)

Exterior wall assembly types

Water damage EIFS

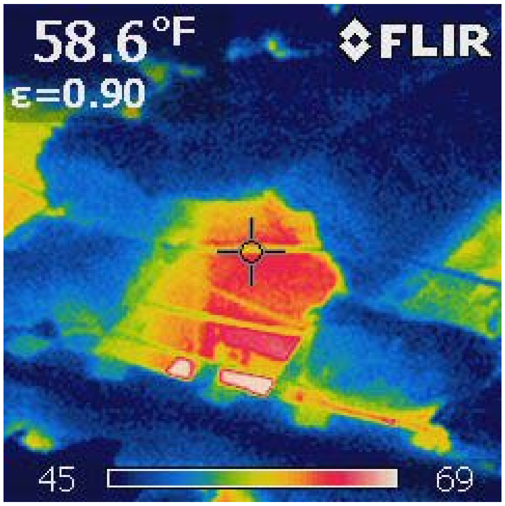
Interior wall finish – lath and plaster wall damage

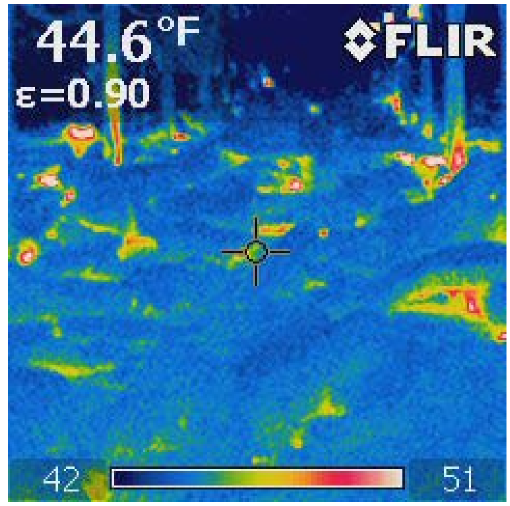
Overall the exterior wall assemblies of the building appear to be in excellent condition with no major issues of concern. There were no additional areas of concern mentioned to SWA at the time of the building audit. SWA recommends regular maintenance to exterior walls, re-pointing brick veneer, caulking around windows or doors, and removing all damage due to insects or rodents. Attention and maintenance should be given to these areas as uncontrolled roof water runoff can potentially penetrate exterior walls and cause energy losses and structural damage. Special attention should be given to roof drainage to avoid water damage to exterior wall assemblies.

2.3.2. Roof

The Frankford Township School roof sections were upgraded in 1996 (pitched asphalt roof section,) in 2001 for EPDM roof section (over classrooms & gymnasium), 1972 for the EPDM roof section over the kitchen, small gym and classrooms and the 2009 EPDM roof section was installed over the music rooms, science lab, and computer lab. At the time of the audit SWA was not able to access the roof due to snow and safety concerns. SWA auditors were told that in-house maintenance personnel perform regular maintenance on all roof sections. Also, SWA was told that during the 2009 roof upgrade additional sealing seams and re-tarring was done around the perimeter of the building. A full set of building drawings was not available to confirm insulation levels for the flat roof sections of the building. The pitched roof section of the building contains approximately 12” of faced fiberglass batts haphazardly placed on the attic floor. This area contains sufficient insulation although SWA recommends installing the fiberglass batts evenly both between the ceiling joists and across the ceiling joists. In order for insulation to perform effectively an air barrier should be installed and in constant and even contact with the insulation. As seen in infrared images below there is considerable heat loss of expensive conditioned air due to penetrations from areas below and from inconsistent insulation. Before removing and installing insulation properly SWA suggests air sealing all penetrations including top-plates, plumbing, HVAC ductwork, electrical penetrations, etc, with (fire-rated) caulk or foam. Improvements such as these may offer further comfort benefits and help to reduce energy loss.

Fiberglass insulation haphazardly displaced





Infrared images showing heat loss with missing batt insulation and haphazard installation


Image showing damaged ceiling tiles in classroom

At the time of the audit, SWA was told there are no roof leaks or roof maintenance issues. Damaged ceiling tiles should be checked and replaced in concern for indoor air quality. Regular maintenance should be performed to prevent potential damage to the integrity of the roofing system. When it is time for roof replacement (considering the 1972 roof section), SWA recommends an Energy Star certified roof membrane and rigid insulation (3") assembly.

2.3.3. Base

There is a CMU walled tunnel under the Elementary School portion of the building with uninsulated walls (under the A wing of the building). According to building staff the purpose of the design was for under-floor hot air flow, but it is no longer used. The rest of the building's base is an uninsulated 4" concrete slab-on grade with a perimeter footing and concrete block stem walls. At the time of the audit snow was melting off the roof and water was pooling in certain areas due to either insufficient grading and/or the downspouts not extending far enough from the base of the building. SWA recommends extending downspouts, installing french drains, or connecting downspouts underground storm water system. No water seepage through the slab or other issues related to thermal performance was detected.

Water pooling at base of building due to extreme weather condition

2.3.4. Windows

The windows of the school building are single pane, aluminum framed windows and appear to be in fair condition. The seals of the windows are ineffective and do not provide an air tight seal from exterior conditions, increasing the loss of expensive conditioned air. The windows are non-thermal break single glazed with un-insulated panels above them and are energy inefficient. SWA recommends replacement of the single pane windows as part of capital improvement and suggests replacing the existing windows with double-glazed thermal break low-E aluminum framed units. Regular maintenance should be performed, re-caulking around the perimeter of windows (exterior and interior) to ensure a tight seal.

Open window on day of audit, approximately 28°F

Additionally window AC units should be removed for winter conditions. If removal of these units is not feasible, SWA recommends airtight covers such as Chill Stop-R or a gasketed cover for optimum performance.

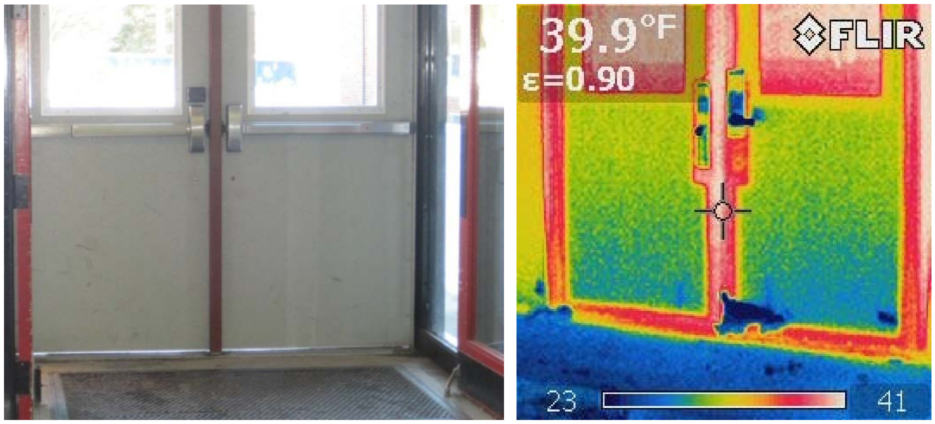
Single pane aluminum framed windows

2.3.5. Exterior doors

At the time of the audit SWA was told all main exterior doors were replaced in 2000. The FRP exterior doors were inspected and observed to be in very good condition. The exterior wood doors found in various classrooms are in need of replacement. Bubbling of paint (seen in the image below) may lead to rot or warping of the door.

Older exterior wood door (serving as exit from classroom)

SWA recommends checking the weather-stripping of each door on a regular basis and replacing any broken seals. Tight seals around doors will help ensure the building to be is kept continuously insulated. When exterior doors or garage doors warrant replacement SWA recommends upgrading existing doors with doors containing a higher R-value with effective seals.



Exterior types of doors all requiring maintenance to verify air tight seals

2.3.6. Building air tightness

In addition to the above mentioned recommendations SWA suggests air sealing, caulking and / or insulating around all plumbing, electrical, HVAC and structural envelope penetrations. This should include bottom and top plates, recessed light fixtures, electrical boxes, chimney walls and window, or sleeve air conditioner units. If units cannot be removed SWA recommends Chill Stop-R or similar tight sealing gasketed cover to prevent loss of expensive conditioned air.

Window air conditioner units left in winter conditions; Infrared image showing loss of heated air around perimeter of unit (also aluminum windows frames heated by sun)


PVC pipe entering building should be sealed with foam or caulk

2.4. HVAC Systems

Frankford Township School is primarily heated by hot water, but there are also some small offices where the A wing and B wing meet that are heated by electric baseboard heaters. Hot water is provided by two heating plants, each housed in a separate boiler room. One plant contains two (2) boilers that heat the A wing and B wing, and one plant has one boiler that serves the C wing and D wing. There is no natural gas service to the building and no utility natural gas mains nearby available for connection. Boilers are served by number 2 fuel oil from an underground storage tank located outside the B wing. The A wing was originally built in 1950 and renovated in 1988. The B wing was added in 1958, the C wing was added in 1968 and the D wing was added in 1974.

2.4.1 Heating

The classrooms in the A wing contain hot water terminal units in the form of ceiling-mounted unit ventilators. In addition, the Media Center and the Art Room both contain two (2) ceiling-mounted unit ventilators and each of the Elementary School offices each contain a ceiling-mounted unit ventilator (six (6) total offices).This equipment was installed as part of a 1988 renovation to this wing of the building. These unit ventilators are in good condition and appear to be operating.

The classrooms in the remaining wings contain wall mounted unit ventilators. It appears that all of the original unit ventilators from the 1958, 1968 and 1974 construction of these wings are still present in the building. This equipment is in fair to poor condition. In total, the school contains approximately sixty (60) Nesbitt unit ventilators of varying ages.

Unit Ventilators in B Wing (Left) and C Wing (Right)

The building also contains enclosed wall mounted and ceiling mounted finned tube radiation in the corridors, vestibules, toilet rooms and in the Middle School offices.

Each unit ventilator contains a heating coil, fan assembly, damper, filter and controls within a metal cabinet. Equipment was designed to introduce outdoor air via a grille and damper located on the outside wall. The units are designed to mix room air with outside air, heat the air as required, and deliver the air to the occupied space. The older wall mounted unit ventilators deliver the air directly through a grille on the top of the unit. The air from the ceiling-mounted units is discharged through a grille on the front face of the unit directly into the room.

The Large Gymnasium, which also serves as the Cafeteria and Multipurpose Room, is heated by two (2) heating and ventilating (H&V) units, with fresh air provided via rooftop vents. There is one vertical unit located in a small room adjacent to the kitchen. The second unit is horizontal type and is mounted above the Stage. The Small Gym is heated by a large H&V unit suspended from the roof with fresh air provided through a wall louver.

H&V Unit Suspended From Roof in Small Gym

The Kitchen Storage room that contains the walk-in cooler/freezer is heated by a hot water H&V unit located above the Middle School Copy Room, with fresh air provided via a rooftop vent.

The Boy's and Girl's Locker Rooms are heated via hot water cabinet unit heaters suspended from the ceiling.

The Occupational Therapy, Speech and Child Study Team offices, which are located where the A wing and B wing meet, are heated by electric baseboard heaters. The offices also have curtain walls and single pane windows, and it was reported by the staff in these offices that the electric baseboard heaters run constantly during the heating season. These rooms are in close proximity to the A/B wing boiler room, and replacing these electric baseboard units with hot water unit ventilators, along with providing insulated walls and windows, would yield savings in energy and operating costs.

The heating hot water for the A wing and B wing is produced by two (2) oil-fired hot water boilers located in the A/B boiler room. There are two (2) sets of floor-mounted hot water pumps that distribute the heating water out to the two wings. These pumps operate in lead-lag fashion, so only one of each pair is operating at one time. This hot water heating system is piped in a primary pumping arrangement.

The boilers have a capacity of 2,247 MBH and 2,403 MBH respectively. The boilers are cast iron sectional type. One boiler was installed in 1986 and the other boiler was installed in 1992. According to their age, the boilers have about 6 years and 11 years respectively remaining on their expected service life of 30 years, as published in the 2007 ASHRAE HVAC Applications Handbook. The burners were installed in 1986 and 1992 respectively, and are fed from a 10,000 gallon underground oil storage tank that is adjacent to the B Wing. The first burner is beyond its expected service life and the second burner is approaching its expected service life of 21 years, as published in the 2007 ASHRAE HVAC Applications Handbook.

Energy savings could be achieved by replacing these boilers with higher efficiency packaged oil-fired boilers with burner modulation, but this upgrade cannot be justified by energy savings alone.

A/B wing boilers

It is assumed that the circulating pumps were installed in 1986 and 1992 when each boiler was replaced. SWA recommends that the pump motors are replaced with premium efficiency motors.

The heating hot water for the C and D wings is produced by one (1) hot water boiler located in the C/D wing boiler room. There are two (2) sets of hot water pumps that distribute the heating water out to the two wings. One set is floor-mounted and one set is pipe-mounted. These pumps operate in lead-lag fashion, so only one of each pair is operating at one time. This hot water heating system is piped in a primary pumping arrangement.

The boiler has a capacity of 3,330 MBH. The boiler was reportedly installed in 1992. According to its age, the boiler has about 12 years remaining on their expected service life of 30 years, as published in the 2007 ASHRAE HVAC Applications Handbook. The burner is approaching its expected service life of 21 years, as published in the 2007 ASHRAE HVAC Applications Handbook.

Energy savings could be achieved by replacing this boiler with a higher efficiency packaged oil-fired boiler with burner modulation, but this upgrade cannot be justified by energy savings alone.

C/D wing boiler

It is assumed that the circulating pumps were installed in 1992 when the boiler was replaced. SWA recommends that the pump motors are replaced with premium efficiency motors.

Pneumatic Control System Panel in C/D Wing Boiler Room

The building contains two (2) pneumatic controls systems to control the equipment in each pair of wings. The air compressors were noted to run often and in several instances, the thermostats were observed to make a hissing noise indicative of leaking compressed air.

There were no complaints about the ability of the heating system to provide adequate heat to the building occupants. It was reported that the thermostats provide little to no control over the heating equipment and that most areas experience overheating during the heating season. This is leading to excessive operation of the boilers. In addition, it was reported that the fans for several of the unit ventilators and the exhaust fans for the gyms run during unoccupied hours. The expected service life of a pneumatic controls system is 20 years per 2007 ASHRAE HVAC Applications Handbook. Based on these facts, SWA recommends that the pneumatic controls system be replaced with an electronic DDC controls system for all of the equipment in the building.

2.4.2 Cooling

The majority of the cooling is in the form of 1-2 ton window air conditioning units in several classrooms and offices, totaling about 20 in all. Most of these units are not Energy Star rated. The TV Studio and adjacent offices are cooled by a packaged DX cooling only HVAC unit mounted on grade beside the entrance to the Middle School. The equipment is about 15 years old and is therefore at the end of its expected service life of 15 years per 2007 ASHRAE HVAC Applications Handbook. The unit appeared to be in fair condition.

It should be noted that Room 54 in the D-Wing contains 20 computers and no mechanical cooling system. SWA recommends that either window air conditioning or a ductless DX split system is provided for this room due to the expected high heat load from the computers.

Packaged HVAC Unit on Grade Serving TV Studio

2.4.3 Ventilation

As mentioned above, the grilles on the Nesbitt unit ventilators provide fresh air to the classrooms and the Art Room and Library in the A-Wing. SWA recommends that this equipment be replaced as part of a capital improvement, and that the new equipment provided with a means of providing a code compliant level of outside air to the spaces.

The Large Gymnasium, which also serves as the Cafeteria and Multipurpose Room, is ventilated by two (2) heating and ventilating (H&V) units, with fresh air provided via rooftop vents. There is one vertical unit located in a small room adjacent to the kitchen. The second unit is horizontal type and is mounted above the Stage. The Small Gym is ventilated by a large H&V unit suspended from the roof with fresh air provided through a wall louver.

The Kitchen Storage room that contains the walk-in cooler/freezer is ventilated by a hot water H&V unit located above the Middle School Copy Room, with fresh air provided via a rooftop vent.

The Boy's and Girl's Locker Rooms are ventilated via rooftop exhaust fans with makeup air provided from the Multipurpose Room H&V unit.

The kitchen contains a commercial cooking exhaust hood with corresponding rooftop exhaust fans. There is no dedicated makeup air unit so the makeup air is provided the H&V units that serve the Large Gymnasium, Cafeteria and Multipurpose Room.

It appears that the following rooms are not provided with code minimum ventilation air: Elementary Guidance Office (A-Wing), Elementary Janitor's Closet (A-Wing), Nurse's Office (A-Wing), OT/Speech/Child Study Team Offices (A-Wing), Middle School Guidance Office and adjacent Room P1(D-Wing), Middle School Copy Room (D-Wing) . This condition must be addressed during the capital improvement work recommended herein.

The building has a number of exhaust fans on the roof above the corridors, toilet rooms and classrooms of the B, C and D Wings. These fans are original to the respective wings and are beyond their expected service life. There is a pitched roof with attic space above the A Wing, and the classrooms, Art Room and Library are provided with attic-mounted exhaust fans ducted to a wall grille to relieve the fresh air intake and aid in the overall ventilation of these spaces. The toilet rooms are also exhausted via attic-mounted fans. The fans in the A-wing are 22 years old and are beyond their expected service life of 20 years based on the

2007 ASHRAE HVAC Applications Handbook. SWA recommends that this equipment is replaced as part of a capital improvement project, and that it is designed to provide code minimum ventilation rates.

Typical Rooftop Exhaust Fan

2.4.4 Domestic Hot Water

The hot water boilers produce the domestic hot water for the majority of the school. Boiler #2 in the A/B Boiler Room contains two (2) tankless water heater sections that provide domestic hot water for the A and B wings of the school. The Boiler in the C/D Boiler Room contains multiple tankless heater sections that provide domestic hot water for the C and D Wings of the school. Both systems incorporate a hot water recirculating pump. Due to this method of providing domestic hot water, the boilers must be fired even during mild weather when there would normally be no space heating load. SWA recommends providing separate tank-type domestic water heaters to handle the domestic water heating load. This will provide energy savings by allowing the school to not fire the boilers during mild weather.

There is also one (1) electric tank type domestic water heater located in the PTA storage room in the D Wing, presumably serving the toilet rooms in that wing. Replacement would not yield significant energy savings but should be considered due to age.

Typical Tankless Boiler Immersion Domestic Water Heater in A/B Boiler

Updated bathrooms with sensors for toilets and sinks (with 0.5gpm aerators)

2.4.5 Commercial Kitchen Equipment

There is one (1) walk-in cooler/freezer at the rear of the kitchen. This equipment was installed with the construction of the C Wing in 1968 and is in fair condition. The rooftop compressors have been replaced in recent years and are fairly efficient. The cooler was labeled as using R-22 refrigerant and the freezer uses R-502 refrigerant. The evaporator fans are original to the cooler and freezer and the Frankford School could realize some energy savings by replacing these fans with more energy efficient fans.

There is also one (1) walk-in freezer located outside the building, adjacent to the D-Wing. This freezer is much newer than the interior unit and utilizes fractional horsepower evaporator fans. This freezer is in very good condition and utilizes R-404a refrigerant.

There is one (1) 6-door stainless steel electric reach-in commercial refrigeration unit located in the kitchen that utilizes R-12 refrigerant. It is estimated that this equipment was installed in 1976 and is in relatively good condition. However, SWA recommends that the unit is replaced based on potential energy savings and the fact that R-12 is listed by the EPA as an ozone-depleting substance and production of this refrigerant was banned by the Clean Air Act in 1996.

The kitchen also contains one (1) reach-in milk cooler that also uses R-401a as its refrigerant. There was no accessible nameplate found during our survey, but it is estimated that this equipment was installed with the 1976 addition, and it is in fair condition.

In addition to the kitchen equipment, there are two (2) residential style refrigerators in the Home Economics classroom, and one in the B Wing Faculty Lounge, and in the Middle School Copy Room. None of the refrigerators were noted to be Energy Star rated.

The kitchen also contains several pieces of commercial-style cooking equipment, including (2) electric convection ovens and (2) electric range/ovens. There is a large kitchen hood provided for this equipment. The Kitchen also contains a tall electric heated storage cabinet. The makeup air is likely provided via transfer from the adjacent Cafeteria H&V units.

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting - The Frankford Township School building currently consists of mostly older inefficient T12 bulbs with magnetic ballasts. SWA recommends upgrading to high performance T8 fluorescent fixtures with electronic ballasts. There are also fixtures found to contain incandescent bulbs (as seen in the image below). SWA recommends upgrading these fixtures with compact fluorescent bulbs. Based on measurements of lighting levels for each space, there are not any vastly over-illuminated areas. SWA recommends installing occupancy sensors in classrooms, closets, offices and areas where payback on savings is justified. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion or sound is detected within a set time period. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption.

Incandescent bulbs in faculty lounge bathroom

Exit Lights - Exit signs were found to be LED type.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a mix of CFLs and Metal Halide fixtures. Some of the exterior lighting is controlled by photocell sensors. SWA is recommending photocell sensors for all exterior lighting or timers.

Exterior lights left on during daylight hours

2.5.2. Appliances and process

Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. For example, Energy Star refrigerators use as little as 315 kWh / yr. When compared to the average electrical consumption of older equipment, Energy Star equipment results in a large savings. Building management should select Energy Star label appliances and equipment when replacing: refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov. SWA recommends consulting with the vendor that supplies all vending machines, requesting Energy Star models when the contract is due for renewal. Also, energy vending miser devices are now available for conserving energy usage by Drinks and Snacks vending machines. When equipped with the vending miser devices, vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines.

Two vending machines in Cafeteria, one vending machine in faculty lounge

SWA also recommends removal of all unnecessary appliances throughout the school. Small personal refrigerators, additional microwaves, or other appliances add to the school electrical load.

Computers left on in the building consume a lot of energy. A typical desk top computer uses 65 to 250 watts and uses the same amount of energy when the screen saver is left on. Televisions in meeting areas use approximately 3-5 watts of electricity when turned off. SWA recommends all computers and all appliances (i.e. coffee makers, televisions, etc) be plugged in to power strips and turned off each evening just as the lights are turned off.

Smartboards & Computers left on in vacant classrooms

2.5.3. Elevators

The Frankford School is a single story building and there is no elevator.

2.5.4. Emergency Generator

There is one (1) 150KW diesel emergency generator on site. The generator serves all A Wing loads, all Gym and Kitchen loads, the walk-in cooler and freezers, the boiler rooms and the emergency lighting loads in the B, C and D Wings. This generator was installed 2007 and is in good condition.

Emergency Generator

3. EQUIPMENT LIST

Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	Boiler, hot water, cast iron sectional	A/B Boiler Room	HB Smith Model 28A-11 11 Sections, 2,247 MBH Serial #02622	No. 2 Fuel Oil	A Wing	1986	20%
Heating	Boiler burner, A Wing Boiler	A/B Boiler Room	Peabody Gordon-Piatt Model #HR10.1-0-20 22.5 gph oil	No. 2 Fuel Oil	A Wing	1986	0%
Heating	Boiler, hot water, cast iron sectional	A/B Boiler Room	HB Smith Model 28A-11 11 Sections, 2,403 MBH Serial # N91131	No. 2 Fuel Oil	B Wing	1991	35%
Heating	Boiler burner, B Wing Boiler	A/B Boiler Room	Gordon-Piatt Model #HR10.1-0-30 25 gph oil max (15 gph min)	No. 2 Fuel Oil	B Wing	1991	0-10%
Heating	(2) Hot Water Supply Pumps	A/B Boiler Room	Bell & Gossett 1510 Series, 7.5 HP	Electric	A Wing	1986	0%
Heating	(2) Hot Water Supply Pumps	A/B Boiler Room	Bell & Gossett 1510 Series, 2 HP	Electric	B Wing	1991	0-10%
Automatic Temp Controls	Air Compressor	A/B Boiler Room	Colt Industries Duplex, (2) 1/2 HP Serial # FF106-155265301	Electric	A & B Wings	Est. 1986	0%
Heating	Fuel Oil Pump Set	A/B Boiler Room	GE Model# 5KC35JN10H (2) 1/4 HP	Electric	A & B Wings	Est. 1986	20%
Domestic Water	Hot Water Recirculating Pump	A/B Boiler Room	Bell & Gossett Series 100, 1/12 HP	Electric	A & B Wings	Est. 2005	50%
Heating	Hydronic Unit Heater	A/B Boiler Room	Trane Model# UHSA-038W-2C-AAC Serial# 092G08642	Electric	A/B Boiler Room	1992	10-20%
Heating	Boiler, hot water, cast iron sectional	C/D Boiler Room	HB Smith Model 28A-15 15 Sections, 3,330 MBH Serial #N92-210	No. 2 Fuel Oil	C & D Wings	1992	40%
Heating	Boiler burner,A Wing Boiler	C/D Boiler Room	Power Flame Model #C3-OB Serial # 089259703 38 gph oil	No. 2 Fuel Oil	C & D Wings	1992	10%
Heating	(2) Hot Water Supply Pumps	C/D Boiler Room	Bell & Gossett Model# 903574 1-1/2 HP	Electric	C Wing	1992	0%
Heating	(2) Hot Water Supply Pumps	C/D Boiler Room	Bell & Gossett Model# 1-1/2 BB-989F 3HP	Electric	D Wing	1992	10%

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Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Automatic Temp Controls	Air Compressor	C/D Boiler Room	Nameplate Not Noted Estimated Duplex, (2) 1/2 HP	Electric	C & D Wings	Est. 1992	10%
Heating	Fuel Oil Pump Set	C/D Boiler Room	Nameplate Not Noted (2) 1/4 HP	Electric	C & D Wings	Est. 1992	30%
Heating/ Ventilation	Hot Water Heating & Ventilating Unit	Small Gym	Nameplate Not Accessible 6,000 CFM, 1 HP per Original Design Documents	Electric	Small Gym	1974	0%, operating past expected useful life
Heating/ Ventilation	Hot Water Heating & Ventilating Unit	Above MS Copy Room	Nameplate Not Accessible 1,520 CFM, 1/2 HP per Original Design Documents	Electric	Kitchen Storage/Walk-In Box Area	1974	0%, operating past expected useful life
Heating/ Ventilation	Hot Water Heating & Ventilating Unit	Kitchen Storage	Nameplate Not Accessible Est. 3,000 CFM, 1 HP	Electric	Large Gym/Cafeteria	1968	0%, operating past expected useful life
Heating/ Ventilation	Hot Water Heating & Ventilating Unit	Above Stage	Nameplate Not Accessible Est. 3,000 CFM, 1 HP	Electric	Multipurpose Room	1968	0%, operating past expected useful life
Heating/ Ventilation	(26) hot water unit ventilators	A Wing	Nesbitt, CFM ranges from 1,000-1,500 CFM	Electric	A Wing Classrooms, Offices, Art Room & Library	1988	0%, operating past expected useful life
Heating/ Ventilation	(7) hot water unit ventilators	B Wing	Nesbitt, CFM ranges from 1,250-1,500 CFM	Electric	B Wing Classrooms	1958	0%, operating past expected useful life
Heating/ Ventilation	(9) hot water unit ventilators	C Wing	Nesbitt, CFM ranges from 1,250-1,500 CFM	Electric	C Wing Classrooms	1968	0%, operating past expected useful life
Heating/ Ventilation	(18) hot water unit ventilators	D Wing	Nesbitt, CFM ranges from 1,250-1,500 CFM	Electric	D Wing Classrooms	1974	0%, operating past expected useful life
Ventilation	+/- 25 Attic-mounted exhaust fans	A Wing	Varies, Approx 100-500 CFM ea., all fractional HP	Electric	A Wing Classrooms, Offices, Art Room & Library	1988	0%, operating past expected useful life
Ventilation	+/- 5 Roof-mounted exhaust fans	B Wing	Varies, Approx 1 HP ea.	Electric	B Wing	1958	0%, operating past expected useful life
Ventilation	+/- 12 Roof-mounted exhaust fans	C Wing	Varies, Fractional HP.	Electric	C Wing	1968	0%, operating past expected useful life
Ventilation	+/- 20 Roof-mounted and Wall-Mounted (Small Gym) exhaust fans	D Wing	Varies, Fractional HP.	Electric	D Wing	1974	0%, operating past expected useful life

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Building System	**Description**	**Location**	**Model #**	**Fuel**	**Space Served**	**Year Installed**	**Estimated Remaining Useful Life %**
Cooling	(20) window AC units throughout the building	various class-rooms	Varies, Approx. 1-2 tons each	Electric	Various classrooms and officesthroughout building	varies	varies, estimating 25-50%
Heating	Hydronic Unit Heater	Kitchen	Nesbitt Model #2CJ21	Electric	Kitchen	1968	0%, operating past expected useful life
Heating	Hydronic Unit Heater	Kitchen Storage	Nesbitt Model #2CJ21	Electric	Kitchen Storage	1968	0%, operating past expected useful life
Cooling	Packaged HVAC Unit	Exterior on Grade	Carrier Model# 50HJ007521 Serial# 3595G20900	Electric	TV Studio	1995	0%
Refriger.	Walk-in Cooler/Freezer	Kitchen Storage	Bally Model# BF-100A Serial# F0002	Electric	Kitchen	1968	0%
Refriger.	Walk-in Freezer	Exterior	W.A. Brown Evap fans - Heatcraft Model # LSF090BMC6K Serial D06G07377	Electric	Kitchen	Est. 2005	60%
Refriger.	(2) Vending Machines	Cafeteria	Dixie-Narco M# DN 501EMC7S11-9 R-134a; 11A Dixie-Narco M# 501-ET/S IL-9	Electric	Cafeteria	Unknown	Unknown
Refriger.	Reach-in Stainless steel refrigerator	Kitchen	Traulsen & Co. Model# AHT 3-32NUT	Electric	Kitchen	Est.1975	0%
Refriger.	Reach-in milk cooler	Kitchen	No Nameplate	Electric	Kitchen	Est.1975	0%
Cooking	(2) Electric Convection Ovens	Kitchen	Blodgett Model #EF-111 Serial# 969EF10 Serial# 776EF14 11 kW @ 208V-3-phase	Electric	Kitchen	Est.1975	0%
Cooking	(2) Electric Range Ovens	Kitchen	No Nameplate	Electric	Kitchen	Est.1975	0%
Lighting	See details - Appendix A	Building	-	Electric	Building		

Note: The remaining useful life of a system (in %) is an estimate based on the system date of built and existing conditions derived from visual inspection.

4. ENERGY CONSERVATION MEASURES

Based on the assessment of the Frankford Township School builidng, SWA has separated the investment opportunities into three recommended categories:

1. Capital Improvements - Upgrades not directly associated with energy savings
2. Operations and Maintenance - Low Cost / No Cost Measures
3. Energy Conservation Measures - Higher cost upgrades with associated energy savings

Category I Recommendations: Capital Improvements

- Insulate exterior walls - SWA recommends insulating the exterior walls of at least the original structure by adhering 2" polyiso boards (Polyisocyanurate) together with furring strips and gypsum wall boards to the inside of the painted CMU walls.

- Replace wood doors in classrooms with insulated FRP gasketed exterior doors. Investigate R values of doors for improved energy conservation.

- Replace 1972 roof section – Due to age and end of life condition, SWA recommends replacement of the 38 year old single-ply EPDM roof sections with an Energy Star certified membrane and insulation (3" rigid) assembly. Maintenance should be performed at regular intervals with a roofing contractor to prevent future roof leaks or to prevent future damages to the roof assembly. It is also advisable to upgrade any questionable roof integrity areas before photovoltaics are installed, as any repairs after the system is installed will be costly.

- Replace windows - SWA evaluated, as part of a capital improvement plan, replacing all single-pane windows (approximately 2407 sq ft) with newer models with thermal breaks, dual glazing and a low-e rating. A licensed contractor should assess and calculate accurate window areas and rough openings for replacement. Proper flashing and caulking should be performed upon installation of the new windows.

  The building contains approximately 2407 square feet of single-pane fixed and casement aluminum-framed windows with single-glazing. In context of other energy measures proposed in this report and in an effort to maximize the cost-benefit factor for improvements, SWA recommends that these windows be replaced with the next major capital improvement / renovation project. Windows considered for replacement should have the following outline specifications besides conforming to local code and regulations: the windows shall be aluminum frame thermally manufactured as double hung commercial type modules. The clear, low-e, argon filled dual glazing should be 2 independent panes. The walls should be extruded aluminum with integral poured-in-place thermal barrier. All horizontal rails should be of tubular shape and joinery should be butted and coped with stainless steel screws. Air infiltration shall not exceed 0.10 cfm/sf of unit. The conductive thermal transmittance (U-Value) shall not be more than 0.51 Btu/hr sq ft °F. Upgrade building per ADA requirements - SWA recommends that the Frankford Township School Board of Education do as much as possible to comply with the latest ADA regulations.

- Replace unit ventilators - Replace 60 Nesbitt unit ventilators originally installed when the respective wing was constructed (7 in 1958 B Wing, 9 in 1968 C Wing and 18 in 1974 D Wing) except the (26) A Wing units which were replaced in 1988. The B, C and D Wing units are well beyond their expected service life. The A Wing units are also beyond their expected service life by a few years. Considering the increased maintenance repair costs and that replacement parts are difficult to find, SWA recommends replacement of this equipment. There is better control offered by the newer, electronically controlled units, although energy savings are negligible. Typical specifications for the new units can be as follows:

"The fans should be double inlet forward curved of centrifugal variety; have a maximum speed of 1,000 rpm with permanent split capacitor motors. The fan housing should be constructed of heavy gauge metal to help reduce air noise during operation. Wheel motors are to be premium efficiency, single speed, and permanent split capacitor with overload protection. Each fan should be equipped with a three speed switch for air balancing. An ultra-low leak, blade type outside air damper will ensure low leakage of the outside air when the equipment is not operating. The unit shall have a solid-state defrost control system and two separate filters. The air-to-air heat exchanger should be designed to support two air streams in a counter-flow direction. The heat exchanger matrix shall permit less than one percent of cross contamination between the air streams. The heat exchanger shall have an effectiveness of approximately 80% with equal airflow."

Energy savings from the proposed units do not justify the economics for replacement, and is hence recommended as capital improvement. The estimated cost of 60 new fan coil ventilators is $575,000.

- The Frankford Township School may wish to consider adding DX cooling as part of the equipment replacement. In this case, it should be recognized that cooling will result in an increase in energy usage versus providing heating and ventilation only. The estimated budget installed cost for DX coil and air cooled condensing units for the unit ventilators is an additional $220,000. ***Note that the addition of air conditioning may require an upgrade to the existing electric service. The cost of the electric service upgrade is broken out separately below but should be included if the cooling option above is incorporated.***

- Replace (2) H&V units serving the Large Gym and Multipurpose Room - The hot water heating only ventilation system for the Large Gym and Multipurpose Room is beyond its expected service life. SWA recommends that this equipment is replaced as part of a capital improvement project, and that it is designed to provide code minimum ventilation rates. The estimated budget installed cost for (2) hot water H&V units for the Large Gym and Multipurpose Room is $95,000.The Frankford Township School may wish to consider providing DX cooling as part of this system to make the room more functional in warm weather, but should recognize that this will increase energy usage versus providing a heating and ventilation system only. If cooling is desired, it is strongly recommended that a system is provided that utilizes a heat recovery wheel for pretreatment of the outside air and CO2 sensors for demand control ventilation. This is a replacement in kind recommendation which offers negligible energy savings. The estimated budget installed cost for (2) rooftop H&V units with DX cooling and heat recovery wheel is $140,000. ***Note that the addition of air conditioning may require an upgrade to the existing electric service. The cost of the electric service upgrade is broken out separately below but should be included if the cooling option above is incorporated.***

- Replace (1) H&V units serving the Small Gym - The hot water heating only ventilation system for the Small Gym is beyond its expected service life. SWA recommends that this equipment is replaced as part of a capital improvement project, and that it is designed to provide code minimum ventilation rates. The estimated budget installed cost for (1) hot water H&V units for the Small Gym is $45,000.The Frankford Township School may wish to consider providing DX cooling as part of this system to make the room more functional in warm weather, but should recognize that this will increase energy usage versus providing a heating and ventilation system only. If cooling is desired, it is strongly recommended that a system is provided that utilizes a heat recovery wheel for pretreatment of the outside air and CO2 sensors for demand control ventilation. These additional features may require rooftop equipment with side discharge ductwork that would be ducted through the current outside air louver opening, which would involve some residual architectural and/or structural work. This is a replacement in kind recommendation which offers negligible energy savings. The estimated budget installed cost for (1) rooftop H&V unit with DX cooling and heat recovery wheel is $80,000. ***Note that the addition of air conditioning may require an upgrade to the existing electric service. The cost of the electric service upgrade is broken out separately below but should be included if the cooling option above is incorporated.***

- In lieu of DX cooling systems recommended above, add chilled water cooling system along with unit ventilator and H&V unit upgrades -- The estimated budget installed cost for the addition of a chiller, pumps, piping and required terminal equipment is $1,750,000. ***Note that the addition of air conditioning may require an upgrade to the existing electric service. The cost of the electric service upgrade is broken out separately below but should be included if the cooling option above is incorporated.***

- In lieu of DX cooling systems recommended above, add conventional water source heat pump system throughout school with heat exchanger and cooling tower -- The estimated budget installed cost for the addition of the heat exchanger and cooling tower as well as demolition and replacement of all piping to be compatible with this system type is $2,100,000. ***Note that the addition of air conditioning may require an upgrade to the existing electric service. The cost of the electric service upgrade is broken out separately below but should be included if the cooling option above is incorporated.***

- In lieu of chilled water or DX cooling systems recommended above, add geothermal cooling and heating system -- Note that the existing boilers could remain but would have limited use. The estimated budget installed cost for the addition of geothermal wells, pumps, and electric heat pump unit ventilators and electric heat pump terminal equipment is $3,000,000. ***Note that the addition of air conditioning may require an upgrade to the existing electric service. The cost of the electric service upgrade is broken out separately below but should be included if the cooling option above is incorporated.***

- Upgrade Building Management System (BMS) - Currently, the building is controlled by an antiquated, pneumatic temperature control system The BMS should be upgraded to a new Direct Digital Control (DDC) system similar to the Johnson Metasys system to control the new unit ventilators and other equipment replaced as part of the capital improvement recommendations. This upgrade will result in energy savings via improved temperature control and by the elimination of the air compressors. In addition, it was reported by the Supervisor of Buildings & Grounds that about half of the unit ventilators run for 24 hours per day on school days between September and June. In addition, the H&V units and exhaust fans serving the Cafeteria and Multipurpose Room operate from 6:00 am to 11:00 pm on school days. The outside air dampers should open and fans should operate at 8:00 am and close/deenergize at 2:30 pm on each school day. The new DDC system will incorporate this sequence of operation for this equipment. The estimated installed cost of the new controls system is $375,000, including all control, wiring, web-based controller for direct communication and remote control to monitor and alarm all HVAC equipment and all programming, engineering, training and start-up. It is estimated that proper shut-off of the unit ventilators, H&V units and fans listed above will save about 50,000 kwh and approximately 3,900 therms annually.

- Replace common area heating equipment - such as finned tube radiation and cabinet unit heaters in the toilet rooms, vestibules and corridors. This equipment is in fair condition, but age and wear have reduced the heat transfer capacity. This equipment should be replaced with more modern equipment suited for the intended use. These changes cannot be justified based on energy savings alone. However, replacement is strongly recommended along with upgrades to other portions of the heating system. This is a replacement in kind recommendation which offers negligible energy savings.

- Replace window air conditioners – Several of the existing window air conditioners still have some useful life remaining (on the average 0-5 years left) but replacement should be considered with modern, energy efficient systems. The window air conditioners should be replaced with split systems to allow for closing up of the existing window or wall penetrations. These upgrades cannot be justified by energy savings alone but will result in a decrease in energy usage versus the existing equipment. In addition, some of the existing systems utilize R-22 refrigerant, which is not an ozone-friendly refrigerant. Newer systems should be specified with R-410A refrigerant.

- Upgrade electric service – The existing electric service is rated for 1,600 amperes at 208V-3-phase. Based on recent electric demand data from the local utility, there is spare capacity for additional loads in the existing electric service. If cooling is added per some of the recommended capital improvement measures listed above, an upgrade to the electric service is required. The estimated electric service requirement for the addition of air conditioning is 4,000 amps at 208V-3-phase. The estimated budget cost for this upgrade is $150,000.

- The following rooms are not provided with code minimum ventilation air: Elementary Guidance Office (A-Wing), Elementary Janitor's Closet (A-Wing), Nurse's Office (A-Wing), OT/Speech/Child Study Team Offices (A-Wing), Middle School Guidance Office and adjacent Room P1(D-Wing), Middle School Copy Room (D-Wing) . As part of the recommended unit ventilator replacements, provide these rooms with a unit ventilator or other air handling system with outside air provisions.

- Consider replacement of the 1968 Bally walk-in cooler/freezer with a newer model. Although the compressor and condenser package has been replaced, the wall and roof panels of the box itself are likely not insulated to the levels of current walk-in coolers. This is a replacement in kind recommendation which cannot be recommended based on energy savings alone.

- Consider replacement of the reach-in milk cooler in cafeteria with more modern, higher efficiency model.

- Install premium motors when replacements are required - Select NEMA Premium motors when replacing motors that have reached the end of their useful operating lives.

Category II Recommendations: Operations and Maintenance

- Inspect and replace gasketing around door into the walk-in refrigeration boxes in the Kitchen and outside. Ineffective gasketing allows infiltration of warm air into the walk-in box, which increases the run-time of the compressors.

- Water levels in the expansion tanks and the integrity of the tank bladder should be checked to confirm proper operation.

- Use Energy Star labeled appliances - such as Energy Star refrigerators that should replace older energy inefficient equipment.

- Maintain roofs - SWA recommends regular maintenance to verify water is draining correctly.

- Maintain downspouts - Repair / install missing downspouts as needed to prevent water / moisture infiltration and insulation damage.

- Provide weather stripping / air sealing - Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. The perimeter of all window frames should also be regularly inspected and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frames. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.

- Preventative exterior wall maintenance - SWA recommends as part of the maintenance program to install proper flashing, correct masonry efflorescence and seal wall cracks and penetrations wherever necessary in order to keep insulation dry and effective.

- Use smart power electric strips - in conjunction with occupancy sensors to power down computer equipment when left unattended for extended periods of time.

- Create an energy educational program - that teaches how to minimize their energy use. The US Department of Energy offers free information for hosting energy efficiency educational programs and plans, for more information please visit: http://www1.eere.energy.gov/education/

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Table 1 - Highly Recommended 0-5 Year Payback ECMs
2	Install 3 Drinks vending machine misers
3.4	11 New motion sensors to be installed with incentives
4.1	Replace (2) 7.5 Hp hot water circulator pump motors with Premium Efficiency
3.3	88 New occupancy sensors to be installed with incentives
4.4	Replace (2) 3 Hp domestic hot water pump motor with Premium Efficiency
1	Replace old refrigerator with 18 cu ft Energy Star refrigerator
5.1	Replace Cooler Evap Fan Motor with Premium Efficiency Motor
4.2	Replace (2) 2 Hp hot water circulator pump motors with Premium Efficiency
	Table 2 - Recommended 5-10 Year Payback ECMs
5.2	Replace Freezer Evap Fan Motor with Premium Efficiency Motor
4.3	Replace (2) 1.5 Hp domestic hot water pump motor with Premium Efficiency
11	Demand Control Ventilation for Cafeteria & MP Room AHUs
	Table 3 - Recommended Over 10 Year Payback and End of Life Cycle ECMs
7a	Cost to replace boilers with modulating high efficiency oil-fired boilers
3.1	823 New T8 fixtures to be installed with incentives
8a	Replace (1) packaged 6-ton electric cooling rooftop HVAC unit with high efficiency unit
6	Utilize tank type domestic water heater instead of boilers
10a	Replace reach-in stainless steel refrigerator with 42 cu ft Energy Star refrig
3.2	8 New pulse start metal halide fixtures to be installed with incentives
9a	Replace 40 exhaust fans with premium efficiency units
	Table 4 - Renewable Energy Generation Measures
12	Install 151.2 kW PV rooftop system with incentives
12a	Install 49.7 kW PV rooftop system with incentives

ECM#1: *Replace Old Refrigerator with Energy Star Model*

Description:

On the days of the site visit, SWA observed an older refrigerator in the Faculty lounge which is not Energy Star rated (using as much as 1,700 kWh/yr). Appliances, such as refrigerators, that are over 10-12 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing refrigerator which is operating at the end of its useful lives with a more modern, ENERGY STAR®, energy efficient appliance. Besides saving energy, the replacement will also keep the kitchen area cooler. In addition, the existing systems utilize R-12 refrigerant, which is not an ozone-friendly refrigerant. Newer systems should be specified with R-134A or R-404A refrigerant. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

Installation cost:

Estimated installed cost: $750
Source of cost estimate: *Energy Star purchasing and procurement site, similar projects, Manufacturer and Store established costs*

Economics:

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Replace old refrigerator with 18 cu ft Energy Star refrigerator	Energy Star purchasing and procurement site, similar projects	750	0	750	1200	0.1	0	0	0	194	12	804.00	3.9	7	1	1	-83	501

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis. SWA assumed one annual call to a refrigeration contractor to perform minor repairs on old refrigerators.

Rebates/financial incentives:

NJ Clean Energy - There are not any incentives at this time offered by the state of NJ for this energy conservation measure.

Options for funding the Lighting ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#2: *Install Vending Misers on all soda vending machines*

Description:

The Frankford Township School building has three drinks vending machines (located in the Large Gymnasium (2) and Faculty Lounge (1)). Energy vending miser devices are now available for conserving energy with these machines. There is not a need to purchase new machines to reduce operating costs and greenhouse gas emissions. When equipped with the vending miser devices, refrigerated beverage vending machines or coolers use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines. Vending miser devices incorporate innovative energy-saving technology into small plug-and-play devices that installs in minutes, either on the wall or on the vending machine. Vending miser devices use a Passive Infrared Sensor (PIR) to: Power down the machine when the surrounding area is vacant; Monitor the room's temperature; Automatically repower the cooling system at one- to three-hour intervals, independent of sales; Ensure the product stays cold.

Snacks vending miser devices can be used on Snacks vending machines to achieve maximum energy savings that result in reduced operating costs and decreased greenhouse gas emissions with existing machines. Snacks vending miser devices also use a Passive Infrared Sensor (PIR) to determine if there is anyone within 25 feet of the machine. It waits for 15 minutes of vacancy, then powers down the machine. If a customer approaches the machine while powered down, the snacks vending miser will sense the presence and immediately power up.

Installation cost (including labor):

Estimated installed cost: $837
Source of cost estimate: www.usatech.com *and established costs*

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
2	Install 3 Drinks vending machine misers	www.usatech.com and established costs	837	0	837	4,316	1.4	0	0.2	0	699	12	8,390	1.2	902	75	112	8,500	5,913

Assumptions: SWA assumes energy savings based on 85 operating hours/week; the modeling calculator found at www.usatech.com or http://www.usatech.com/energy_management/energy_calculator.php

Rebates/financial incentives:

NJ Clean Energy - There are not any incentives at this time offered by the state of NJ for this energy conservation measure.

Options for funding ECM:

This project may benefit from applying for grant funding for school districts in regular operating districts (ROD) to offset a portion of the cost of implementation.

http://www.state.nj.us/education/facilities/projectapplication/rod/

This project may benefit from applying for a grant from the State of New Jersey Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.

http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

ECM#3: *Building Lighting Upgrades*

Description:

On the day of the site visit, SWA completed a lighting inventory of the Frankford Township School building (see Appendix A). The existing lighting consists of mostly older inefficient T12 fluorescent fixtures with magnetic ballasts. SWA recommends upgrades to high performance T8 fluorescent bulbs with efficient electronic ballasts. All incandescent bulbs should be replaced with compact fluorescents, using a quarter of the energy. SWA has performed an evaluation of installing occupancy sensors in classrooms, offices and closets where the payback is justified. The labor in all these installations was evaluated using prevailing electrical contractor wages. The Frankford Township School Board of Education may decide to perform this work with in-house resources from its Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor to obtain savings.

Installation cost (including labor):

Estimated installed cost: $181,761
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	Est. operating cost, 1st yr savings, $	est. energy & operating 1st year cost savings, $	life of measure, yrs	Est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3.1	823 New T8 fixtures to be installed with incentives	RS Means, lit search	154,183	24,690	129,493	21,529	4.5	0	0.8	6,995	10,482	15	157,236	12.4	21	1	3	-6,146	29,495
3.2	8 New pulse start metal halide fixtures to be installed with incentives	RS Means, lit search	5,798	200	5,598	1,739	0.4	0	0.1	-51	231	15	3,465	24.2	38	3	-5	-2,879	2,382
3.3	88 New occupancy sensors to be installed with incentives	RS Means, lit search	19,360	1,760	17,600	40,404	8.4	0	1.5	0	6545	15	98,182	2.7	458	31	37	59,421	55,354
3.4	11 New motion sensors to be installed with incentives	RS Means, lit search	2,420	220	2,200	5,902	1.2	0	0.2	0	956	15	14,342	2.3	552	37	43	9,051	8,086
	TOTALS		181,761	26,870	154,891	69,575	14	0	2.6	6,944	18,215	-	273,226	42	-	-	77	59,447	95,317

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 4 hrs/yr to replace aging burnt out lamps vs. newly installed.

Rebates/financial incentives:

NJ Clean Energy - Wall Mounted occupancy and motion sensors ($20 per control)
Maximum incentive amount is $1,980.

NJ Clean Energy - T8 lamps with electronic ballast in existing facilities ($10-30 per fixture, depending on quantity and lamps)
Maximum incentive amount is $24,690.

NJ Clean Energy – Pulse start metal halide fixtures ($25 per fixture)
Maximum incentive amount is $200.

Options for funding ECM:

This project may benefit from applying for grant funding for school districts in regular operating districts (ROD) to offset a portion of the cost of implementation.

http://www.state.nj.us/education/facilities/projectapplication/rod/

This project may benefit from applying for a grant from the State of New Jersey Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.

http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

ECM#4: *Install Premium Efficiency Motors on Heating Hot Water Circulators*

Description:

The A/B boiler room houses two sets of two (2) floor-mounted circulator pumps as part of the hot water heating system to serve the hot water unit ventilators and other hot water terminal units listed in this report. The pumps are in relatively good condition. One pair of pumps serves the A wing of the building. Each pump is rated at 7.5 Hp. The other two pumps serve the B wing, and each pump is rated at 2 Hp. In addition, the C/D boiler room houses one set of two (2) floor-mounted circulator pumps and one set of two (2) pipe-mounted circulator pumps as part of the hot water heating system to serve the hot water unit ventilators and other hot water terminal units listed in this report. These pumps are in fair to good condition. The pair of pipe-mounted pumps serves the C wing of the building. Each pump is rated at 1.5 Hp. The other two pumps serve the D wing, and each pump is rated at 3 Hp. Each set operates in a lead-lag fashion. All pump motors are standard efficiency. The Frankford Township School will realize energy savings by utilizing premium efficiency motors for the pumps.

Installation cost:

Estimated installed cost: $3,075
Source of cost estimate: Similar projects and DOE Motor Master International selection & savings analysis

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4.1	Replace (2) 7.5 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	1,112	162	950	2,173	0.5	0	0.1	0	361	20	7,214	2.6	659	33	38	4,417	2,977
4.2	Replace (2) 2 Hp hot water circulator pump motors with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	642	108	534	658	0.1	0	0	0	109	20	2,185	4.9	309	15	20	1,091	901
4.3	Replace (2) 1.5 Hp domestic hot water pump motor with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	606	90	516	584	0.1	0	0	0	97	20	1,939	5.3	276	14	18	926	800
4.4	Replace (2) 3 Hp domestic hot water pump motor with Premium Efficiency	similar projects, DOE International Motor Master selection & savings analysis	714	108	606	1,113	0.2	0	0	0	185	20	3,695	3.3	510	25	30	2,143	1,525

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. The DOE Motor Master International selection and calculator was used with the assumption that one of each set of heating water pumps operates for the heating season. According to weather bin data for Newark, each set of pumps considered should operate for approximately 5,000 hours per year.

Rebates/financial incentives:

NJ Clean Energy – Premium three-phase motors ($45-$700 per motor)
Maximum incentive amount is $468.

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#5: *Install Premium Efficiency Motors on Walk-In Box Evaporator Fans*

Description:

There is one combination walk-in cooler and freezer box in the Kitchen of the Frankford Township School. Typically, the evaporator and condenser fans of walk-in coolers will operate 24 hours per day, 7 days per week. The walk-in freezer fans run about 18 hours per day, 7 days per week with the off times occurring while the system runs a defrost cycle. The fan motors are fractional horsepower. The motors on these fans are standard efficiency, shaded pole motors. The Frankford Township School will realize energy savings by utilizing premium efficiency motors for these fans

Installation cost:

Estimated installed cost: $1,000
Source of cost estimate: Similar projects and DOE Motor Master International selection & savings analysis

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
5.1	Replace Cooler Evap Fan Motor with Premium Efficiency Motor	Manufacturer's Operations Data, DOE International Motor Master Savings analysis	500	0	500	800	0.2	0	0	0	133	20	2,656	3.8	431	22	26	1,476	1,096
5.2	Replace Freezer Evap Fan Motor with Premium Efficiency Motor	Manufacturer's Operations Data, DOE International Motor Master Savings analysis	500	0	500	600	0.1	0	0	0	100	20	1,992	5	298	15	19	982	822

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. The DOE Motor Master International selection and calculator was used with the assumption that the cooler fans operate for 8,760 hours per year and the freezer fans operate for 6,570 hours per year.

Rebates/financial incentives:

NJ Clean Energy – There are no incentives available since these motors are fractional horsepower. Maximum incentive amount is $0.

Options for funding ECM:

This project may benefit from applying for grant funding for school districts in regular operating districts (ROD) to offset a portion of the cost of implementation.

http://www.state.nj.us/education/facilities/projectapplication/rod/

This project may benefit from applying for a grant from the State of New Jersey Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.

http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

ECM#6: Install Tank-Type Domestic Water Heaters

Description:

Currently a boiler in each boiler room produces the domestic hot water for the entire year. Due to this method of providing domestic hot water, the boilers must be fired even during mild weather when there would normally be no space heating load. SWA recommends providing separate tank-type domestic water heaters to handle the domestic water heating load and make required piping modifications to reconnect to the existing domestic water piping system. This will provide energy savings by allowing the school to not fire the boilers during mild weather. Frankford Township School may wish to install two (2) ASME-rated heaters, one in each boiler room, that meet the current requirements of ASHRAE/IESNA Standard 90.1 (similar to AO Smith model COF-199) and remove or disconnect the boiler immersion heaters. Aside from the higher efficiency of the heaters, there should be a savings due to reduced standby losses compared to the current insulated storage tanks. The associated recirculating pump in the A/B Boiler Room appears to be operating adequately and replacement of the pump motor would yield negligible savings since it is fractional horsepower.

Installation cost:

Estimated installed cost: $16,000
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
6	Utilize tank type domestic water heater instead of boilers	Similar Projects	16,000	0	16,000	0	0	790	0.9	0	1,175	15	17,630	14	10	1	1	-1,969	9,243

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. The efficiency of the existing boiler is in the range of 65-70%, and a new high efficiency oil water heater would operate with an efficiency of approximately 81%.

Rebates/financial incentives:

NJ Clean Energy does not offer rebates for oil-fired heating
Maximum incentive amount is $0.

Options for funding ECM:

This project may benefit from applying for grant funding for school districts in regular operating districts (ROD) to offset a portion of the cost of implementation.

http://www.state.nj.us/education/facilities/projectapplication/rod/

This project may benefit from applying for a grant from the State of New Jersey Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.

http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

ECM#7: *Replace Boilers with New High Efficiency Modulating Boilers*

Description:

The current hot water boilers range in age from 18 to 24 year old and are relatively inefficient as compared to more modern equipment. SWA recommends providing two (2) packaged cast iron sectional boilers with modulating burners in each boiler room (similar to Weil-McLain 88 Series 2), sized in accordance with the building heating load. This will provide energy savings by providing a thermal efficiency of approximately 85% versus the estimated 65-70% of the currently operating boilers. These boilers would incorporate a two-pass flue fuel oil #2 design, would be CSD-1 code-compliant with low water cutoff and manual high level aquastat.

Installation cost:

Estimated installed cost: $170,000
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
7a	Cost to replace boilers with modulating high efficiency oil-fired boilers	Similar Projects	170,000	0	170,000	0	0	9,000	10	1,820	15,210	25	334,755	11	124	5	7	94,857	105,300
7b	Incremental cost to replace boilers with modulating high efficiency oil-fired boilers	Similar Projects	12,000	0	12,000	0	0	2,470	2.7	1,820	5,495	25	91,872	2.2	1045	42	46	83,683	28,899

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. SWA estimated that the annual fuel oil #2 usage for the water heating system is approximately 52,250 therms. The efficiency of the existing boiler is in the range of 65-70%, and a new modulating oil water heater similar to the one mentioned above would operate with an efficiency of approximately 85%.

Rebates/financial incentives:

NJ Clean Energy does not offer rebates for oil-fired heating
Maximum incentive amount is $0.

Options for funding ECM:

This project may benefit from applying for grant funding for school districts in regular operating districts (ROD) to offset a portion of the cost of implementation.

http://www.state.nj.us/education/facilities/projectapplication/rod/

This project may benefit from applying for a grant from the State of New Jersey Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.

http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

ECM#8: *Replace Packaged HVAC Unit with a High Efficiency Unit*

Description:

The packaged rooftop HVAC unit serving the TV Studio was installed in 1995 and at the end of its expected service life of 15 years. SWA recommends replacement of this equipment to see an increase in operating efficiency. This upgrade cannot be justified by energy savings alone.

The current equipment has a cooling Energy Efficiency Ratio (EER) of approximately 9.0. The new equipment should have a minimum 11.5 EER rating, preferably closer to 12.5 or 13.0. The higher EER will involve increased cost for the equipment over units with lower EER, but 11.5 EER is the minimum required for this equipment capacity to qualify for a NJ Clean Energy Program rebate. The equipment shall be Energy Star certified and ASHRAE 90.1 compliant. The equipment shall utilize R-410A refrigerant. The compressors shall be fully hermetic, scroll type with on demand crankcase heaters for cooling duty and induced draft fuel oil #2 combustion for heating duty. Evaporator fan wheel shall be steel with a corrosion-resistant finish, shall be double-inlet type with forward-curved blades and shall be dynamically balanced. Fan motors shall be continuous operation, open-drip proof with sealed, permanently lubricated ball bearings. Evaporator and condenser coils shall have aluminum lanced plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed. Heat exchanger shall be aluminized 20-gage steel coated with 1.2 mil aluminum-silicone alloy or similar for corrosion resistance. The estimated simple payback on this recommendation is greater than 25 years.

Installation cost:

Estimated installed cost: $16,000
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
8a	Replace (1) packaged 6-ton electric cooling rooftop HVAC unit with high efficiency unit	similar projects	16,000	438	15,562	1,750	0.4	0	0	900	1,191	15	4,358	13	15	1	2	-1,350	2,398
8b	Incremental cost to replace (1) packaged electric cooling rooftop HVAC unit with high efficiency unit	similar projects	3,000	438	2,562	938	0.2	0	0	900	1,056	15	2,336	2.4	518	35	41	10,041	1,285

Assumptions: SWA calculated the savings for this measure using nameplate data taken the days of the field visit.

Rebates/financial incentives:
NJ Clean Energy – Unitary HVAC and Split Systems ($73-$92 per ton)
Maximum incentive amount is $438.

Options for funding ECM: *This project may benefit from applying for grant funding for school districts in regular operating districts (ROD) to offset a portion of the cost of implementation.*

http://www.state.nj.us/education/facilities/projectapplication/rod/

This project may benefit from applying for a grant from the State of New Jersey Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.

http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#9: Replace Exhaust Fans with High Efficiency Units

Description:

Several of the building rooftop exhaust fans are in fair to poor condition and beyond their expected service life. These fans should be considered for replacement. Some of the fans are not operating at all. SWA recommends replacement of approximately forty (40) of the building exhaust fans that are operating beyond their useful lives. The motors are small, in the fractional to 1 horsepower range, and replacement units will have small energy savings over the existing.

Installation cost:

Estimated installed cost: $128,000
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
9a	Replace 40 exhaust fans with premium efficiency units	similar projects, DOE Motor Master International	128,000	0	128,000	7,000	1.5	0	0.1	3,200	4,362	10	11,620	29	-66	-7	N/A	-90,791	9,590
9b	Incremental cost to replace 40 exhaust fans with premium efficiency units	similar projects, DOE Motor Master International	15,000	0	15,000	7,000	0.5	0	0.1	3,200	4,362	10	11,620	3.4	191	19	26	22,209	9,590

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

NJ Clean Energy – There is no incentive since these motors are fractional horsepower
Maximum incentive amount is $0.

Options for funding the ECM: *This project may benefit from applying for grant funding for school districts in regular operating districts (ROD) to offset a portion of the cost of implementation.*

http://www.state.nj.us/education/facilities/projectapplication/rod/

This project may benefit from applying for a grant from the State of New Jersey Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.

http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

ECM#10: *Replace Old Commercial sized Refrigerators and Freezers with Energy Star Models*

Description:

On the days of the site visits, SWA observed that there is an existing solid door commercial refrigerator in the kitchen area which is not Energy Star rated (using approximately 5,600 kWh/yr). Appliances, such as refrigerators, that are over 10-12 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing refrigerator which is operating at the end of their useful life with a more modern, ENERGY STAR®, energy efficient system. Besides saving energy, the replacement will also keep the kitchen and other areas cooler. In addition, the existing systems utilize R-12 refrigerant, which is not an ozone-friendly refrigerant. Newer systems should be specified with R-134A or R-404A refrigerant. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

Installation cost:

Estimated installed cost: $13,000
Source of cost estimate: *Energy Star purchasing and procurement site, similar projects, Manufacturer and Store established costs*

Economics:

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
10a	Replace reach-in stainless steel refrigerator with 42 cu ft Energy Star refrig	Energy Star purchasing and procurement site, similar projectsefficiency unit	13,000	0	13,000	4,130	0.9	0	0	0	644	12	7,731	20	-41	-3	-7	-6,587	5,658
10b	Incremental cost to replace reach-in stainless steel refrigerator with 42 cu ft Energy Star refrig	Energy Star purchasing and procurement site, similar projectsefficiency unit	3,000	0	3,000	4,130	0.9	0	0	0	644	12	7,731	4.7	158	13	19	3,413	5,658

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit, using the billing analysis and assuming 24 hour per day operation for 180 school days per year.

Rebates/financial incentives:

NJ Clean Energy - There are not any incentives at this time offered by the state of NJ for this energy conservation measure.

Options for funding the ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#11: *Provide Demand Control Ventilation for Cafeteria and Multipurpose Room Air Handling Units*

Description:

The air handling units for the Cafeteria and Multipurpose Room provide a fixed amount of outside air during occupied hours. Conditioning outside air can be a significant portion of the heating load seen by the air handling unit. Demand control ventilation involves providing carbon dioxide (CO_2) sensors in the occupied space to estimate occupancy. When the space is underutilized or unoccupied during occupied hours, the CO_2 sensors can partially or totally shut down the outside air intake damper to the air handling unit. This control method can greatly reduce the heating or cooling load seen by the air handling unit and therefore save energy. The Frankford Township School will realize energy savings by installing the required control devices and incorporating this control method into the new BMS system programming.

Installation cost:

Estimated installed cost: $6,000
Source of cost estimate: RS Means Cost Data & Similar Projects

Economics (with no incentives):

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
11	Demand Control Ventilation for Cafeteria & MP Room AHUs	RS Means Cost Data & Similar Projects	6,000	0	6,000	680	0.1	400	0.5	0	708	15	10,620	8.5	77	5	8	2,452	5,612

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. SWA estimated that the Cafeteria is unutilized for 60% of the day, and the Multipurpose is unutilized for 40% of the day, for 180 school days in a calendar year.

Rebates/financial incentives:

There are no utility rebates available for this work.

Options for funding ECM:

This project may benefit from applying for grant funding for school districts in regular operating districts (ROD) to offset a portion of the cost of implementation.

http://www.state.nj.us/education/facilities/projectapplication/rod/

This project may benefit from applying for a grant from the State of New Jersey Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.

http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

ECM#12: *Install 151.2 kW PV system*

Description:

Currently the Frankford Township School does not use any renewable energy systems. Renewable energy systems such as photovoltaic panels, can be mounted on the building roofs, and can offset a portion of the purchased electricity for the building. Power stations generally have two separate electrical charges: usage and demand. Usage is the amount of electricity in kilowatt-hours that a building uses from month to month. Demand is the amount of electrical power that a building uses at any given instance in a month period. During the summer periods, when electric demand at a power station is high due to the amount of air conditioners, lights, equipment, etc… being used within the region, demand charges go up to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems not only offset the amount of electricity use by a building, but also reduce the building's electrical demand, resulting in a higher cost savings as well. It is recommended at this time that the Frankford Township School further review installing a 151.2 kW PV system to offset electrical demand and reduce the annual net electric consumption for the building, and review guaranteed incentives from NJ rebates to justify the investment. Frankford Township School is also not eligible for a 30% federal tax credit. Instead, the Frankford Township School may consider applying for a grant and/or engage a PV generator/leaser who would install the PV system and then sell the power at a reduced rate. JCP&L provides the ability to buy SREC's at $600/MWh or best market offer.

There are many possible locations for a 151.2 kW PV installation on the building roofs. A commercial crystalline 230 watt panel has 17.5 square feet of surface area (13.1 watts per square foot). Considering the shading on the roof of this facility, a 151.2 kW system needs approximately 720.0 panels which would take up 12,600 square feet. The installation of a renewable Solar Photovoltaic power generating system could serve as a good educational tool and exhibit for the community.

Installation cost:

Estimated installed cost: $1,171,800
Source of cost estimate: Similar Projects

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
12	Install 151.2 kW PV rooftop system with incentives	similar projects	1,171,800	0	1,171,800	161,025	151	N/A	6.1	0	123,345	25	668,254	9.5	92.5	3.7	8.2	552,593	220,604

Assumptions: SWA estimated the cost and savings of the system based on past PV projects. SWA projected physical dimensions based on a typical Polycrystalline Solar Panel (230 Watts, model #ND-U230C1). PV systems are sized based on Watts and physical dimensions for an array will differ with the efficiency of a given solar panel (W/sq ft).

Rebates/financial incentives:

NJ Clean Energy - Renewable Energy Incentive Program, Incentive based on $1.00 / watt Solar PV application for systems 50kW or less. Incentive amount for this application is $0 for the proposed option.

http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program

NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. A total annual SREC credit of $96,600 has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#12A: *Install 49.7 kW PV system*

Description:

Should funding or grant money not be available for a 151.2 kW photovoltaic system making it infeasible, an alternative recommendation to ECM#4 regarding would be for the Frankford Township School to consider installing a 49.7 kW PV system to offset electrical demand and reduce the annual net electric consumption for the building, and review guaranteed incentives from NJ rebates to justify the investment. As mentioned above, NJ Clean Energy incentives are available for systems no larger than 50 kW. A 49.7 kW PV system would qualify for such incentives JCP&L provides the ability to buy SREC's at $600/MWh or best market offer.

There are many possible locations for a 49.7 kW PV installation on the building roofs. A commercial crystalline 230 watt panel has 17.5 square feet of surface area (13.1 watts per square foot). Considering the shading on the roof of this facility, a 49.7 kW system needs approximately 236.0 panels which would take up 4,130 square feet. The installation of a renewable Solar Photovoltaic power generating system could serve as a good educational tool and exhibit for the community.

Installation cost:

Estimated installed cost: $385,175
Source of cost estimate: Similar Projects

ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
12a	Install 49.7 kW PV rooftop system with incentives	similar projects	385,175	49,700	335,475	53,920	50	N/A	2	0	41,303	25	223,768	8.1	654	26.2	43.8	1,598,883	73,870

Assumptions: SWA estimated the cost and savings of the system based on past PV projects. SWA projected physical dimensions based on a typical Polycrystalline Solar Panel (230 Watts, model #ND-U230C1). PV systems are sized based on Watts and physical dimensions for an array will differ with the efficiency of a given solar panel (W/sq ft).

Rebates/financial incentives:

NJ Clean Energy - Renewable Energy Incentive Program, Incentive based on $1.00 / watt Solar PV application for systems 50kW or less. Incentive amount for this application is $49,700 for the proposed option.

http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program

NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. A total annual SREC credit of $31,200 has been incorporated in the above costs, however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

5.1. Existing systems

There are not currently any existing renewable energy systems.

5.2. Wind

Description:

A Wind system is not applicable for this building because the area does not have winds of sufficient velocity to justify installing a wind turbine system.

5.3. Solar Photovoltaic

Please see the above recommended ECM#12 or 12a.

5.4. Solar Thermal Collectors

Description:

Solar thermal collectors are not cost effective for this building and would not be recommended due to the insufficient and not constant use of domestic hot water throughout the building to justify the expenditure.

5.5. Combined Heat and Power

Description:

CHP is not applicable for this building because of insufficient thermal baseload.

5.6. Geothermal

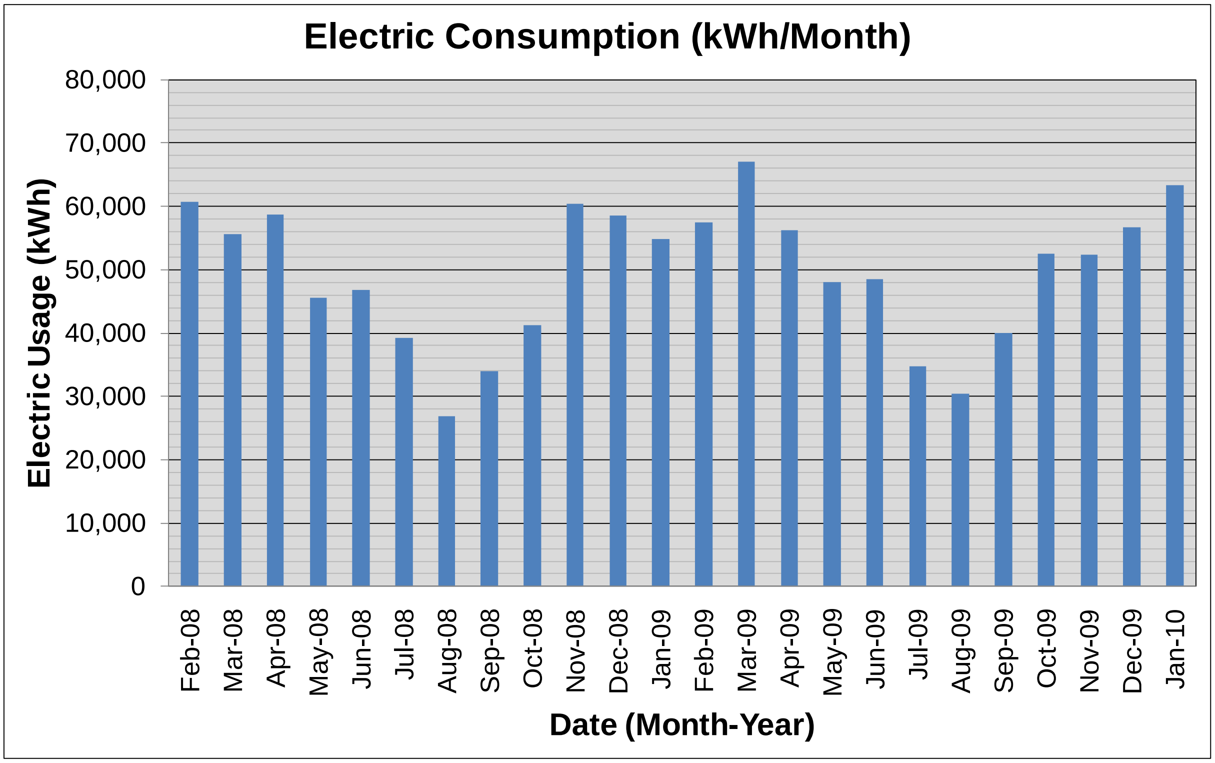
Description:

Currently, the building is heated but not cooled. Should the school district investigate the addition of air conditioning to the school's HVAC system, an estimated energy savings analysis versus other systems can be studied. Several system types have been studied and the system summaries and estimated costs have been presented in the ***Capital Improvements*** *section above.*

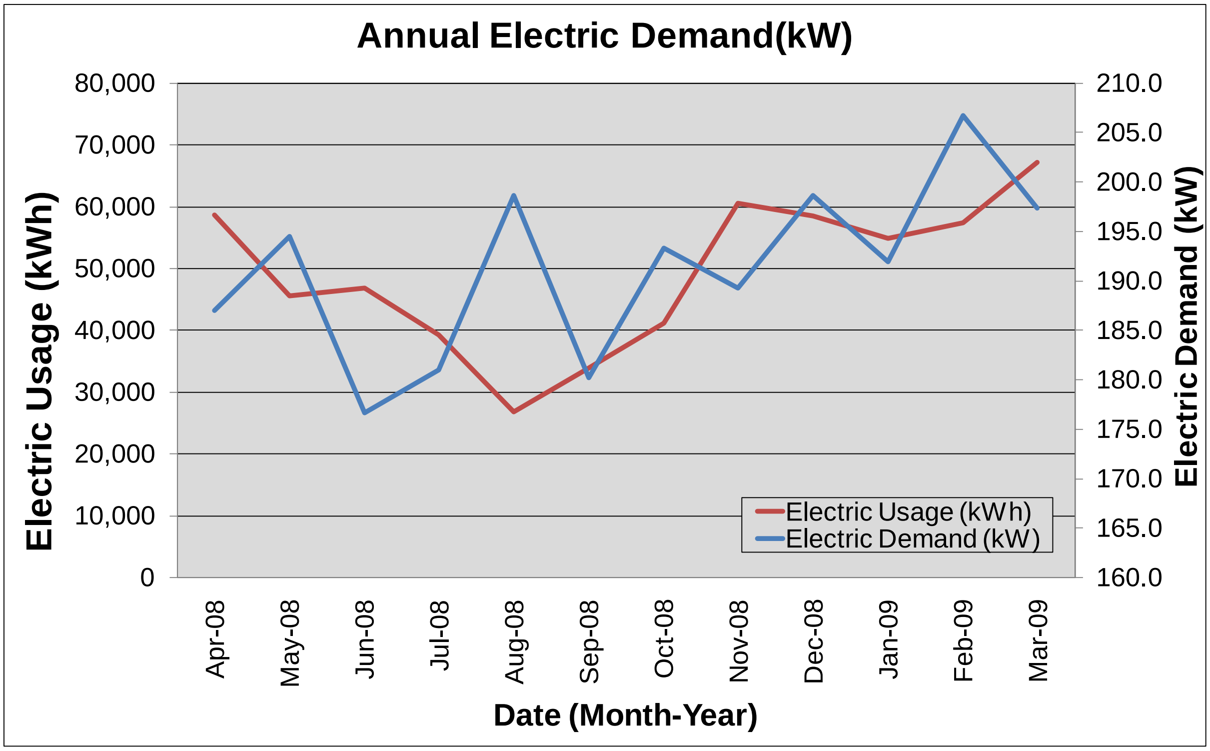
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

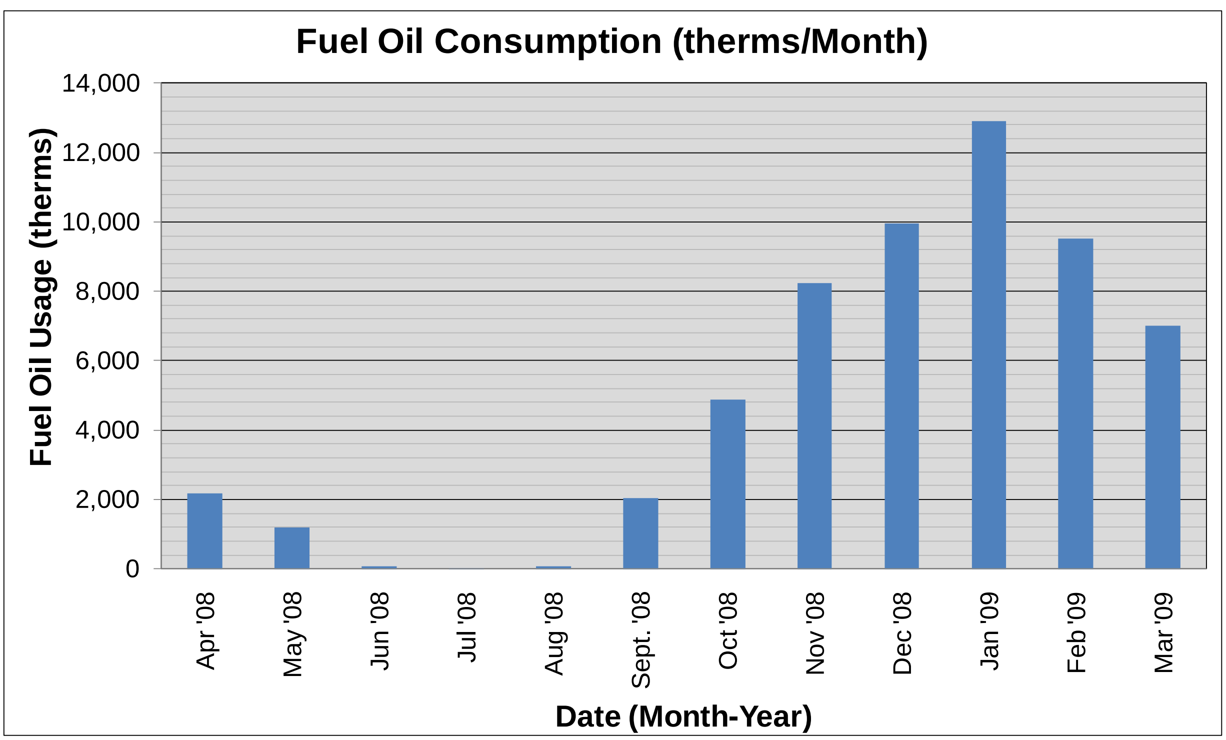
The following charts show annual electric and fuel oil #2 load profiles for the Frankford Township School:

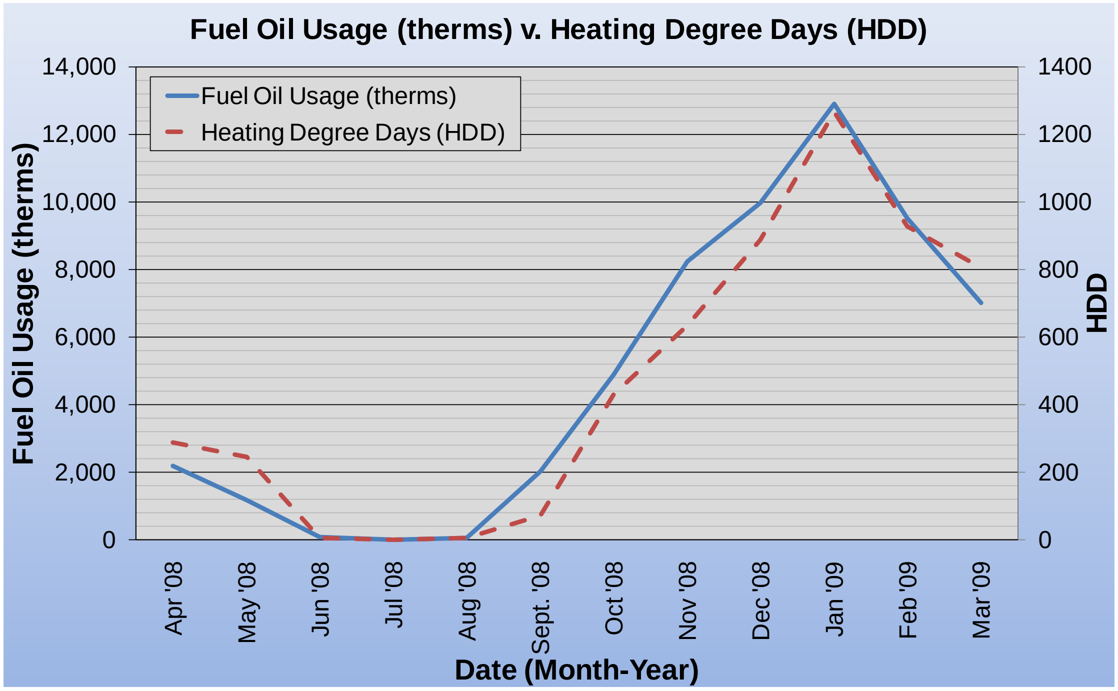


Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks – our observation that it is either a faulty meter read or input error on the part of utility.



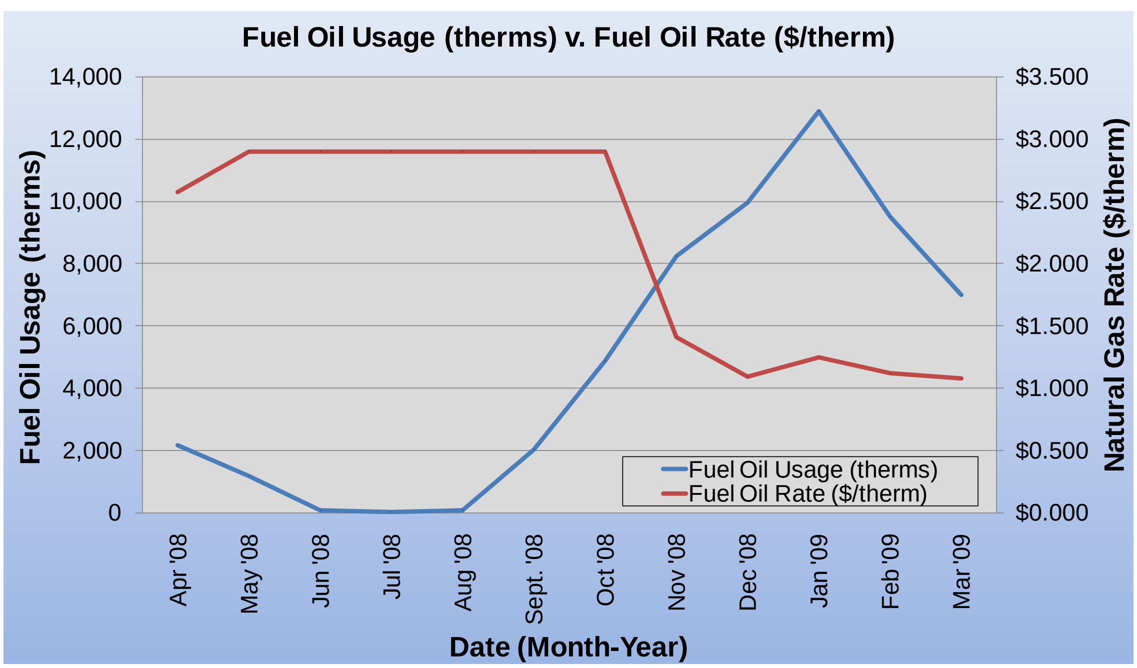
The following chart shows the estimated use of fuel oil #2 annual load for the building, peaking in the coldest months of the year and another chart showing fuel oil #2 consumption following the "heating degree days" curve; the annual oil use has been tailored to follow the HDD curve and excludes assumed 1226 therms of annual use for DHW.





6.2. Tariff analysis

Currently, fuel oil #2 is supplied to the Frankford Township School building by Flinch Fuel oil, sold to the Township School at a the prevailing market rate. Typically, the fuel oil #2 prices increase during the heating months when fuel oil #2 is used by the hot water boiler units. The high fuel oil #2 price per therm in the summer may be due to high energy costs that occurred in 2008. The price for the months of June to September is flat because the school did not purchase any fuel during this period, only using the fuel purchased in April/May.



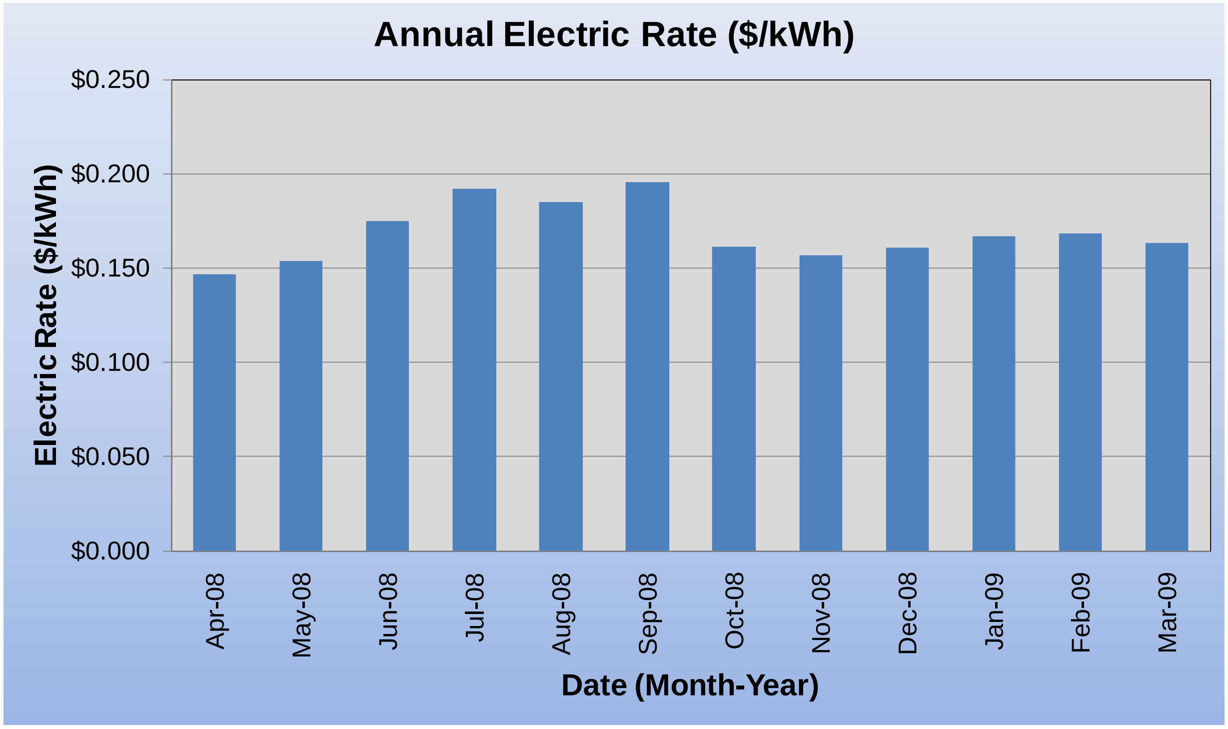
The Frankford Township School building is direct-metered (via one main meter) and currently purchases electricity from the local utility at a general service rate. The general service rate for electric charges are market-rate based on use and the Frankford Township School building billing does show a breakdown of demand costs. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the electricity prices increase during the cooling months when electricity is used by air conditioning equipment.

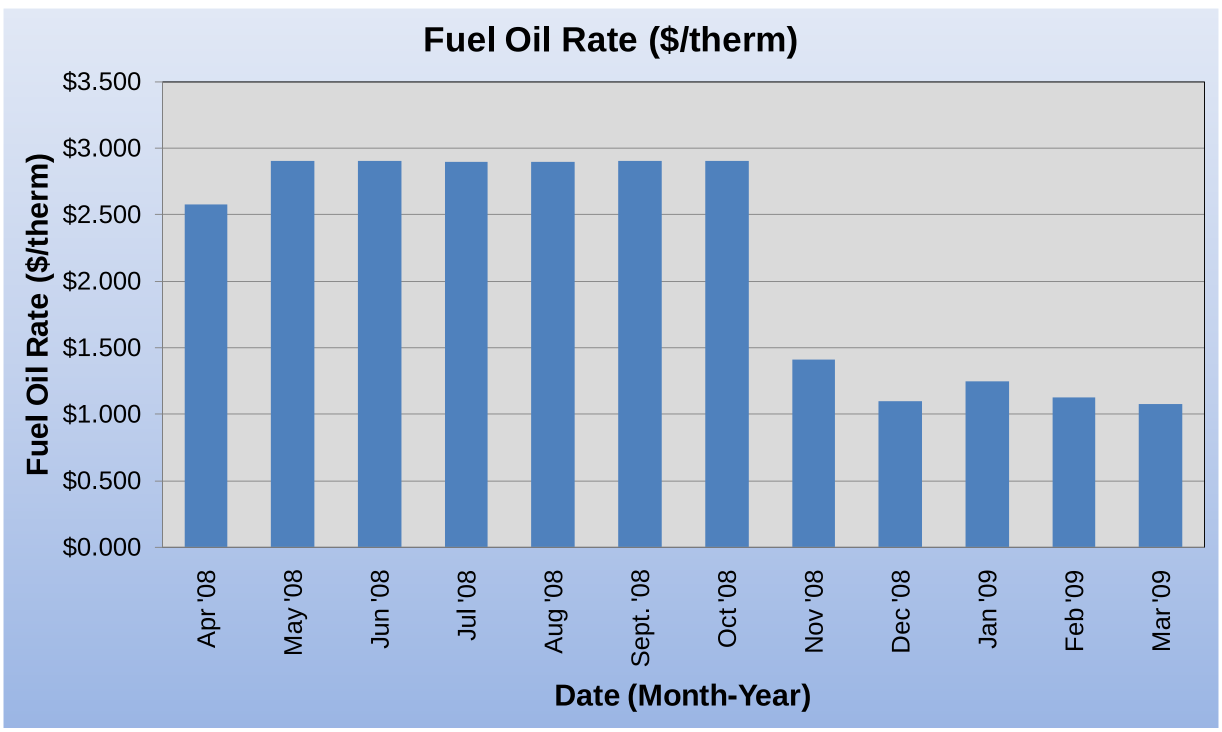
6.3. Energy Procurement strategies

The Frankford Township School building receives fuel oil #2 from Flinch Fuel oil supplies the fuel oil #2 and transports it. There is not an ESCO engaged in the process. An Energy Services Company (ESCO) is a consultancy group that engages in a performance based contract with a client firm to implement measures which reduce energy consumption and costs in a technically and financially viable manner. Electricity is also purchased via one incoming meter directly for the Frankford Township School building from Frankford Township electric utility consortium without an ESCO. SWA analyzed the utility rate for fuel oil #2 and electricity supply over an extended period. Electric bill analysis shows fluctuations up to 20% over the most recent 12 month period. Some of these fluctuations may have been caused by adjustments between estimated and actual meter readings, others may be due to unusual high and escalating energy costs in 2008. The average estimated NJ commercial utility rates for electric and fuel oil #2 are $0.150/kWh and $2.19/gallon respectively. The Frankford Township School building annual electric cost is $6,703 higher for electric when compared to the average estimated NJ commercial electric rates. The fuel oil was purchased at competitive rates.

SWA recommends that the Frankford Township School Board of Education further explore opportunities of purchasing electricity from an ESCO in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Frankford Township School building. Appendix B contains a complete list of third party energy suppliers for the Frankford Township service area. The Frankford Township School Board of Education may want to consider partnering with other school districts, municipalities, townships and communities to aggregate a substantial electric and fuel oil #2 use for better leveraging in negotiations with their local utility and ESCOs. This sort of activity is happening in many parts of the country and in New Jersey. Also, the Frankford Township School building would not be eligible for enrollment in a Demand Response Program, because there isn't the capability at this time (without a large capital investment) to shed a minimum of 150 kW electric demand when requested by the utility during peak demand periods, which is the typical threshold for considering this option.

The following charts show the Frankford Township School building monthly spending per unit of energy in 2008.


Annual Electric Rate ($/kWh)
Electric Rate ($/kWh)
$0.250
$0.200
$0.150
$0.100
$0.050
$0.000
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Mar-09
Date (Month-Year)


Fuel Oil Rate ($/therm)
Fuel Oil Rate ($/therm)
$3.500
$3.000
$2.500
$2.000
$1.500
$1.000
$0.500
$0.000
Apr '08
May '08
Jun '08
Jul '08
Aug '08
Sept. '08
Oct '08
Nov '08
Dec '08
Jan '09
Feb '09
Mar '09
Date (Month-Year)

7. METHOD OF ANALYSIS

7.1. Assumptions and tools

Energy modeling tool:	Established / standard industry assumptions, E-Quest
Cost estimates:	RS Means 2009 (Facilities Maintenance & Repair Cost Data)
	RS Means 2009 (Building Construction Cost Data)
	RS Means 2009 (Mechanical Cost Data)
	Published and established specialized equipment material and labor costs
	Cost estimates also based on utility bill analysis and prior experience with similar projects

7.2. Disclaimer

This engineering audit was prepared using the most current and accurate fuel consumption data available for the site. The estimates that it projects are intended to help guide the owner toward best energy choices. The costs and savings are subject to fluctuations in weather, variations in quality of maintenance, changes in prices of fuel, materials, and labor, and other factors. Although we cannot guarantee savings or costs, we suggest that you use this report for economic analysis of the building and as a means to estimate future cash flow.

THE RECOMMENDATIONS PRESENTED IN THIS REPORT ARE BASED ON THE RESULTS OF ANALYSIS, INSPECTION, AND PERFORMANCE TESTING OF A SAMPLE OF COMPONENTS OF THE BUILDING SITE. ALTHOUGH CODE-RELATED ISSUES MAY BE NOTED, SWA STAFF HAVE NOT COMPLETED A COMPREHENSIVE EVALUATION FOR CODE-COMPLIANCE OR HEALTH AND SAFETY ISSUES. THE OWNER(S) AND MANAGER(S) OF THE BUILDING(S) CONTAINED IN THIS REPORT ARE REMINDED THAT ANY IMPROVEMENTS SUGGESTED IN THIS SCOPE OF WORK MUST BE PERFORMED IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL LAWS AND REGULATIONS THAT APPLY TO SAID WORK. PARTICULAR ATTENTION MUST BE PAID TO ANY WORK WHICH INVOLVES HEATING AND AIR MOVEMENT SYSTEMS, AND ANY WORK WHICH WILL INVOLVE THE DISTURBANCE OF PRODUCTS CONTAINING MOLD, ASBESTOS, OR LEAD.

Appendix A: Lighting Study

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	1	Classroom (42)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
2	1	Classroom (43)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
3	1	Classroom (44)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
4	1	Classroom (45)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
5	1	Classroom (41)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
6	1	Classroom (46)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
7	1	Classroom (47)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
8	1	Classroom (40A)	Recessed	M	4'T12	4	2	34	S	9	184	15	332	550	T8	ecesse	4'T8	E	OS	4	2	32	7	184	6	280	348	86	116	202
9	1	Classroom (49)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
10	1	Classroom (50)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
11	1	Classroom (51)	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
12	1	Classroom (53)	Recessed	M	4'T12	16	4	34	S	9	184	24	2,560	4,239	T8	ecesse	4'T8	E	OS	16	4	32	7	184	13	2256	2802	503	934	1437
13	1	Classroom (54)	eiling Suspende	M	4'T12	12	3	34	S	9	184	20	1,464	2,424	T8	g Susp	4'T8	E	OS	12	3	32	7	184	10	1272	1580	318	527	845
14	1	Classroom (55)	eiling Suspende	M	4'T12	15	4	34	S	9	184	24	2,400	3,974	T8	g Susp	4'T8	E	OS	15	4	32	7	184	13	2115	2627	472	876	1348
15	1	Classroom (56)	eiling Suspende	M	4'T12	16	3	34	S	9	184	20	1,952	3,233	T8	g Susp	4'T8	E	OS	16	3	32	7	184	10	1696	2106	424	702	1126
16	1	Storage Closet (560)	Ceiling Mounted	M	4'T12	3	2	34	S	2	184	20	264	97	T8	ng Mou	4'T8	E	S	3	2	32	2	184	6	210	77	20	0	20
17	1	office (56C)	Ceiling Mounted	M	4'T12	1	2	34	S	2	184	15	83	31	T8	ng Mou	4'T8	E	S	1	2	32	2	184	6	70	26	5	0	5
18	1	Office (56D)	Ceiling Mounted	M	4'T12	1	2	34	S	9	184	15	83	137	T8	ng Mou	4'T8	E	S	1	2	32	9	184	6	70	116	22	0	22
19	1	Classroom (57)	Recessed	M	4'T12	16	3	34	S	9	184	20	1,952	3,233	T8	ecesse	4'T8	E	OS	16	3	32	7	184	10	1696	2106	424	702	1126
20	1	Hallway	Recessed	E	2'T8	8	2	17	S	17	184	3	296	926	C	ecesse	2'T8	E	MS	8	2	17	13	184	3	296	694	0	231	231
21	1	Hallway	Recessed	N	LED	1	1	5	N	24	365	0	5	44	N/A	ecesse	LED	N	N	1	1	5	24	365	0	5	44	0	0	0
22	1	Hallway	Recessed	N	LED	1	1	5	N	24	365	0	5	44	N/A	ecesse	LED	N	N	1	1	5	24	365	0	5	44	0	0	0
23	1	Hallway	Recessed	E	2'T8	4	2	17	N	17	184	3	148	463	C	ecesse	2'T8	E	MS	4	2	17	13	184	3	148	347	0	116	116
24	1	Classroom (30)	Recessed	E	4'T8	10	2	32	S	9	184	6	700	1,159	C	ecesse	4'T8	E	OS	10	2	32	7	184	6	700	869	0	290	290
25	1	Cafeteria	eiling Suspende	N	MV	8	1	400	S	8	184	0	3,200	4,710	N/A	g Susp	CFL	N	OS	8	1	250	6	184	0	2000	2208	1766	736	2502
26	1	Gymnasium	eiling Suspende	N	MV	5	1	400	S	9	184	0	2,000	3,312	N/A	g Susp	CFL	N	OS	5	1	250	7	184	0	1250	1553	1242	518	1760
27	1	Gymnasium	Exit Sign	N	LED	2	1	5	N	9	365	1	12	39	N/A	xit Sig	LED	N	N	2	1	5	9	365	1	12	39	0	0	0
28	1	Gymnasium	eiling Suspende	M	4'T12	20	2	34	S	9	184	15	1,660	2,749	T8	g Susp	4'T8	E	OS	20	2	32	7	184	6	1400	1739	431	580	1010
29	1	Kitchen	eiling Suspende	M	4'T12	21	2	34	S	9	184	15	1,743	2,886	T8	g Susp	4'T8	E	OS	21	2	32	7	184	6	1470	1826	452	609	1061
30	1	Kitchen	eiling Suspende	M	4'T12	1	2	34	S	9	184	15	83	137	T8	g Susp	4'T8	E	S	1	2	32	9	184	6	70	116	22	0	22
31	1	Kitchen office	Recessed	M	4'T12	4	2	34	S	9	184	15	332	550	T8	ecesse	4'T8	E	OS	4	2	32	7	184	6	280	348	86	116	202
32	1	Kitchen closet	eiling Suspende	M	4'T12	3	2	34	S	9	184	15	249	412	T8	g Susp	4'T8	E	OS	3	2	32	7	184	6	210	261	65	87	152
33	1	Classroom (28)	eiling Suspende	M	4'T12	35	2	34	S	9	184	15	2,905	4,811	T8	g Susp	4'T8	E	OS	35	2	32	7	184	6	2450	3043	753	1014	1768
34	1	Office phys Ed	eiling Suspende	M	4'T12	6	2	34	S	9	184	15	498	825	T8	g Susp	4'T8	E	OS	6	2	32	7	184	6	420	522	129	174	303
35	1	Classroom (26)	eiling Suspende	M	4'T12	20	2	34	S	9	184	15	1,660	2,749	T8	g Susp	4'T8	E	OS	20	2	32	7	184	6	1400	1739	431	580	1010
36	1	Hallway	eiling Suspende	M	4'T12	12	2	34	S	17	184	15	996	3,115	T8	g Susp	4'T8	E	MS	12	2	32	13	184	6	840	1971	488	657	1145
37	1	Classroom (24)	eiling Suspende	M	4'T12	20	2	34	S	9	184	15	1,660	2,749	T8	g Susp	4'T8	E	OS	20	2	32	7	184	6	1400	1739	431	580	1010
38	1	Classroom (22)	eiling Suspende	M	4'T12	20	2	34	S	9	184	15	1,660	2,749	T8	g Susp	4'T8	E	OS	20	2	32	7	184	6	1400	1739	431	580	1010
39	1	Hallway	Recessed	M	4'T12	8	2	34	S	17	184	15	664	2,077	T8	ecesse	4'T8	E	MS	8	2	32	13	184	6	560	1314	325	438	763
40	1	Hallway	Exit Sign	N	LED	2	1	5	N	24	365	1	12	105	N/A	xit Sig	LED	N	N	2	1	5	24	365	1	12	105	0	0	0
41	1	Bathroom Women	Recessed	N	4'T8	2	3	32	OS	7	184	10	212	273	N/A	ecesse	4'T8	N	OS	2	3	32	7	184	10	212	273	0	0	0
42	1	Bathroom Women	Recessed	E	T8 U-Shap	1	2	32	OS	7	184	6	70	90	T8	ecesse	U-Sh	E	OS	1	2	32	7	184	6	70	90	0	0	0
43	1	Bathroom Men	Recessed	E	T8 U-Shap	1	2	32	OS	7	184	6	70	90	T8	ecesse	U-Sh	E	OS	1	2	32	7	184	6	70	90	0	0	0
44	1	Bathroom Men	Recessed	E	4'T8	2	3	32	OS	7	184	10	212	273	N/A	ecesse	4'T8	E	OS	2	3	32	7	184	10	212	273	0	0	0
45	1	Classroom (29)	eiling Suspende	M	4'T12	20	2	34	S	9	184	15	1,660	2,749	T8	g Susp	4'T8	E	OS	20	2	32	7	184	6	1400	1739	431	580	1010
46	1	Classroom (31)	eiling Suspende	M	4'T12	20	2	34	S	9	184	15	1,660	2,749	T8	g Susp	4'T8	E	OS	20	2	32	7	184	6	1400	1739	431	580	1010
47	1	Classroom (33)	eiling Suspende	M	4'T12	20	2	34	S	9	184	15	1,660	2,749	T8	g Susp	4'T8	E	OS	20	2	32	7	184	6	1400	1739	431	580	1010
48	1	Classroom (35)	eiling Suspende	M	4'T12	40	2	34	S	9	184	15	3,320	5,498	T8	g Susp	4'T8	E	OS	40	2	32	7	184	6	2800	3478	861	1159	2020
49	1	Office (35A)	eiling Suspende	M	4'T12	2	2	34	S	2	184	15	166	61	T8	g Susp	4'T8	E	S	2	2	32	2	184	6	140	52	10	0	10
50	1	Office (35B)	eiling Suspende	M	4'T12	2	2	34	S	2	184	15	166	61	T8	g Susp	4'T8	E	S	2	2	32	2	184	6	140	52	10	0	10
51	1	Display case	Recessed	N	CFL	3	1	42	S	2	184	0	126	46	N/A	ecesse	CFL	N	S	3	1	42	2	184	0	126	46	0	0	0
52	1	Classroom (37B)	Recessed	N	4'T12	4	4	34	S	9	184	24	640	1,060	T8	ecesse	4'T8	E	OS	4	4	32	7	184	13	564	700	126	233	359
53	1	Classroom (37A)	Recessed	N	4'T12	4	4	34	S	9	184	24	640	1,060	T8	ecesse	4'T8	E	OS	4	4	32	7	184	13	564	700	126	233	359
54	1	Conference room	Recessed	N	4'T12	2	4	34	S	9	184	24	320	530	T8	ecesse	4'T8	E	OS	2	4	32	7	184	13	282	350	63	117	180
55	1	MS Principal office	Recessed	N	4'T12	4	4	34	S	9	184	24	640	1,060	T8	ecesse	4'T8	E	OS	4	4	32	7	184	13	564	700	126	233	359
56	1	S Principal office hallw	Recessed	N	4'T12	1	4	34	S	9	184	24	160	265	T8	ecesse	4'T8	E	OS	1	4	32	7	184	13	141	175	31	58	90
57	1	Hallway	Recessed	M	4'T12	6	4	34	S	17	184	24	960	3,003	T8	ecesse	4'T8	E	MS	6	4	32	13	184	13	846	1985	357	662	1018

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
58	1	Hallway	Recessed	E	2'T8	7	2	17	S	17	184	3	259	810	C	ecesse	2'T8	E	MS	7	2	17	13	184	3	259	608	0	203	203
59	1	Hallway display	Recessed	N	Halogen	2	1	35	S	17	184	0	70	219	N/A	ecesse	aloge	N	S	2	1	35	17	184	0	70	219	0	0	0
60	1	Copy room	Recessed	E	4'T12	3	2	34	S	9	184	15	249	412	T8	ecesse	4'T8	E	OS	3	2	32	7	184	6	210	261	65	87	152
61	1	Bathroom Women	Recessed	E	4'T8	4	3	32	OS	7	184	10	424	546	N/A	ecesse	4'T8	E	OS	4	3	32	7	184	10	424	546	0	0	0
62	1	Bathroom Men	Recessed	E	4'T8	4	3	32	OS	7	184	10	424	546	N/A	ecesse	4'T8	E	OS	4	3	32	7	184	10	424	546	0	0	0
63	1	Bathroom Men	Recessed	E	T8 U-Shap	1	2	32	OS	7	184	6	70	90	T8	ecesse	U-Sh	E	OS	1	2	32	7	184	6	70	90	0	0	0
64	1	Bathroom Women	Recessed	E	T8 U-Shap	1	2	32	OS	7	184	6	70	90	T8	ecesse	U-Sh	E	OS	1	2	32	7	184	6	70	90	0	0	0
65	1	Hallway	Recessed	E	2'T8	16	2	17	S	17	184	3	592	1,852	C	ecesse	2'T8	E	MS	16	2	17	13	184	3	592	1389	0	463	463
66	1	Hallway	Recessed	E	2'T8	12	2	17	S	17	184	3	444	1,389	C	ecesse	2'T8	E	MS	12	2	17	13	184	3	444	1042	0	347	347
67	1	Classroom (20)	Ceiling Mounted	E	4'T12	18	2	34	S	9	184	15	1,494	2,474	T8	ng Mou	4'T8	E	OS	18	2	32	7	184	6	1260	1565	388	522	909
68	1	Classroom (25)	Ceiling Mounted	E	4'T12	18	2	34	S	9	184	15	1,494	2,474	T8	ng Mou	4'T8	E	OS	18	2	32	7	184	6	1260	1565	388	522	909
69	1	Faculty rm bathroom	Sconce	E	Inc	1	2	60	S	9	184	0	120	199	N/A	Sconce	CFL	N	OS	1	2	15	7	184	0	30	37	149	12	161
70	1	Faculty rm bathroom	Sconce	E	Inc	1	2	60	S	9	184	0	120	199	N/A	Sconce	CFL	N	OS	1	2	15	7	184	0	30	37	149	12	161
71	1	aculty rm phone boot	Ceiling Mounted	M	2'T12	1	2	17	S	9	184	3	37	61	T8	ng Mou	2'T8	E	OS	1	2	17	7	184	1	35	43	3	14	18
72	1	Classroom (18)	Ceiling Mounted	M	4'T12	18	2	34	S	9	184	15	1,494	2,474	T8	ng Mou	4'T8	E	OS	18	2	32	7	184	6	1260	1565	388	522	909
73	1	Classroom (23)	Ceiling Mounted	M	4'T12	18	2	34	S	9	184	15	1,494	2,474	T8	ng Mou	4'T8	E	OS	18	2	32	7	184	6	1260	1565	388	522	909
74	1	Classroom (16)	Ceiling Mounted	M	4'T12	18	2	34	S	9	184	15	1,494	2,474	T8	ng Mou	4'T8	E	OS	18	2	32	7	184	6	1260	1565	388	522	909
75	1	Classroom (14)	Ceiling Mounted	M	4'T12	18	2	34	S	9	184	15	1,494	2,474	T8	ng Mou	4'T8	E	OS	18	2	32	7	184	6	1260	1565	388	522	909
76	1	Bathroom Women	Recessed	E	4'T8	3	3	32	OS	7	184	10	318	410	T8	ecesse	4'T8	E	OS	3	3	32	7	184	10	318	410	0	0	0
77	1	Bathroom Men	Recessed	E	4'T8	3	3	32	OS	7	184	10	318	410	T8	ecesse	4'T8	E	OS	3	3	32	7	184	10	318	410	0	0	0
78	1	Bathroom Men	Recessed	E	T8 U-Shap	1	2	32	OS	7	184	6	70	90	T8	ecesse	U-Sh	E	OS	1	2	32	7	184	6	70	90	0	0	0
79	1	Bathroom Women	Recessed	E	T8 U-Shap	1	2	32	OS	7	184	6	70	90	T8	ecesse	U-Sh	E	OS	1	2	32	7	184	6	70	90	0	0	0
80	1	Office	Ceiling Mounted	M	4'T12	4	2	34	S	9	184	15	332	550	T8	ng Mou	4'T8	E	OS	4	2	32	7	184	6	280	348	86	116	202
81	1	Hallway	Recessed	E	2'T8	4	2	17	S	17	184	3	148	463	T8	ecesse	2'T8	E	MS	4	2	17	13	184	3	148	347	0	116	116
82	1	Classroom (15B)	Ceiling Mounted	E	4'T12	2	2	34	S	9	184	15	166	275	T8	ng Mou	4'T8	E	OS	2	2	32	7	184	6	140	174	43	58	101
83	1	Classroom (15A)	Ceiling Mounted	M	4'T12	4	2	34	S	9	184	15	332	550	T8	ng Mou	4'T8	E	OS	4	2	32	7	184	6	280	348	86	116	202
84	1	Classroom (12D)	Ceiling Mounted	M	4'T12	4	4	34	S	9	184	24	640	1,060	T8	ng Mou	4'T8	E	OS	4	4	32	7	184	13	564	700	126	233	359
85	1	Classroom (12C)	Ceiling Mounted	M	4'T12	4	4	34	S	9	184	24	640	1,060	T8	ng Mou	4'T8	E	OS	4	4	32	7	184	13	564	700	126	233	359
86	1	Classroom (12B)	Ceiling Mounted	M	4'T12	4	4	34	S	9	184	24	640	1,060	T8	ng Mou	4'T8	E	OS	4	4	32	7	184	13	564	700	126	233	359
87	1	Classroom (12A)	Ceiling Mounted	M	4'T12	4	4	34	S	9	184	24	640	1,060	T8	ng Mou	4'T8	E	OS	4	4	32	7	184	13	564	700	126	233	359
88	1	r Room With Work S	Ceiling Mounted	M	8'T12	2	2	80	S	4	184	24	368	271	T8	ng Mou	8'T8	E	OS	2	2	59	3	184	13	262	145	78	48	126
89	1	Classroom (21)	Recessed	M	4'T12	11	4	34	S	9	184	24	1,760	2,915	T8	ecesse	4'T8	E	OS	11	4	32	7	184	13	1551	1926	346	642	988
90	1	Classroom bath (21A	Recessed	M	4'T12	1	2	34	S	9	184	15	83	137	T8	ecesse	4'T8	E	OS	1	2	32	7	184	6	70	87	22	29	51
91	1	lassroom walkthroug	Recessed	M	4'T12	1	2	34	S	2	184	15	83	31	T8	ecesse	4'T8	E	S	1	2	32	2	184	6	70	26	5	0	5
92	1	Classroom (19)	Recessed	M	4'T12	6	4	34	S	9	184	24	960	1,590	T8	ecesse	4'T8	E	OS	6	4	32	7	184	13	846	1051	189	350	539
93	1	Library	Recessed	M	4'T12	19	4	34	S	9	184	24	3,040	5,034	T8	ecesse	4'T8	E	OS	19	4	32	7	184	13	2679	3327	598	1109	1707
94	1	Nurse's	Recessed	M	4'T12	2	4	34	S	9	184	24	320	530	T8	ecesse	4'T8	E	OS	2	4	32	7	184	13	282	350	63	117	180
95	1	Nurse's	Recessed	M	12 U-Shap	2	2	34	S	9	184	15	166	275	T8	ecesse	U-Sh	E	OS	2	2	32	7	184	6	140	174	43	58	101
96	1	Nurse's bath	Recessed	M	12 U-Shap	1	2	34	S	9	184	15	83	137	T8	ecesse	U-Sh	E	OS	1	2	32	7	184	3	67	83	26	28	54
97	1	Office Area	Recessed	M	4'T12	12	4	34	S	9	184	24	1,920	3,180	T8	ecesse	4'T8	E	OS	12	4	32	7	184	13	1692	2101	378	700	1078
98	1	Office	Recessed	M	4'T12	1	4	34	S	9	184	24	160	265	T8	ecesse	4'T8	E	OS	1	4	32	7	184	13	141	175	31	58	90
99	1	Office conference	Recessed	M	4'T12	4	4	34	S	9	184	24	640	1,060	T8	ecesse	4'T8	E	OS	4	4	32	7	184	13	564	700	126	233	359
100	1	Office conference	Recessed	M	12 U-Shap	2	2	34	S	9	184	15	166	275	T8	ecesse	U-Sh	E	OS	2	2	32	7	184	6	140	174	43	58	101
101	1	Office bath	Sconce	N	Inc	1	3	60	S	9	184	0	180	298	N/A	Sconce	CFL	N	OS	1	3	15	7	184	0	45	56	224	19	242
102	1	Office hallway	Ceiling Mounted	M	4'T12	1	2	34	S	9	184	15	83	137	T8	ng Mou	4'T8	E	OS	1	2	32	7	184	6	70	87	22	29	51
103	1	Office closet	Ceiling Mounted	E	4'T8	1	4	32	S	4	184	13	141	104	T8	ng Mou	4'T8	E	S	1	4	32	4	184	13	141	104	0	0	0
104	1	Entrance Hallway	Recessed	E	4'T12	13	4	34	S	17	184	24	2,080	6,506	T8	ecesse	4'T8	E	MS	13	4	32	13	184	13	1833	4300	773	1433	2206
105	1	Hallway	Recessed	M	4'T12	8	4	34	S	17	184	24	1,280	4,004	T8	ecesse	4'T8	E	MS	8	4	32	13	184	13	1128	2646	475	882	1358
106	1	Hallway	Exit Sign	N	LED	3	1	5	N	24	365	1	18	158	N/A	xit Sig	LED	N	N	3	1	5	24	365	1	18	158	0	0	0
107	1	Classroom (15)	Recessed	M	4'T12	12	3	34	S	9	184	20	1,464	2,424	T8	ecesse	4'T8	E	OS	12	3	32	7	184	10	1272	1580	318	527	845
108	1	Classroom office	Recessed	M	4'T12	1	2	34	S	4	184	15	83	61	T8	ecesse	4'T8	E	S	1	2	32	4	184	6	70	52	10	0	10
109	1	Office (13)	Recessed	M	12 U-Shap	1	2	34	S	9	184	15	83	137	T8	ecesse	U-Sh	E	OS	1	2	32	7	184	6	70	87	22	29	51
110	1	Office (13A)	Recessed	M	4'T12	1	4	34	S	9	184	24	160	265	T8	ecesse	4'T8	E	OS	1	4	32	7	184	13	141	175	31	58	90
111	1	Office (13B)	Recessed	M	4'T12	4	4	34	S	9	184	24	640	1,060	T8	ecesse	4'T8	E	OS	4	4	32	7	184	13	564	700	126	233	359
112	1	Office	Recessed	M	12 U-Shap	1	2	34	S	9	184	15	83	137	T8	ecesse	U-Sh	E	S	1	2	32	9	184	6	70	116	22	0	22
113	1	Office bath	Ceiling Mounted	M	4'T12	1	2	34	S	9	184	15	83	137	T8	ng Mou	4'T8	E	S	1	2	32	9	184	6	70	116	22	0	22
114	1	Office closet	Ceiling Mounted	M	4'T12	1	2	34	S	9	184	15	83	137	T8	ng Mou	4'T8	E	S	1	2	32	9	184	6	70	116	22	0	22
115	1	Janitor's Closet	Ceiling Mounted	M	4'T12	1	2	34	S	4	184	15	83	61	T8	ng Mou	4'T8	E	S	1	2	32	4	184	6	70	52	10	0	10
116	1	Bathroom Women	Recessed	E	4'T8	4	3	32	OS	7	184	10	424	546	T8	ecesse	4'T8	E	OS	4	3	32	7	184	10	424	546	0	0	0
117	1	Bathroom Men	Recessed	E	4'T8	4	3	32	OS	7	184	10	424	546	T8	ecesse	4'T8	E	OS	4	3	32	7	184	10	424	546	0	0	0
118	1	Bathroom Men	Recessed	E	T8 U-Shap	1	2	32	OS	7	184	6	70	90	T8	ecesse	U-Sh	E	OS	1	2	32	7	184	6	70	90	0	0	0

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
119	1	Bathroom Women	Recessed	E	T8 U-Shape	1	2	32	OS	7	184	6	70	90	T8	ecesse	U-Sha	E	OS	1	2	32	7	184	6	70	90	0	0	0
120	1	Classroom 13	Recessed	M	4'T12	3	3	34	S	9	184	20	366	606	T8	ecesse	4'T8	E	OS	3	3	32	7	184	10	318	395	79	132	211
121	1	Classroom 13	Recessed	M	2'T12	2	3	20	S	9	184	24	168	278	T8	ecesse	2'T8	E	OS	2	3	17	7	184	4	110	137	96	46	142
122	1	Classroom 13 bath	Recessed	M	2'T12	1	2	20	S	9	184	16	56	93	T8	ecesse	2'T8	E	OS	1	2	17	7	184	3	37	46	31	15	47
123	1	Classroom (10)	Recessed	M	4'T12	9	4	34	S	9	184	24	1,440	2,385	T8	ecesse	4'T8	E	OS	9	4	32	7	184	13	1269	1576	283	525	809
124	1	Classroom (11)	Recessed	M	4'T12	8	4	34	S	9	184	24	1,280	2,120	T8	ecesse	4'T8	E	OS	8	4	32	7	184	13	1128	1401	252	467	719
125	1	Classroom bath	Recessed	M	4'T12	1	2	34	S	2	184	15	83	31	T8	ecesse	4'T8	E	S	1	2	32	2	184	6	70	26	5	0	5
126	1	Classroom (8)	Recessed	M	4'T12	8	3	34	S	9	184	20	976	1,616	T8	ecesse	4'T8	E	OS	8	3	32	7	184	10	848	1053	212	351	563
127	1	Classroom (9)	Recessed	E	4'T8	8	4	32	S	9	184	13	1,128	1,868	C	ecesse	4'T8	E	OS	8	4	32	7	184	13	1128	1401	0	467	467
128	1	Classroom (7)	Recessed	E	4'T8	9	4	32	S	9	184	13	1,269	2,101	C	ecesse	4'T8	E	OS	9	4	32	7	184	13	1269	1576	0	525	525
129	1	Classroom (5)	Recessed	E	4'T8	9	4	32	S	9	184	13	1,269	2,101	C	ecesse	4'T8	E	OS	9	4	32	7	184	13	1269	1576	0	525	525
130	1	Classroom (3)	Recessed	E	4'T8	9	4	32	S	9	184	13	1,269	2,101	C	ecesse	4'T8	E	OS	9	4	32	7	184	13	1269	1576	0	525	525
131	1	Classroom (2)	Recessed	E	4'T8	9	4	32	S	9	184	13	1,269	2,101	C	ecesse	4'T8	E	OS	9	4	32	7	184	13	1269	1576	0	525	525
132	1	Classroom (1)	Recessed	E	4'T8	9	4	32	S	9	184	13	1,269	2,101	C	ecesse	4'T8	E	OS	9	4	32	7	184	13	1269	1576	0	525	525
133	1	Hallway	Recessed	M	4'T8	5	2	32	S	17	184	6	350	1,095	C	ecesse	4'T8	E	OS	5	2	32	13	184	6	350	821	0	274	274
134	1	Hallway	Exit Sign	N	LED	2	1	5	N	24	365	1	12	105	N/A	xit Sig	LED	N	N	2	1	5	24	365	1	12	105	0	0	0
135	1	Hallway	Recessed	M	4'T8	12	2	32	N	17	184	6	840	2,628	C	ecesse	4'T8	E	OS	12	2	32	13	184	6	840	1971	0	657	657
136	1	Classroom (4)	Recessed	E	4'T8	8	4	32	S	9	184	13	1,128	1,868	C	ecesse	4'T8	E	OS	8	4	32	7	184	13	1128	1401	0	467	467
137	1	Classroom (6)	Recessed	E	4'T8	8	4	32	S	9	184	13	1,128	1,868	C	ecesse	4'T8	E	OS	8	4	32	7	184	13	1128	1401	0	467	467
138	1	Boiler Rm	Ceiling Mounted	M	4'T12	7	2	34	S	2	184	15	581	214	T8	ng Mou	4'T8	E	S	7	2	32	2	184	6	490	180	33	0	33
139	1	Janitor's Closet	Ceiling Mounted	M	4'T12	2	2	34	S	4	184	15	166	122	T8	ng Mou	4'T8	E	S	2	2	32	4	184	6	140	103	19	0	19
140	1	Boiler Rm	Ceiling Mounted	M	4'T12	9	2	34	S	24	184	15	747	3,299	T8	ng Mou	4'T8	E	S	9	2	32	24	184	6	630	2782	517	0	517
141	Ext	Exterior	Screw-in	N	MH	7	1	70	PC	12	365	18	616	2,698	PSMH	Screw-i	PSMH	N	PC	7	1	45	12	365	10	385	1686	1012	0	1012
142	Ext	Exterior	Screw-in	N	CFL	10	1	23	S	12	365	0	230	1,007	C	Screw-i	CFL	N	PC	10	1	23	9	365	0	230	756	0	252	252
143	Ext	Exterior	Screw-in	N	MH	1	1	400	PC	12	365	100	500	2,190	PSMH	Screw-i	PSMH	N	PC	1	1	275	12	365	59	334	1463	727	0	727
Totals:						**1,028**	**377**	**5,741**				**2,155**	**115,038**	**205,473**						**1,028**	**377**	**4,951**			**1,175**	**99,986**	**137,079**	**26,798**	**41,596**	**68,394**

Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space

Proposed Lighting Summary Table			
Total Surface Area (SF)	90,000		
Average Power Cost ($/kWh)	0.1660		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	5,895	3,905	**1,991**
Exterior Power (watts)	1,346	949	**397**
Total Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	199,578	133,174	**68,394**
Lighting Power (watts)	113,692	99,037	**14,655**
Lighting Power Density (watts/SF)	1.26	1.10	**0.16**
Estimated Cost of Fixture Replacement ($)	159,761		
Estimated Cost of Controls Improvements ($)	22,000		
Total Consumption Cost Savings ($)	**18,493**		

Legend				
Fixture Type	**Lamp Type**	**Control Type**	**Ballast Type**	**Retrofit Category**
Exit Sign	LED	N (None)	N/A (None)	N/A (None)
Screw-in	Inc (Incandescent)	S (Switch)	E (Electronic)	T8 (Installl new T8)
Pin	1'T5	OS (Occupancy Sensor)	M (Magnetic)	T5 (Install new T5)
Parabolic	2'T5	T (Timer)		CFL (Install new CFL)
Recessed	3'T5	PC (Photocell)		LEDex (Install new LED Exit)
2'U-shape	4'T5	D (Dimming)		LED (Install new LED)
Circiline	2'T8	DL (Daylight Sensor)		D (Delamping)
Exterior	3'T8	M (Microphonic Sensor)		C (Controls Only)
	4'T8			PSMH (Install new Pulse-Start Metal Halide)
	6'T8			
	8'T8			
	2'T12			
	3'T12			
	4'T12			
	6'T12			
	8'T12			
	CFL (Compact Fluorescent Lightbulb)			
	MR16			
	MV (Mercury Vapor)			
	MH (Metal Halide)			
	HPS (High Pressure Sodium			
	LPS (Low Pressure Sodium)			

Appendix B: Third Party Energy Suppliers (ESCOs)

http://www.state.nj.us/bpu/commercial/shopping.html

Third Party Electric Suppliers for JCPL Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
BOC Energy Services, Inc. 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 www.boc.com
Commerce Energy, Inc. 4400 Route 9 South, Suite 100 Freehold, NJ 07728	(800) 556-8457 www.commerceenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 www.newenergy.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
FirstEnergy Solutions 300 Madison Avenue Morristown, NJ 07926	(800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640	(877) 569-2841 www.glacialenergy.com
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com
Liberty Power Delaware, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Liberty Power Holdings, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(800) 363-7499 www.libertypowercorp.com
Pepco Energy Services, Inc. 112 Main St. Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.semprasolutions.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Suez Energy Resources NA, Inc. 333 Thornall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com

Appendix C

Glossary and Method of Calculations

Glossary of ECM Terms

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Net ECM Cost: The net ECM cost is the cost experienced by the customer, which is typically the total cost (materials + labor) of installing the measure minus any available incentives. Both the total cost and the incentive amounts are expressed in the summary for each ECM.

Annual Energy Cost Savings (AECS): This value is determined by the audit firm based on the calculated energy savings (kWh or Therm) of each ECM and the calculated energy costs of the building.

Lifetime Energy Cost Savings (LECS): This measure estimates the energy cost savings over the lifetime of the ECM. It can be a simple estimation based on fixed energy costs. If desired, this value can factor in an annual increase in energy costs as long as the source is provided.

Simple Payback: This is a simple measure that displays how long the ECM will take to break-even based on the annual energy and maintenance savings of the measure.

ECM Lifetime: This is included with each ECM so that the owner can see how long the ECM will be in place and whether or not it will exceed the simple payback period. Additional guidance for calculating ECM lifetimes can be found below. This value can come from manufacturer's rated lifetime or warranty, the ASHRAE rated lifetime, or any other valid source.

Operating Cost Savings (OCS): This calculation is an annual operating savings for the ECM. It is the difference in the operating, maintenance, and / or equipment replacement costs of the existing case versus the ECM. In the case where an ECM lifetime will be longer than the existing measure (such as LED lighting versus fluorescent) the operating savings will factor in the cost of replacing the units to match the lifetime of the ECM. In this case or in one where one-time repairs are made, the total replacement / repair sum is averaged over the lifetime of the ECM.

Return on Investment (ROI): The ROI is expresses the percentage return of the investment based on the lifetime cost savings of the ECM. This value can be included as an annual or lifetime value, or both.

Net Present Value (NPV): The NPV calculates the present value of an investment's future cash flows based on the time value of money, which is accounted for by a discount rate (assumes bond rate of 3.2%).

Internal Rate of Return (IRR): The IRR expresses an annual rate that results in a break-even point for the investment. If the owner is currently experiencing a lower return on their capital than the IRR, the project is financially advantageous. This measure also allows the owner to compare ECMs against each other to determine the most appealing choices.

Calculation References

ECM = Energy Conservation Measure
AOCS = Annual Operating Cost Savings
AECS = Annual Energy Cost Savings
LOCS = Lifetime Operating Cost Savings
LECS = Lifetime Energy Cost Savings
LCS = Lifetime Cost Savings

NPV = Net Present Value
IRR = Internal Rate of Return
DR = Discount Rate

Net ECM Cost = Total ECM Cost – Incentive
LECS = AECS X ECM Lifetime
AOCS = LOCS / ECM Lifetime
LCS = LOCS+LECS

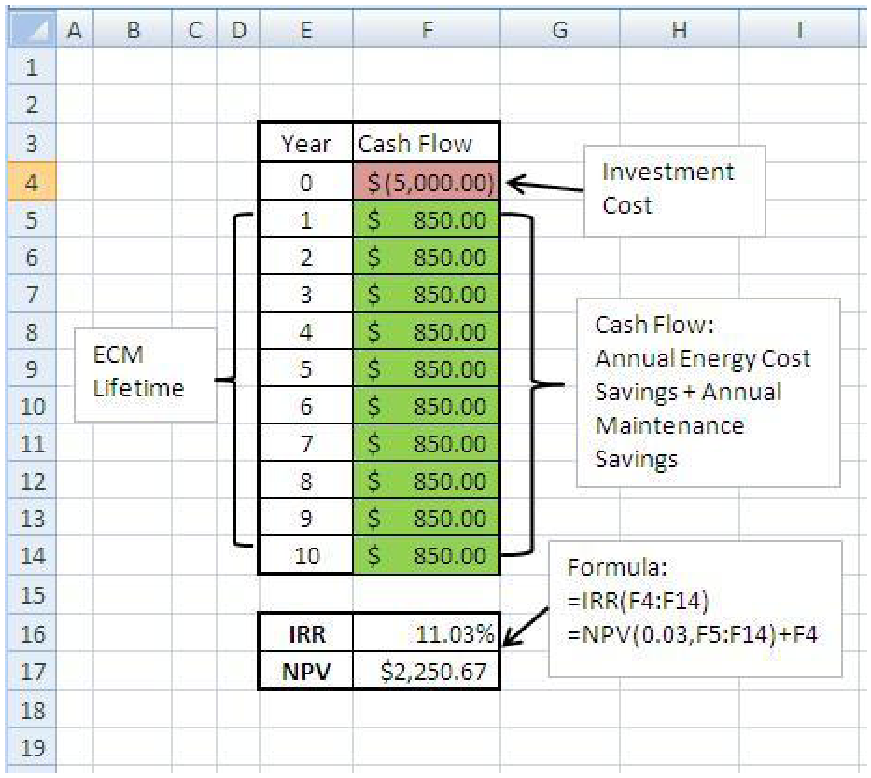
Note: The lifetime operating cost savings are all avoided operating, maintenance, and / or component replacement costs over the lifetime of the ECM. This can be the sum of any annual operating savings, recurring or bulk (i.e. one-time repairs) maintenance savings, or the savings that comes from avoiding equipment replacement needed for the existing measure to meet the lifetime of the ECM (e.g. lighting change outs).

Simple Payback = Net ECM Cost / (AECS + AOCS)
Lifetime ROI = (LECS + LOCS – Net ECM Cost) / Net ECM Cost
Annual ROI = (Lifetime ROI / Lifetime) = (AECS + OCS) / Net ECM Cost – 1 / Lifetime

It is easiest to calculate the NPV and IRR using a spreadsheet program like Excel.

Excel NPV and IRR Calculation

In Excel, function =IRR(values) and =NPV(rate, values) are used to quickly calculate the IRR and NPV of a series of annual cash flows. The investment cost will typically be a negative cash flow at year 0 (total cost - incentive) with years 1 through the lifetime receiving a positive cash flow from the annual energy cost savings and annual maintenance savings. The calculations in the example below are for an ECM that saves $850 annually in energy and maintenance costs (over a 10 year lifetime) and takes $5,000 to purchase and install after incentives:



ECM and Equipment Lifetimes

Determining a lifetime for equipment and ECM's can sometimes be difficult. The following table contains a list of lifetimes that the NJCEP uses in its commercial and industrial programs. Other valid sources are also used to determine lifetimes, such as the DOE, ASHRAE, or the manufacturer's warranty.
Lighting is typically the most difficult lifetime to calculate because the fixture, ballast, and bulb can all have different lifetimes. Essentially the ECM analysis will have different operating cost savings (avoided equipment replacement) depending on which lifetime is used.

When the bulb lifetime is used (rated burn hours / annual burn hours), the operating cost savings is just reflecting the theoretical cost of replacing the existing case bulb and ballast over the life of the recommended bulb. Dividing by the bulb lifetime will give an annual operating cost savings.

When a fixture lifetime is used (e.g. 15 years) the operating cost savings reflects the avoided bulb and ballast replacement cost of the existing case over 15 years minus the projected bulb and ballast replacement cost of the proposed case over 15 years. This will give the difference of the equipment replacement costs between the proposed and existing cases and when divided by 15 years will give the annual operating cost savings.

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NJCEP C & I Lifetimes

Measure	Measure Life
Commercial Lighting — New	15
Commercial Lighting — Remodel/Replacement	15
Commercial Custom — New	18
Commercial Chiller Optimization	18
Commercial Unitary HVAC — New - Tier 1	15
Commercial Unitary HVAC — Replacement - Tier 1	15
Commercial Unitary HVAC — New - Tier 2	15
Commercial Unitary HVAC — Replacement Tier 2	15
Commercial Chillers — New	25
Commercial Chillers — Replacement	25
Commercial Small Motors (1-10 HP) — New or Replacement	20
Commercial Medium Motors (11-75 HP) — New or Replacement	20
Commercial Large Motors (76-200 HP) — New or Replacement	20
Commercial VSDs — New	15
Commercial VSDs — Retrofit	15
Commercial Comprehensive New Construction Design	18
Commercial Custom — Replacement	18
Industrial Lighting — New	15
Industrial Lighting — Remodel/Replacement	15
Industrial Unitary HVAC — New - Tier 1	15
Industrial Unitary HVAC — Replacement - Tier 1	15
Industrial Unitary HVAC — New - Tier 2	15
Industrial Unitary HVAC — Replacement Tier 2	15
Industrial Chillers — New	25
Industrial Chillers — Replacement	25
Industrial Small Motors (1-10 HP) — New or Replacement	20
Industrial Medium Motors (11-75 HP) — New or Replacement	20
Industrial Large Motors (76-200 HP) — New or Replacement	20
Industrial VSDs — New	15
Industrial VSDs — Retrofit	15
Industrial Custom — Non-Process	18
Industrial Custom — Process	10
Small Commercial Fuel oil #2 Furnace — New or Replacement	20
Small Commercial Fuel oil #2 Boiler — New or Replacement	20
Small Commercial Fuel oil #2 DHW — New or Replacement	10
C&I Fuel oil #2 Absorption Chiller — New or Replacement	25
C&I Fuel oil #2 Custom — New or Replacement (Engine Driven Chiller)	25
C&I Fuel oil #2 Custom — New or Replacement (Fuel oil #2 Efficiency Measures)	18
O&M savings	3
Compressed Air (GWh participant)	8