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March 24th, 2010

Local Government Energy Program
Energy Audit Final Report

For

Closter Board of Education

Tenakill Middle School
275 High Street
Closter, NJ 07624

Project Number: LGEA34

TABLE OF CONTENTS

INTRODUCTION

As an approved energy consulting firm under the Local Government Energy Audit Program (LGEA), Steven Winter Associates, Inc. (SWA) was selected to perform an energy audit and assessment for the Closter Board of Education. The audit included a review of the Tenakill Middle School and Hillside Elementary School. The buildings are located in Closter, NJ. A separate energy audit report is issued for each of the referenced buildings.

This report addresses the Tenakill Middle School building located at 275 High Street, Closter, NJ. The current conditions and energy-related information were collected in order to analyze and suggest the implementation of building improvements and energy conservation measures.

Tenakill Middle School located at 275 High Street was opened in 1929, with additions completed in 1996 and 2004. The building is a two story free standing structure with a total floor area of 80,655 square feet of conditioned space which is used for both a school and the main offices for the Closter Board of Education administrative, maintenance and custodial staff. The school is split into two separate wings that differentiate the original structure and new addition. The occupancy for the school is approximately 50 full time employees and 635 students.

The goal of this Local Government Energy Audit (LGEA) is to provide sufficient information to the Closter Board of Education to make decisions regarding the implementation of the most appropriate and most cost effective energy conservation measures for the 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, after applying eligible NJ SmartStart Buildings incentives, exceeds the remaining cost of the audit, then that additional 25% will also be paid by the program. The Board of Public Utilities (BPU's) Office of Clean Energy has assigned TRC Energy Services to administer the Program.

- Section 1 and section 2 of the report cover a description and analysis of the building existing conditions.
- Section 3 provides a detail inventory of major electrical and mechanical systems in the building.
- Sections 4 through 7 provide a description of our recommendations.
- Appendices include further details and information supporting our recommendations.

EXECUTIVE SUMMARY

The energy audit performed by Steven Winter Associates (SWA) encompasses the Tenakill Middle School located at 275 High Street, Closter, NJ. The building is a two story free standing structure with a total floor area of 80,655 square feet of conditioned space which is used for both a school and the Closter Board of Education administrative, maintenance and custodial staff. The school is split into two separate wings that differentiate the original structure and new addition.

Based on the field visit performed by the SWA staff on November 6th, 2009 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, cooling, and electric usage.

Existing conditions

From March 2008 through February 2009, the period of analysis for this audit, the building consumed 662,640 kWh or $106,600 worth of electricity at an approximate rate of $0.161/kWh and 51,916 therms or $79,852 worth of natural gas at an approximate rate of $1.538 per therm. The joint energy consumption for the building, including both electricity and fossil fuel was 7,453 MMBtus of energy that cost a total of $186,452.

SWA has entered energy information about the school in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. Currently, the building receives a performance rating of 33 which means that it is ineligible to receive an Energy Star certification. SWA encourages the Closter 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 94.3 kBtu/sq ft yr compared to the national average of a school consuming 81 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 0.4 kBtu/sqft yr, with an additional 0.9 kBtu/sq ft yr from the recommended ECMs and 3.3 kBtu/sq ft yr from the recommended End of Life Cycle (>10 year payback) ECMs.

Recommendations

Implementing this report's recommendations will reduce use by approximately 4.6 kBtu/ft^{2}yr, which would decrease the building's energy use intensity to 89.7 kBtu/ft^{2}yr.

Tenakill Middle School was originally built in 1929 with major additions and renovations in 1996 and 2004. The School building as a whole has been well-maintained. When the latest renovation occurred in 2004, most of the equipment was installed new or replaced. A package of measures that addresses mostly the lighting and heating systems has been recommended in order to reduce energy consumption in the most effective way possible. One major concern is that there is asbestos insulation located on the flue and ductwork directly behind Boilers #1 and #2. Asbestos can cause severe health problems and must be properly abated before any work is undertaken that may encroach the area.

Based on the assessment of the 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

- Replace electric DHW heater with a gas-fired unit
- Replace roof of original building

Category II Recommendations: Operations and Maintenance

- Perform bi-annual maintenance inspections of exterior walls including windows and doors
- Provide weather stripping / air sealing
- Provide water efficient fixtures and controls
- Use Energy Star labeled appliances
- Teaching/Educational program

Category III Recommendations: Energy Conservation Measures

At this time, SWA highly recommends a total of **2** Energy Conservation Measures (ECMs) for Tenakill Middle School that is summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$1,200**. SWA estimates a first year savings of **$1,404** with a simple payback of **0.9 years**. SWA also recommends **3** ECMs with a 5-10 year payback that is summarized in Table 2 and **2** End of Life Cycle ECMs.

The implementation of all the recommended ECMs would reduce the building electric usage by 57,367 kWh annually, or 9% of the building's current electric consumption. The implementation of all the recommended ECMs would also reduce the building natural gas usage by 1,699 therms, or 3% of the building's current natural gas consumption. SWA estimates that implementing these ECMs will reduce the carbon footprint of Tenakill Middle School by **121,443 lbs of CO_2**, which is equivalent to removing approximately 9 cars from the roads each year or avoiding the need of 292 trees to absorb the annual CO_2 produced. SWA also recommends that Closter Board of Education contacts third party energy suppliers in order to negotiate a lower electricity rate. Comparing the current electric rate to average utility rates of similar type buildings in New Jersey, it may be possible to save up to $0.011/kWh, which would have equated to $7,289 for the past 12 months.

There are various incentives that Closter Board of Education could apply for that could also help lower the cost of installing the ECMs. SWA recommends that the Closter Board of Education 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, to be rolled out soon, could also assist to cover 80% of the capital investment.

There are additional incentives available for replacing the existing boilers, however; these incentives can only be calculated if a custom measure incentive application is submitted to the NJ Office of Clean Energy.

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 JCP&L.

The following three tables summarize the proposed Energy Conservation Measures (ECM) and their economic relevance.

Table 1 - Highly Recommended 0-5 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 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	Install 8 new CFL lamps	RSMeans	120	0	120	6,474	1.3	0	0.3	36	1,078	15	16,175	0.1	13378.9	891.9	898.6	12,753	11,592
2	Install 12 new Occupancy Sensors	RSMeans	1,320	240	1,080	2,021	0.4	0	0.1	0	325	15	4,881	3.3	351.9	23.5	27.5	1,696	3,619
	TOTALS		**1,440**	**240**	**1,200**	**8,495**	**1.7**	**0**	**0.4**	**36**	**1,404**	**-**	**21,055**	**0.9**	**-**	**-**	**-**	**14,448**	**15,210**

Assumptions: Discount Rate: 3.2% per DOE FEMP; Energy Price Escalation Rate: 0% per DOE FEMP Guidelines
Note: A 0.0 electrical demand reduction / month indicates that it is very low / negligible

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 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	Install 19 new Pulse Start Metal Halide fixtures	RSMeans	16,043	475	15,568	7,507	7.0	0	0.3	1,035	2,244	15	33,654	6.9	116.2	7.7	11.7	11,216	13,441
4	Install 10 kW Solar Photovoltaic system	Similar Projects	70,000	10,000	60,000	11,804	11.8	0	0.5	0	8,500	25	212,511	7.1	254.2	10.2	12.0	51,883	21,135
5	Replace three 10 HP heating hot water circulation pump motors	Motor Master	2,301	270	2,031	885	0.8	0	0.0	90	232	10	2,325	8.7	14.5	1.4	2.5	-48	1,585
	TOTALS		**88,344**	**10,745**	**77,599**	**20,196**	**19.6**	**0**	**0.9**	**1,125**	**10,977**	**-**	**248,490**	**7.1**	**-**	**-**	**-**	**63,052**	**36,161**

Table 3 - Recommended 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 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	Install 642 new T8 fluorescent fixtures with electronic ballasts	RS Means	138,235	19,260	118,975	28,676	6.0	0	1.2	2,960	7,577	15	113,653	15.7	-4.5	-0.3	-0.6	-28,523	51,344
7	Replace entire Central Heating Plant (3 boilers) with high efficiency units	RS Means	181,967	2,498	179,469	0	0.0	1,699	2.1	1,500	4,113	25	102,827	43.6	-42.7	-1.7	-20.5	-144,384	18,728
	TOTALS		**320,202**	**21,758**	**298,444**	**28,676**	**6.0**	**1,699**	**3.3**	**4,460**	**11,690**	**-**	**216,479**	**25.5**	**-**	**-**	**-**	**-172,907**	**70,072**

Note: For more details on End of Life Cycle ECMs and associated incremental cost for high efficiency equipment and performance see Section 4.

1. HISTORIC ENERGY CONSUMPTION

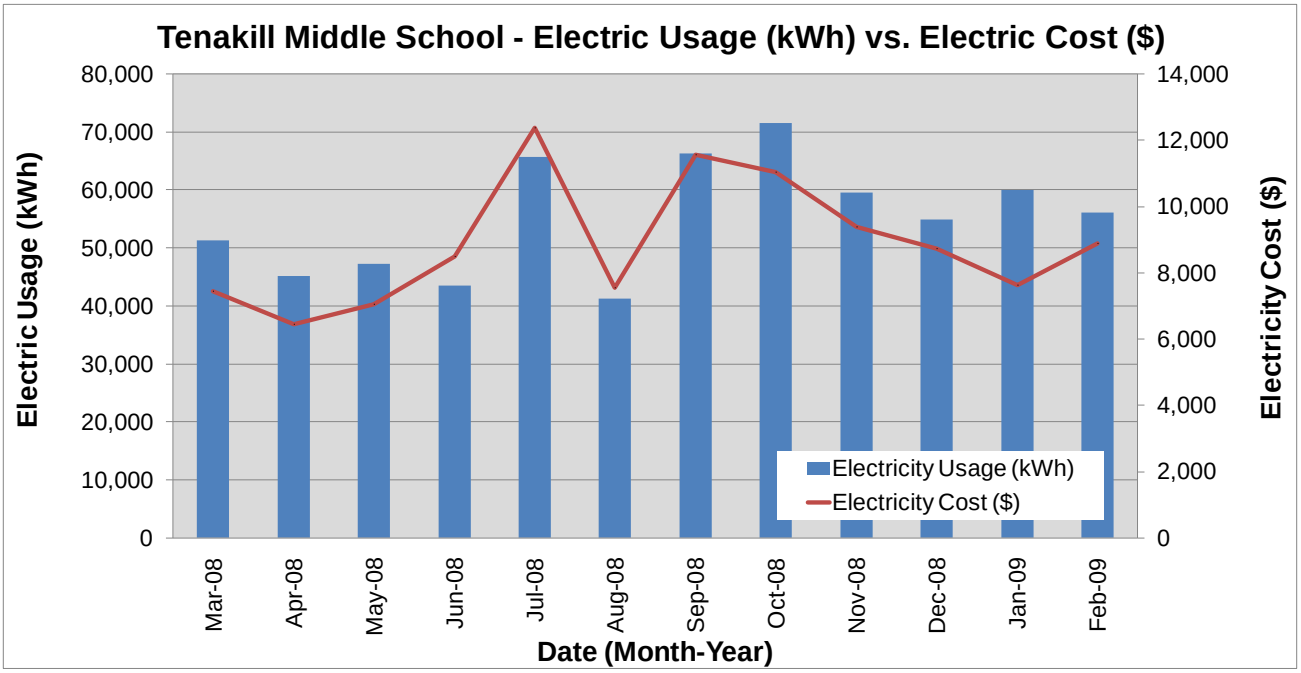
1.1. Energy usage, load profiles and cost analysis

SWA analyzed utility bills from **March 2008 through February 2009**(period of analysis) that were received from the utility companies supplying Tenakill Middle School with electric and natural gas.

Electricity - Tenakill Middle School buys electricity from Orange and Rockland at **an average rate of $0.161/kWh** based on 12 months of utility bills from March 2008 to February 2009. Tenakill Middle School purchased **approximately 662,640 kWh or $106,600 worth of electricity** in the previous year. Tenakill Middle School is currently charged for demand (kW) which has been factored into each monthly bill.

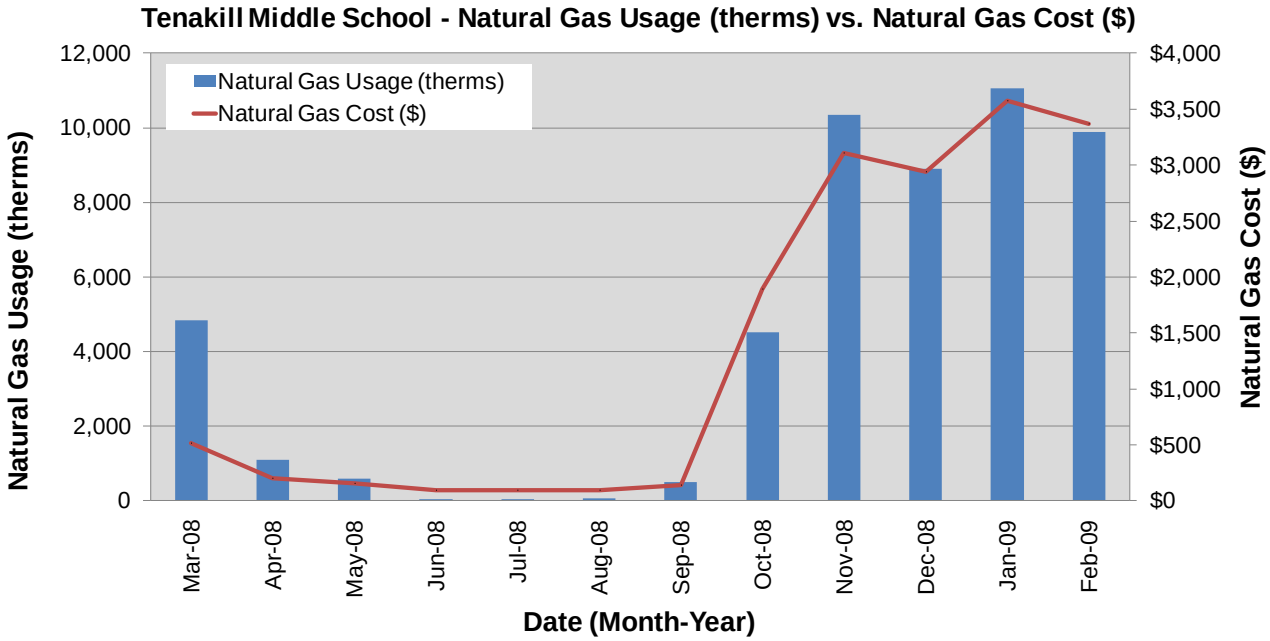
Natural gas - Tenakill Middle School is currently served by one meter for natural gas. They currently buy natural gas from Public Service Enterprise Group (PSEG) which acts as the transportation company and Hess as a 3rd part energy supplier at **an average aggregated rate of $1.538/therm** based on 12 months of utility bills for March 2008 to February 2009. Tenakill Middle School purchased **approximately 51,916 therms or $79,852 worth of natural gas** in the 12 month period of March 2008 to February 2009.

The following chart shows electricity use versus cost for Tenakill Middle School based on utility bills for the 12 month period of March 2008 to February 2009.



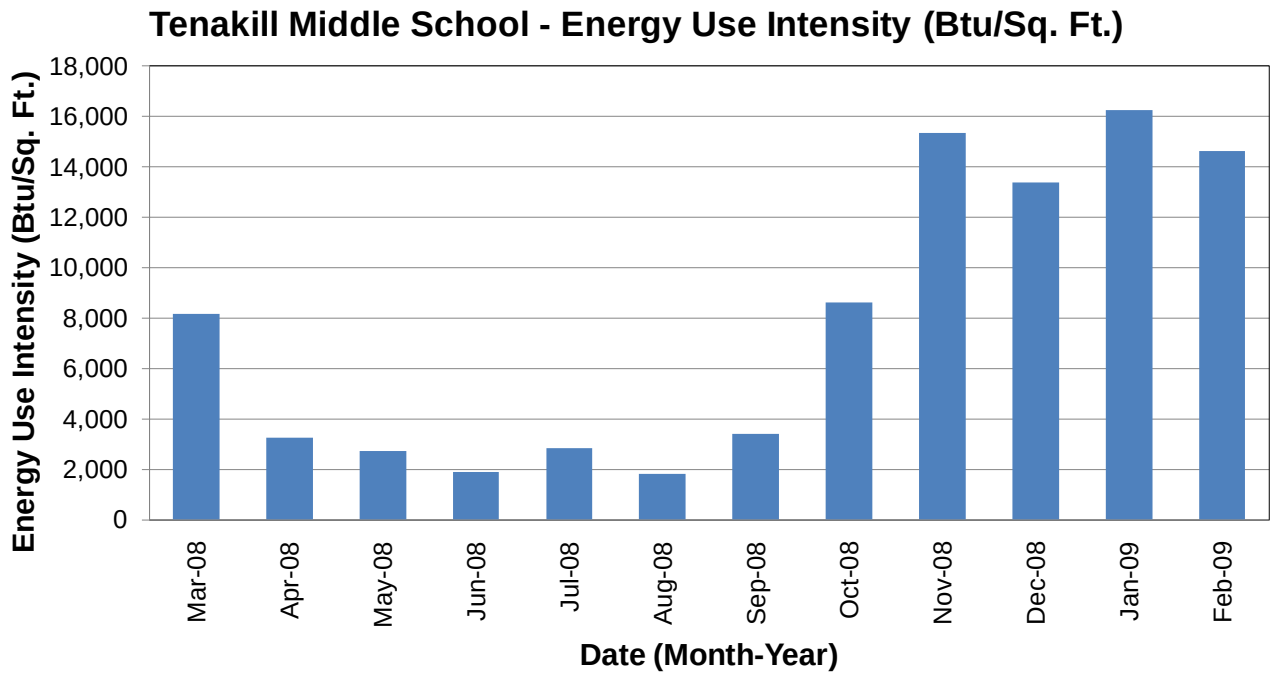
Electricity use follows a trend as expected; peaking during the summer months when air conditioning units are used most and decreases during the winter. The cost of electricity fluctuates as expected with usage.

The following is a chart of the natural gas annual load profile for the building versus natural gas costs, peaking in the coldest months of the year and a chart showing natural gas consumption following the "heating degree days" curve.



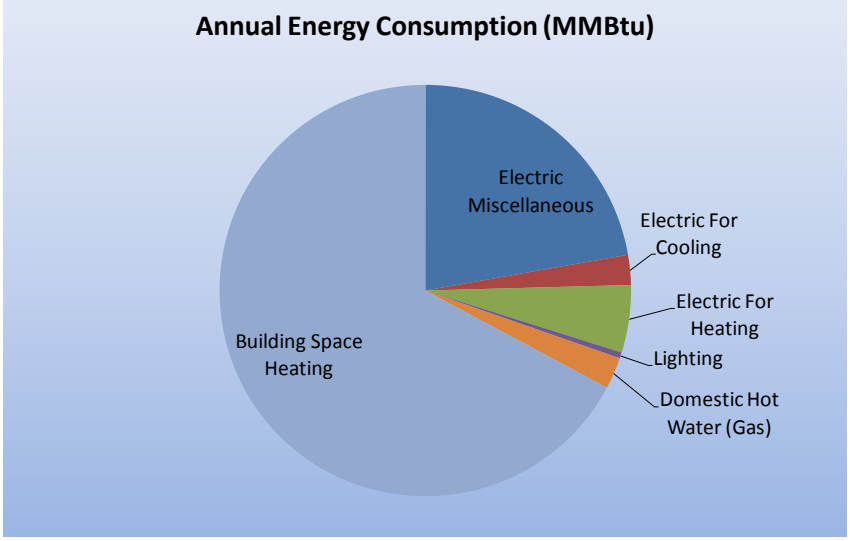
In the above chart, the natural gas use follows a heating trend as expected. During the summer it is clear that the natural gas use is very minimal which reflects that heat is not being used and the domestic hot water (DHW) load is minimal.

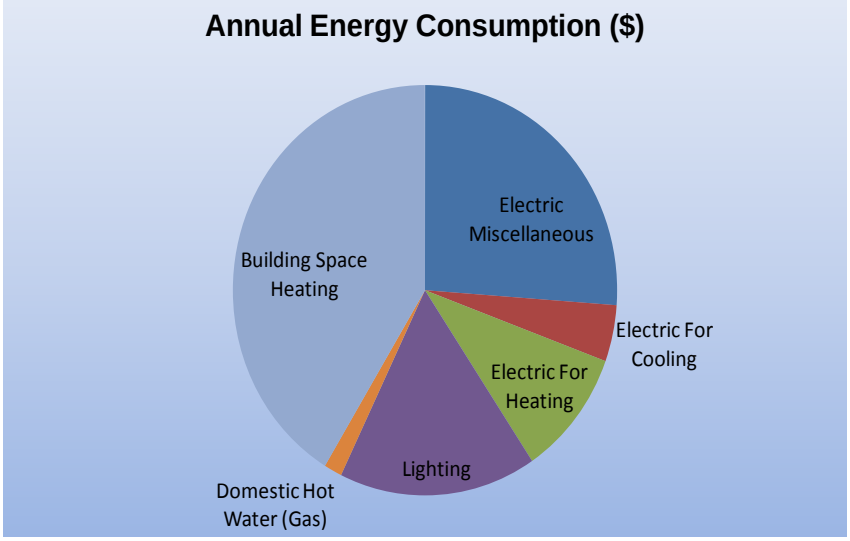
The following chart shows combined natural gas and electric consumption in Btu/sq ft for Tenakill Middle School based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for Tenakill Middle School based on utility bills for the 12 month period of March 2008 to February 2009. Note electrical cost at $47/MMBtu of energy is more than 3 times as expensive to use as natural gas at $15/MMBtu.

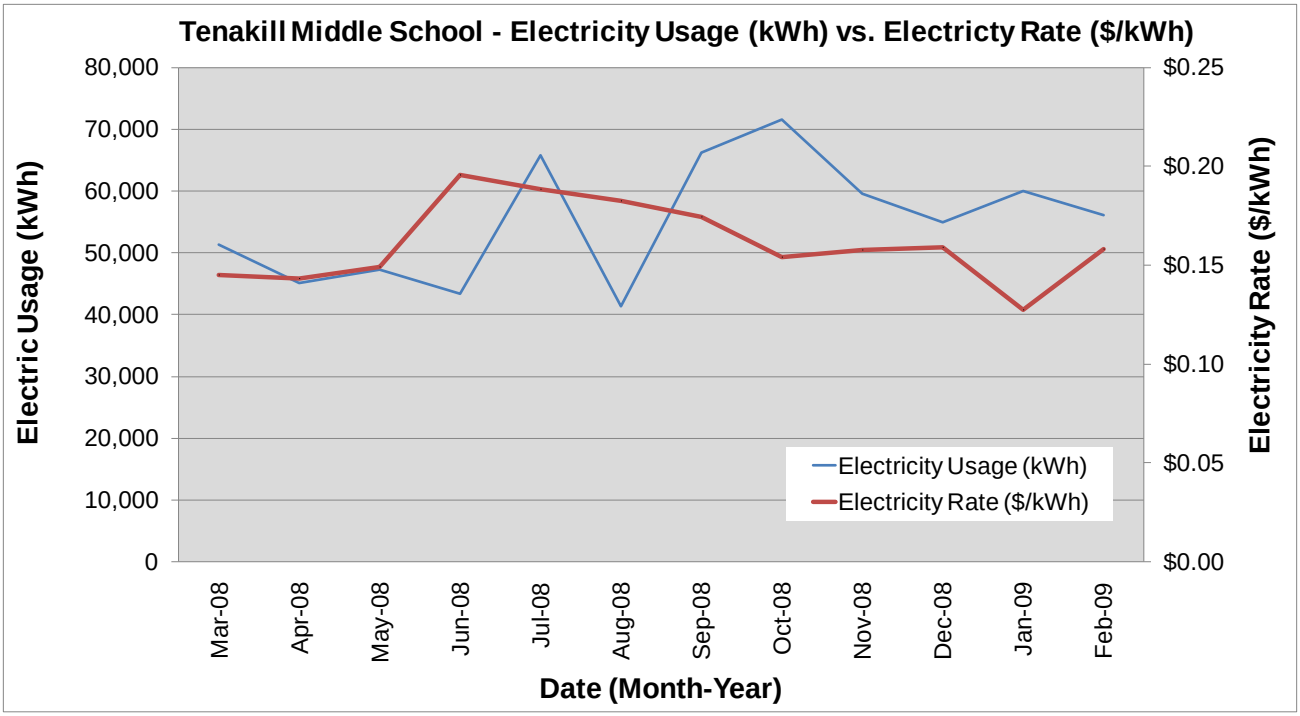
March 2008 - Feb. 2009 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	1,035	14%	$48,795	26%	47
Electric For Cooling	176	2%	$8,301	4%	47
Electric For Heating	395	5%	$18,610	10%	47
Lighting	656	9%	$30,927	17%	47
Domestic Hot Water (Gas)	184	2%	$2,835	2%	15
Building Space Heating	5,007	67%	$77,017	41%	15
Totals	7,453	100%	$186,453	100%	
Total Electric Usage	2,261	30%	$106,600	57%	47
Total Gas Usage	5,192	70%	$79,852	43%	15
Totals	7,453	100%	$186,453	100%	



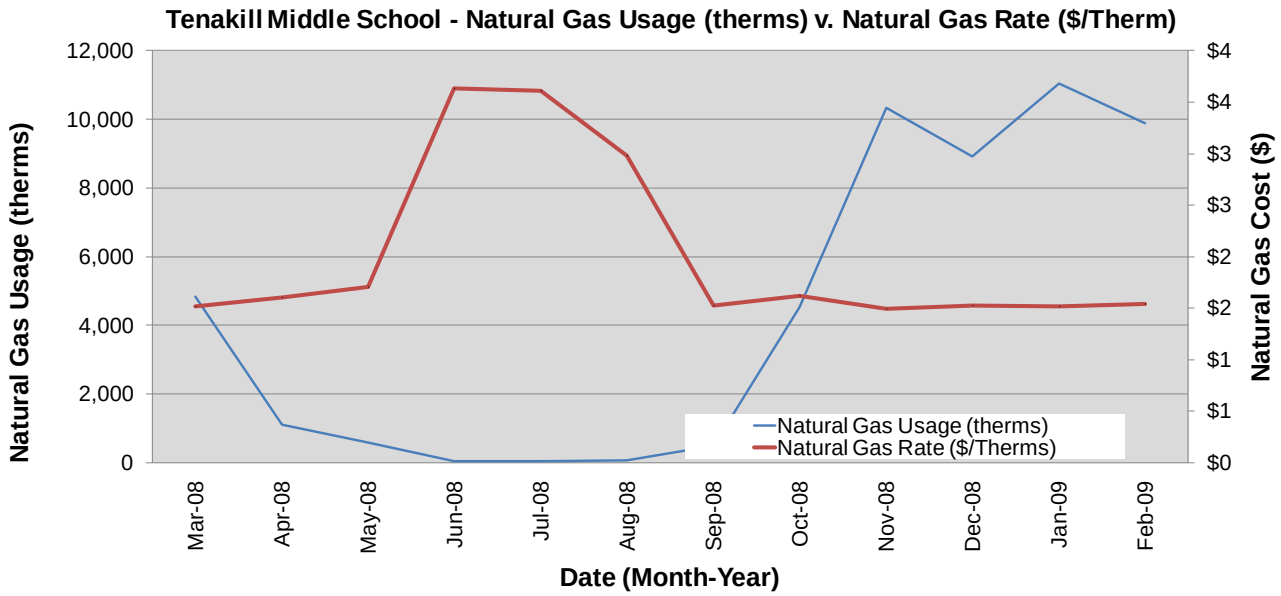


1.2. Utility rate analysis

Tenakill Middle School currently purchases electricity from Orange and Rockland at a general service market rate for electricity use (kWh) including a separate (kW) demand charge that is factored into each monthly bill. Tenakill Middle School currently pays an average rate of approximately $0.161/kWh based on the 12 months of utility bills of March 2008 to February 2009. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. The electric rate does not show large fluctuations throughout the year except for an anticipated rise in the summer time and small increase in the winter that corresponds to a spike in fuel prices. Based on these observations this appears to be the appropriate rate for the building.



Tenakill Middle School currently purchases natural gas from Public Service Enterprise Group (PSEG) which acts as the transportation company and Hess as a 3rd party energy supplier at a general service market rate for natural gas (therms). There is one gas meter that provides natural gas service to Tenakill Middle School currently. The average aggregated rate (supply and transport) for the meter is approximately $1.538/therm based on 12 months of utility bills for March 2008 to February 2009. The suppliers' general service rate for natural gas charges a market-rate price based on use and Tenakill Middle School billing does not breakdown demand costs for all periods. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the natural gas prices increase during the summer months when natural gas is only used by the hot water boilers. The high gas price per therm fluctuations in the summer may be due to low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months.



1.3. Energy benchmarking

SWA has entered energy information about the school in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. Currently, the building receives a performance rating of 33 which means that it is still ineligible for Energy Star. SWA encourages the Closter 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 94.3 kBtu/sq ft yr compared to the national average of a school consuming 81 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 0.4 kBtu/sqft yr, with an additional 0.9 kBtu/sq ft yr from the recommended ECMs and 3.3 kBtu/sq ft yr from the recommended End of Life Cycle ECMs.

Per the LGEA program requirements, SWA has assisted the Closter Board of Education to create an *Energy Star Portfolio Manager* account and has shared the building facility information to allow future data to be added and tracked using the benchmarking tool. SWA is sharing this Portfolio Manager Site information with TRC Energy Services. As per requirements, the account information is provided below:

Username: ClosterBoardOfEducation
Password: CLOSTER

Also, below is a statement of energy performance generated based on historical energy consumption from the Portfolio Manager Benchmarking tool.

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Closter BOE - Tenakill Middle School

Building ID: 1929015
For 12-month Period Ending: February 28, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: January 05, 2010

Facility	**Facility Owner**	**Primary Contact for this Facility**
Closter BOE - Tenakill Middle School 275 Hight Street Closter, NJ 07624	Closter Board of Education 340 Homans Avenue Closter, NJ 07624	Peter Iappelli 340 Homans Avenue Closter, NJ 07624

Year Built: 1929
Gross Floor Area (ft²): 80,655

Energy Performance Rating[2] (1-100) 33

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	2,252,357
Natural Gas (kBtu)[4]	5,354,840
Total Energy (kBtu)	7,607,197
Energy Intensity[5]	
Site (kBtu/ft²/yr)	94
Source (kBtu/ft²/yr)	163
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	502
Electric Distribution Utility	
Rockland Electric Co	
National Average Comparison	
National Average Site EUI	81
National Average Source EUI	140
% Difference from National Average Source EUI	16%
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.

Certifying Professional
N/A

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**

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.

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

Tenakill Middle School located at 275 High Street was opened in 1929, with additions completed in 1996 and 2004. The building is a two story free standing structure with a total floor area of 80,655 square feet of conditioned space which is used for both a school and the Closter Board of Education maintenance and custodial staff. The school is split into two separate wings that differentiate the original structure and new addition.

2.2. Building occupancy profiles

The occupancy for the school is approximately 50 full time employees and 635 students. Standard student occupancy is between 8:35 AM to 3:10 PM with the education staff from 8:00 AM to 4:00 PM and the buildings custodial staff from 7:00 AM to 7:00 PM.

2.3. Building envelope

2.3.1. Exterior Walls

There are two typical types of exterior walls at Tenakill that are unique for each wing. The original west wing part of the school has walls constructed of a 2" red masonry brick veneer at the exterior with a 1.5" air gap, 1.5" layer of rigid insulation, and 8" concrete masonry wall to the interior. The newer east wing of the school has walls constructed of composite metal faced wall panel system and 6" stud wall to the interior filled with R-19 batt insulation, vapor barrier and 5/8" gypsum board layer at the interior.

Existing Exterior Walls

Overall, exterior and interior wall finishes of the envelope were found to be in age-appropriate, good condition with no major signs of water or air leakage. There were some isolated instances at surface transitions, mechanical penetrations, and building corners that are beginning to show signs of cracking and slight water damage. SWA recommends biannual maintenance inspections to inspect the exterior walls with a focus on cracks and pointing of the masonry, degraded caulking, and locating sources of water and air leakage.

2.3.2. Roof

There are multiple roofing systems installed at Tenakill Middle School. Above the newer east wing of the school has a flat ethylene propylene diene monomer (EPDM) roof that is slightly pitched for drainage with a 6" layer of rigid insulation, metal decking and structural members to the interior. There are also small sections of the newer east wing where the roof is a sloped metal roof with a pitch of 8.5:12 with a 6" layer of rigid insulation, metal decking and structural members to the interior. Above the older west wing of the school is a sloped asphalt shingle roof and a small area of flat rolled asphalt roof with gravel bed.

Example of gravel bed roof

Example of sloped asphalt shingle roof

Example of EPDM flat roof

The roofs are in good age appropriate condition however, there are some isolated instances where the roof eaves, gutters and cornices show some initial signs of damage. The original section of the building still contains slat roofing with minimal insulation. Replacing this roof and adding insulation would not be cost-effective however SWA recommends adding a minimum of R-30 insulation and replacing the roof surface to form a better vapor and air barrier. Given the age of the major additions, there are no improvements to the newer roof assembly or insulation that would provide a significant improvement to the building performance; however, SWA does recommend biannual maintenance inspections with a focus on the drainage, penetrations, flashing and seams of the roof.

2.3.3. Base

The building's base is a 4" concrete slab-on-grade with a vapor barrier layer and 4" thick layer of gravel beneath it. There is also a 2" layer of rigid insulation installed alongside the foundation walls and two feet inward on the slabs. There were no reported problems with water penetration or moisture, physical damage or sagging. This is standard for this type of structure. SWA does not recommend any additional insulation as it would not be cost effective.

2.3.4. Windows

There are numerous and different types of windows at Tenakill Middle School. In the older west wing, the windows are part of a 3-piece aluminum frame system with the bottom two parts forming an operable double hung unit and the upper third piece is a fixed clerestory unit. There are also a few operable double hung units, transom, and fixed casement units. Additionally some of the double hung units on the first floor are equipped as emergency exits. There are also a variety of clear and tinted insulated panels installed in combination with some of the windows. The windows appear to be double glazed with an air gap and clear glass. Nearly every unit is equipped with some sort of blind system for providing shade for classrooms or rooms with permanent occupancy. For the most part the units are in adequate age appropriate condition. However, there are a few instances of damaged windowsills and cracks along the window frames.

In the new east wing there are a lot of fixed structural windows and fixed casement windows. A variety of operable and fixed double hung units, transom and combination units that are one piece

fixed casement and another part push out casement are also installed. Some of the windows are also equipped with insulated panels. The windows in the newer wing appear to be double glazed with low-e coating and a medium tint to it. In addition to these units there are also some instances of wire glass windows that for safety measures should not be replaced. Except for the structural windows alongside the hallways nearly every unit is equipped with some sort of blind system for providing shade. For the most part the units are in good age appropriate condition with no reported troubles regarding water damage or infiltration.

Example of typical installed windows

Examples of typical installed windows

SWA recommends that all windows be inspected at least twice per year. Any gaps, cracks, or damage to weather-stripping or caulking should be repaired or replaced, as needed, to minimize energy loss around those openings.

2.3.5.Exterior doors

There are three different types of exterior doors at Tenakill Middle School in the older west wing. They are all metal framed and are either: hollow core metal, paneled metal with fiberglass panels or paneled metal with glass panels. The exterior doors are in adequate condition and a majority of the weather-stripping is still intact, however, some of the doors should be replaced.

Examples of typical exterior doors

Examples of typical exterior doors

There are three different types of exterior doors at Tenakill Middle School in the newer west wing as well. They are all metal framed and are either glass, paneled metal with glass panels or hollow core

metal. The exterior doors are in good condition and while nearly all of the weather-stripping is still intact, some of the doors have large sections of damaged weather-stripping which should be replaced.

Examples of typical exterior doors

If not properly maintained, exterior doors can become major sources of heat loss and infiltration. As a best practice, SWA recommends checking the weather-stripping of each door on a regular basis and replacing any broken seals immediately. This will help optimize comfort and energy performance.

2.3.6. Building air tightness

Based on a visual inspection and communication with the building staff, the building was observed to be well-sealed and air tight which is consistent with the age and intended use of the building. As a best practice, weather-stripping on doors and windows should be checked every 6 months for deficiencies and replaced as they fail.

2.4. HVAC Systems

2.4.1. Heating

Tenakill Middle School contains one central heating plant located in the mechanical room on the first floor. This mechanical room contains three gas-fired Smith boilers that were installed in different years. Boilers #1 and #2 each have an input of 5,067 MBH with nameplate efficiencies of 78% and Boiler #3 has an input of 2,498 MBH with a nameplate efficiency of 78%. Although the boilers have been reasonably well-maintained, Tenakill Middle School could benefit from replacing each boiler with newer boilers of similar size that have efficiencies of over 85%. It is important to note that SWA observed asbestos located around the flue areas of Boiler #1 and #2. Before any recommendations are implemented that may disturb any areas that may contain asbestos, the Closter Board of Education must have the asbestos properly abated.

In addition to the hot water heating boilers, the heating system also consists of three heating hot water circulation pumps with 10 HP Baldor motors installed. These motors were observed to have a NEMA nominal efficiency of 85.5%. SWA recommends replacing all three motors with motors that are

NEMA premium efficiency of 91.7% or higher. The heating system is controlled centrally by a pneumatic system. Classrooms and office areas each contain thermostats with a limited temperature range of 3F in either direction from the setpoint. Programmable thermostats are not necessary since the central control system shuts the system down at night and adjusts it for outside temperature.

The Tenakill Middle School central heating plant feeds into a hot water system that is used by a variety of units throughout the building. Most areas, such as hallways and some classrooms are heated via force air from an air handling unit that contains hot water coils. Some classrooms, mostly in the older areas contain unit ventilators that contain hot water coils. Other areas such as stairwells, corridors and mechanical rooms are heated by either cabinet unit heaters or unit heaters that also contain hot water coils.

2.4.2. Cooling

Tenakill Middle School does not contain a central cooling system. SWA observed some small, window AC units that were installed in a few different classrooms and offices. These units are isolated from the general building system and were installed for spot-cooling specific areas.

2.4.3. Ventilation

Tenakill Middle School relies on rooftop units to introduce fresh air into the corridors of the building. In addition to these rooftop units, air handling units that contain hot water coils mix fresh air with return air and help ventilate classrooms, offices and other spaces throughout the building. In a limited number of classrooms there are unit ventilators that supply and exhaust air directly through the wall ducts of the specified classrooms.

In addition to the rooftop and air handling units, exhaust fans are installed on the roof that help rid the building of stale air and also help induce fresh air into the building. These rooftop exhaust fans were observed to all be working with no major maintenance issues.

2.4.4. Domestic Hot Water

There are two separate Domestic Hot Water (DHW) systems located throughout the building. The main DHW unit is an AO Smith electric domestic hot water heater located in the Main Boiler Room on the first floor of the original section of the building. This unit provides DHW throughout the original building. This electric hot water heater is brand new and was recently installed in November of 2009. As a best practice, SWA recommends that electric water heaters are replaced with gas-fired units however; since this unit was installed this year, SWA recommends that this unit is not replaced until the unit nears the end of its useful life. The second DHW unit is a PVI Industries gas-fired domestic hot water heater located in Mechanical Room A209. This unit provides DHW to all areas in the 2004 school addition.

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting – Tenakill Middle School contains mostly inefficient lighting. Most of the lighting in the building uses 2', 4' or 8' T12 fixtures with magnetic ballasts that should be replaced with similar length T8 fixtures and electronic ballasts. Also installed are a variety of incandescent fixtures and CFL's (Compact Fluorescent Light bulb). Any installed incandescent fixture should be replaced with a CFL. Additionally, there are also metal halide fixtures that should be replaced with pulse start

metal halide fixtures. SWA also recommends installing 12 new occupancy sensors to reduce electricity usage. See attached lighting schedule in Appendix A for a complete lighting inventory throughout the building and estimated power consumption.

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

Exterior Lighting - The exterior lighting surveyed during the building audit were found to be CFL's, metal halide and halogen fixtures. All exterior metal halide and halogen fixtures should be replaced with pulse start metal halide fixtures except for the 60W halogen fixtures which should be replaced with a 20W CFL.

Parking - The parking lights surveyed during the building audit were found to be 250W pole mounted high pressure sodium fixtures. SWA recommends replacing them with 175 W pulse start metal halide lamps.

2.5.2. Appliances

SWA performed a basic survey of appliances installed at Tenakill Middle School and has determined that it would not be cost-effective to replace any appliances at this time due to the age of the building. 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, and computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

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. refrigerators, coffee makers, televisions, etc) be plugged in to power strips and turned off each evening just as the lights are turned off. Tenakill Middle School computers are generally programmed for the power save mode, to shut down after a period of time that they have not been used.

2.5.3. Elevators

Tenakill Middle School contains one Payton hydraulic elevator that would not be cost-effective to upgrade at this point in time.

2.5.4. Process and others electrical systems

There are no other process or electrical systems located within the building.

3. EQUIPMENT LIST

Inventory

Building System	Description	Physical Location	Make/ Model	Fuel	Space served	Date Installed	Estimated Remaining useful life %
Heating	B-1; HB Smith cast iron boiler, with 5,067 MBH input, estimated 78% efficiency	Main Boiler Room	HB Smith, 450 Mills, Model #M450L, Serial #03021	Natural Gas	All Areas	1983	10%
Heating	B-2; HB Smith cast iron boiler, with 5,067 MBH input, estimated 78% efficiency	Main Boiler Room	HB Smith, 450 Mills, Model #M450L, Serial #03020	Natural Gas	All Areas	1978	10%
Heating	B-3; Smith cast iron boiler, with 2,498 MBH input, estimated 78% efficiency	Main Boiler Room	Smith, Series 28A-10, Model #NA, Serial #N95-590	Natural Gas	All Areas	1995	30%
Heating	P-1; Hot Water circulation pump motor, Baldor Motor, 10 HP, NEMA nominal efficiency 89.5%	Main Boiler Room	Baldor, Standard-E, Cat #M3313T, Spec. #37B1014514H1	Electricity	All Areas	2003	30%
Heating	P-2; Hot Water circulation pump motor, Baldor Motor, 10 HP, NEMA nominal efficiency 85.5%	Main Boiler Room	Baldor, Cat #M3313T, Spec #37B01X35	Electricity	All Areas	2003	30%
Heating	P-3; Hot Water circulation pump motor, Baldor Motor, 10 HP, NEMA nominal efficiency 85.5%	Main Boiler Room	Baldor, Cat #M3313T, Spec #37B01X33	Electricity	All Areas	2003	30%
Heating/ Ventilation	AHU-2; Trane air handling unit, 6,130 CFM Design	Mechanical Room A209	Trane, Model #MCCA0086AK0ABA000F0CAA00EAA0000AA000B000000, Serial #K95G51250	Electricity	2004 addition	2004	60%
Heating/ Ventilation	AHU-4; Trane air handling unit, 10,000 CFM Design	Mechanical Room A209	Trane, Model #NA, Serial #NA	Electricity	2004 addition	2004	60%
Heating/ Ventilation	AHU-3; Trane air handling unit, 10,000 CFM Design	Mechanical Room 212	Trane, Model #MCCA012BBD0EA0A00000, Serial #NA	Electricity	2004 addition	2004	60%
Heating/ Ventilation	AHU-5; Trane air handling unit, 13,000 CFM Design	Mechanical Room 212	Trane, Model #NA, Serial #NA	Electricity	2004 addition	2004	60%
Heating/ Ventilation	AHU-6; Trane air handling unit, 7,800 CFM Design, 300 MBH output	Auditorium Storage	Trane, Model #NA, Serial #NA	Natural Gas/ Electricity	Auditorium	2004	60%
Heating/ Ventilation	AHU-7; Trane air handling unit, 2,000 CFM Design	Maintenance Area	Trane, Model #NA, Serial #NA	Electricity	Maintenance Area	2004	60%
Heating/ Ventilation	RTU-1; Lennox rooftop unit	2004 Upper Roof section	Lennox, L series, Model #L**042H28N1, Serial #5605H01421, Cat. #C9317	Electricity	2004 addition	2004	60%
Heating/ Ventilation	RTU-2; Lennox rooftop unit	2004 Lower Roof section	Lennox, L series, Model #L**042H28N1, Serial #NA	Electricity	2004 addition	2004	60%
Domestic Hot Water	AO Smith, Energy Star label->4990 kWh/year, 4500 watts upper/4500 watts lower, 66 gallons	Main Boiler Room	AO Smith, Promax, Model #ECT66200, Serial #0834A023854	Electricity	All Areas	2009	95%
Domestic Hot Water	PVI Industries, DHW boiler, input 600 MBH, 175 gallon capacity, estimated efficiency of 82%	Mechanical Room A209	PVI Industries, Model #750 P 175A TP, Serial #109 586 290	Natural Gas	Original section/ 1996 Addition	2004	40%
Elevator	Payton Elevator, with 25 HP motor,	Elevator machine room, Second floor	Payton Elevator, Model #MF90HYD-1-579, Serial #155361	Electricity	All Areas	1995	30%

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 Police Headquarters, 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

- Replace electric DHW heater with gas-fired unit – The main boiler room contains one electric DHW heater that was installed in 2009. Due to the young age of this unit, it is not cost-effective to replace at this time. SWA recommends that this unit is replaced with a gas-fired unit as soon as it reaches the end of its useful lifetime. A gas-fired unit will require the same amount of energy to meet the domestic hot water load, however since electricity is far more expensive than gas, each unit of energy will cost less to produce using natural gas.

- Replace roof of original building – The original building contains slat roofing with minimal insulation. As roofs deteriorate, they allow moisture and air to penetrate into the building shell while at the same time allowing valuable heat to escape out of the building shell. Based on thermal calculations, replacing would not be justified based on the cost of energy savings alone. SWA recommends that the Closter Board of Education consider replacing the roof of the building to improve the vapor, air and thermal barrier that the roof provides.

Category II Recommendations: Operations and Maintenance

- Perform bi-annual maintenance inspections of exterior walls including windows and doors – SWA recommends bi-annual inspections by maintenance staff with a focus on cracks, masonry damage and degraded caulking. Maintenance staff should be trained to identify potential problems with the building envelope. SWA observed areas that showed signs of damage but have not yet reached the point of creating severe problems.

- Provide weather stripping / air sealing – SWA observed that all windows and doors had proper weather-stripping and air sealing due to their age. As a best practice, SWA recommends that each window and door is inspected twice per year for deficiencies. Any time that a seal has been compromised, building maintenance staff should repair and replace the seal immediately to ensure that thermal barriers are not breached.

- Provide water efficient fixtures and controls - Adding controlled on / off timers on all lavatory faucets is a cost-effective way to reduce domestic hot water demand and save water. Building staff can also easily install faucet aerators and / or low-flow fixtures to reduce water consumption. There are many retrofit options, which can be installed now or incorporated as equipment is replaced. Routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy. Retrofitting with more efficient water-consumption fixtures / appliances will save both energy and money through reduced energy consumption for water heating, while also decreasing water / sewer bills.

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

- Teaching / Educational program – There is currently a program available from NJ for maintenance staff. SWA recommends involving staff in the educational program.

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1	Install 8 new CFL lamps
2	Install 12 new Occupancy Sensors
	Description of Recommended 5-10 Year Payback ECMs
3	Install 19 new Pulse Start Metal Halide fixtures
4	Install 10 kW Solar Photovoltaic system
5	Replace three 10 HP heating hot water circulation pump motors
	Description of Recommended End of Life Cycle ECMs
6	Install 642 new T8 fluorescent fixtures with electronic ballasts
7	Replace entire Central Heating Plant (3 boilers) with high efficiency units

ECM#1: *Install 8 new CFL lamps*

Description:

The Tenakill Middle School building currently contains 8 halogen lights that are used for some of the exterior lighting. SWA recommends replacing these lamps with more efficient, CFL reflector lamps that have equivalent light output but consume less energy. In addition, there will be operating cost savings associated with each bulb since CFLs have a longer rated lifetime than incandescent bulbs. See Appendix A for complete lighting schedule and analysis.

Installation cost:
Estimated installed cost: $120
Source of cost estimate: RS *Means; Published and 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 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	Install 8 new CFL lamps	RSMeans	120	0	120	6,474	1.3	0	0.3	36	1,078	15	16,175	0.1	13378.9	891.9	898.6	12,753	11,592

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumes operation cost savings based on avoided bulb replacement when upgrading to lighting that consists of longer rated burn hours.

Rebates / financial incentives:
There are currently no incentives available for this measure.

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#2: *Install 12 new Occupancy Sensors*

Description:

SWA observed 12 areas within the Tenakill Middle School building that could benefit from the installation of occupancy sensors. These areas include spaces such as small office areas that are used infrequently, storage closets and bathrooms. See Appendix A for complete lighting schedule and analysis.

Installation cost:
Estimated installed cost: $1,080
Source of cost estimate: RS *Means; Published and 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 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 12 new Occupancy Sensors	RSMeans	1,320	240	1,080	2,021	0.4	0	0.1	0	325	15	4,881	3.3	351.9	23.5	27.5	1,696	3,619

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 – Lighting Controls, Wall-mounted Occupancy Sensors ($20 per control)
Maximum incentive amount is $240.

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#3: *Install 19 new Pulse Start Metal Halide fixtures*

Description:

SWA observed 19 existing Probe Start Metal Halide exterior lighting fixtures at Tenakill Middle School that should be upgraded to Pulse Start Metal Halide fixtures. Probe Start Metal Halides are installed at excessive wattages since they degrade rapidly overtime. Pulse Start Metal Halide fixtures do not degrade over time, allowing a lower wattage fixture to be installed that provides a better quality, safer light for exterior areas. See Appendix A for complete lighting schedule and analysis.

Installation cost:
Estimated installed cost: $15,568
Source of cost estimate: RS *Means; Published and 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 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	Install 19 new Pulse Start Metal Halide fixtures	RSMeans	16,043	475	15,568	7,507	7.0	0	0.3	1,035	2,244	15	33,654	6.9	116.2	7.7	11.7	11,216	13,441

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumes operation cost savings based on avoided bulb replacement when upgrading to lighting that consists of longer rated burn hours.

Rebates / financial incentives:
NJ Clean Energy – Prescriptive Lighting, Metal halide w/pulse start ($25 per fixture)
Maximum incentive amount is $475.

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#4: *Install 10kW Solar Photovoltaic system*

Description:

Currently, the Tenakill Middle 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. SWA presents below the economics, and recommends at this time that Closter Board of Education further review installing a 10kW 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. The Tenakill Middle School is not eligible for a 30% federal tax credit. Instead, Closter Board of Education 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. Orange Rockland provides the ability to buy SRECs at $600 / MWh or best market offer.

There are a few locations for a 10kW PV installation on the roof of the school. The size of the system was determined using the amount of roof surface area as a limiting factor. A PV system could be installed on a portion of the sloped roof that faces South or West. The recommended system would fit on the roof section of the 2004 addition. A commercial multi-crystalline 123 watt panel (17.2 volts, 7.16 amps) has 10.7 square feet of surface area (11.51 watts per square foot). A 10kW system needs approximately 82 panels which would take up 878 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: $60,000
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 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	Install 10 kW Solar Photovoltaic system	Similar Projects	70,000	10,000	60,000	11,804	11.8	0	0.5	0	8,500	25	212,511	7.1	254.2	10.2	12.0	51,883	21,135

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 (123 Watts, model #ND-123UJF). 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. Incentive amount for this application is $10,000.
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. $6,600 has been incorporated into the above annual costs for a period of 15 years (limit of SREC agreement); 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#5: *Replace three 10 HP heating hot water circulation pump motors*

Description:

SWA recommends replacing the thre 10 HP motors installed on the Hot Water Circulation Pumps in the main boiler room. These 10HP motors have current NEMA nominal efficiencies of 85.5% and should be upgraded to a motor with NEMA premium efficiency of 91.7%.

Installation cost:
Estimated installed cost: $2,031
Source of cost estimate: *Motor Master v. 4.0*

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 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	Replace three 10 HP heating hot water circulation pump motors	Motor Master	2,301	270	2,031	885	0.8	0	0.0	90	232	10	2,325	8.7	14.5	1.4	2.5	-48	1,585

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Cost and savings calculations were completed using MotorMaster software version 4.0. Savings are calculated based on an existing motor efficiency of 86.5% and a replacement motor efficiency of 93.0%.

Rebates / financial incentives:
NJ Clean Energy – Premium Motor Efficiency incentive, based on a 10HP motor, 1800 RPM, 91.7% efficiency ($90 per motor)
Maximum incentive amount is $270.

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#6: *Install 642 new T8 fluorescent fixtures with electronic ballasts*

Description:

SWA observed 642 general lighting fixtures that contained T12 fluorescent lamps with magnetic ballasts. SWA recommends that each of these fixtures is replaced with a more efficient fluorescent fixture that contains T8 fluorescent lamps with electronic ballasts. Upgrading from T12 magnetic fixtures to T8 electronic fixtures typically results in a 30% power consumption savings. T8 electronic fixtures provide a better quality light while consuming less energy. See Appendix A for complete lighting schedule and analysis.

Installation cost:
Estimated installed cost: $118,975
Source of cost estimate: RS *Means; Published and 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 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	Install 642 new T8 fluorescent fixtures with electronic ballasts	RSMeans	138,235	19,260	118,975	28,676	6.0	0	1.2	2,960	7,577	15	113,653	15.7	-4.5	-0.3	-0.6	-28,523	51,344

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumes operation cost savings based on avoided bulb replacement when upgrading to lighting that consists of longer rated burn hours.

Rebates / financial incentives:
NJ Clean Energy – Prescriptive Lighting, T-8 lamps with electronic ballast in existing facilities ($30 per fixture)
Maximum incentive amount is $19,260.

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#7: *Replace entire Central Heating Plant (3 boilers) with high efficiency units*

Description:

Tenakill Middle School contains one central heating plant located in the mechanical room on the first floor. This mechanical room contains three gas-fired Smith boilers that were installed in different years. Boilers #1 and #2 each have an input of 5,067 MBH with nameplate efficiencies of 78% and Boiler #3 has an input of 2,498 MBH with a nameplate efficiency of 78%. Although the boilers have been reasonably well-maintained, Tenakill Middle School could benefit from replacing each boiler with newer boilers of similar size that have efficiencies of over 85%. It is important to note that SWA observed asbestos located around the flue areas of Boiler #1 and #2. Before any recommendations are implemented that may disturb any areas that may contain asbestos, the Closter Board of Education must have the asbestos properly mitigated from the building.

Installation cost:
Estimated installed cost: $179,469
Source of cost estimate: RS *Means; Published and 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 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	Replace entire Central Heating Plant (3 boilers) in-kind	RS Means	163,967	2,498	161,469	0	0.0	515	0.6	1,500	2,292	25	57,302	70.4	-64.5	-2.6	-25.5	-141,917	5,677
7b	Incremental Cost for high efficiency units	RS Means	18,000	0	18,000	0	0.0	1,699	2.1	0	2,613	25	65,327	6.9	262.9	10.5	7.4	4,290	18,728
7	Replace entire Central Heating Plant (3 boilers) with high efficiency units	RS Means	181,967	2,498	179,469	0	0.0	1,699	2.1	1,500	4,113	25	102,827	43.6	-42.7	-1.7	-20.5	-144,384	18,728

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumes that each boiler requires $500 in maintenance and operation costs per year due to the age of the equipment. The nameplate

efficiency of the original unit was observed to be 78% and was confirmed through combustion efficiency tests. Calculations for an in-kind replacement assume that a boiler with efficiency of 80% will be installed. A high efficiency unit is assumed to be 85% efficient.

Rebates / financial incentives:
NJ Clean Energy Gas Heating, Gas-fired boilers >1500-<4000 MBH ($1.00 per MBH)
Maximum incentive amount is $2,498 for Boiler #3.

Additional incentives are available for Boiler #1 and Boiler #2, however due to their large size it is required to submit a custom incentive application to the NJ SmartStart program to receive an incentive estimate.

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 aren't currently any existing renewable energy systems.

5.2. Wind

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

Pleases see the above recommended ECM#4.

5.4. Solar Thermal Collectors

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

CHP is not applicable for this building because of the existing HVAC system and insufficient domestic hot water use.

5.6. Geothermal

Geothermal is not applicable for this building because current HVAC equipment in new.

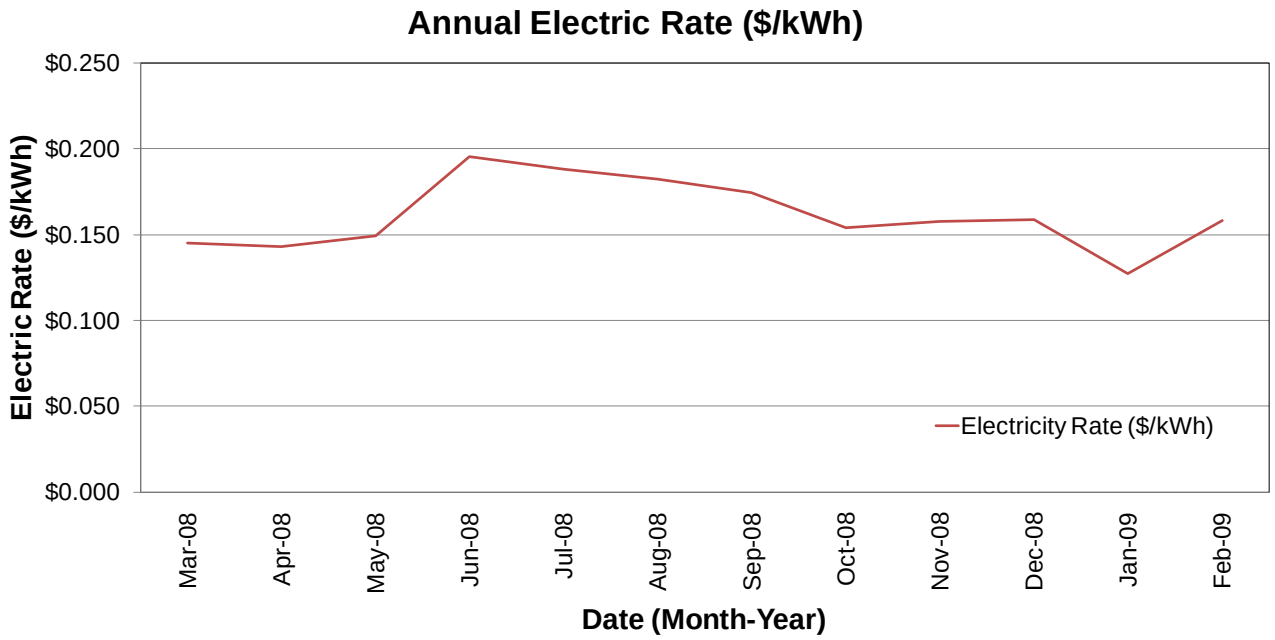
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

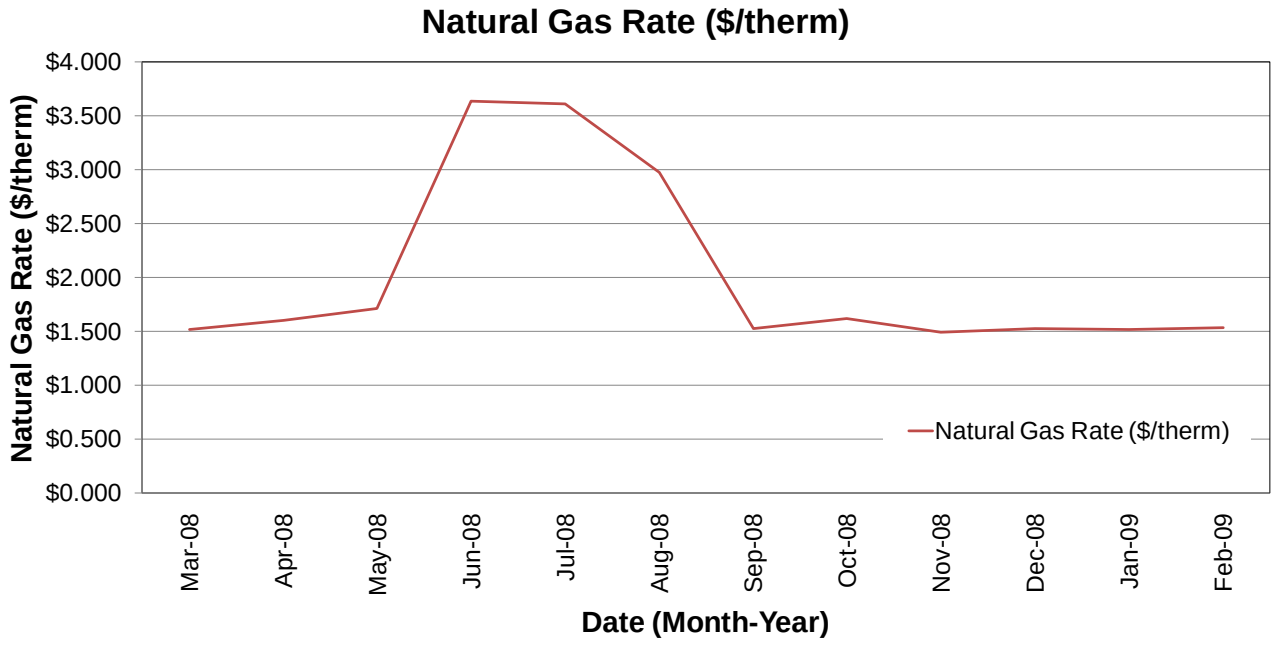
6.1. Energy Purchasing

Tenakill Middle School receives natural gas via one incoming meter from Public Service Enterprise Group (PSEG) which acts as the transportation company and Hess as a 3rd part energy supplier. 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 Tenakill Middle School from Orange and Rockland without an ESCO. SWA analyzed the utility rate for natural gas and electricity supply over an extended period. Electric bill analysis shows fluctuations of 27% over the 12 month period between March 2008 and February 2009. Natural gas bill analysis shows fluctuations up to 12% over the 12 month period between March 2008 and February 2009. The high gas price per therm fluctuations in the summer may be due to low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months.

Currently, New Jersey commercial buildings of similar type pay $0.150/kWh for electricity and $1.55/therm for natural gas. Currently, the electricity rate for the school is $0.161/kWh, which means there is a potential cost savings of $7,289 per year. The current natural gas rate for Tenakill Middle

School is $1.538/therm which is better than the average natural gas cost. A large cost savings potential for electricity exists, however this involves contacting third party suppliers and negotiating utility rates. SWA recommends that the Closter Board of Education further explore opportunities of purchasing electricity from third party energy suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for Hillside Elementary. Appendix B contains a complete list of third party energy suppliers for the Closter Board of Education service area. The Closter Board of Education may want to consider partnering with other school districts, municipalities, townships and communities to aggregate a substantial electric and natural gas use for better leveraging in negotiations with ESCOs and of improving the pricing structures. This sort of activity is happening in many parts of the country and in New Jersey.





6.2. Energy Procurement strategies

Also, Tenakill Middle School would not be eligible for enrollment in a Demand Response Program, because there isn't the capability at this time 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.

7. METHOD OF ANALYSIS

7.1. Assumptions and tools

Energy modeling tool:	Established / standard industry assumptions, DOE 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 of Tenakill Middle School

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	Meeting Room A116	Recessed	N	CFL	4	2	18	S	8	190	0	144	219	N/A	Recessed	CFL	N	S	4	2	18	8	190	0	144	219	0	0	0
2	1	Meeting Room A116	Recessed	M	4'T12	2	2	40	S	8	190	15	190	289	T8	Recessed	4'T8	E	S	2	2	32	8	190	6	140	213	76	0	76
3	1	Meeting Room A115	Screw-in	N	Inc	4	1	150	S	8	190	0	600	912	C	Screw-in	CFL	N	OS	4	1	150	6	190	0	600	684	228	228	228
4	1	Meeting Room A115	Recessed	N	CFL	3	2	18	S	8	190	0	108	164	C	Recessed	CFL	N	OS	3	2	18	6	190	0	108	123	41	41	41
5	1	Storage Room A117	Recessed	M	4'T12	1	2	40	S	2	190	15	95	36	T8	Recessed	4'T8	E	S	1	2	32	2	190	6	70	27	10	0	10
6	1	Bathroom A114	Recessed	M	4'T12	1	2	40	S	8	190	15	95	144	T8	Recessed	4'T8	E	S	1	2	32	8	190	6	70	106	38	0	38
7	1	Bathroom A113	Recessed	M	4'T12	1	2	40	S	8	190	15	95	144	T8	Recessed	4'T8	E	S	1	2	32	8	190	6	70	106	38	0	38
8	1	Nurse's Station A109	Recessed	M	4'T12	2	4	40	S	8	190	24	368	559	T8	Recessed	4'T8	E	OS	2	4	32	6	190	13	282	321	238	107	238
9	1	Nurse's Station A111	Recessed	M	4'T12	3	4	40	S	8	190	24	552	839	T8	Recessed	4'T8	E	OS	3	4	32	6	190	13	423	482	357	161	357
10	1	Nurse's Station A111	Recessed	M	4'T12	2	2	40	S	8	190	15	190	289	T8	Recessed	4'T8	E	S	2	2	32	8	190	6	140	213	76	0	76
11	1	Nurse's Station A112	Recessed	M	4'T12	1	2	40	S	8	190	15	95	144	T8	Recessed	4'T8	E	S	1	2	32	8	190	6	70	106	38	0	38
12	1	Bathroom A108	Recessed	M	4'T12	1	2	40	S	8	190	15	95	144	T8	Recessed	4'T8	E	S	1	2	32	8	190	6	70	106	38	0	38
13	1	Storage Room A107	Recessed	M	4'T12	2	4	40	S	2	190	24	368	140	T8	Recessed	4'T8	E	S	2	4	32	2	190	13	282	107	33	0	33
14	1	Office A106	Recessed	M	4'T12	2	4	40	S	8	190	24	368	559	T8	Recessed	4'T8	E	S	2	4	32	8	190	13	282	429	131	0	131
15	1	Office A106	Recessed	N	CFL	2	2	18	S	8	190	0	72	109	N/A	Recessed	CFL	N	S	2	2	18	8	190	0	72	109	0	0	0
16	1	Office A105	Recessed	M	4'T12	2	4	40	S	8	190	24	368	559	T8	Recessed	4'T8	E	S	2	4	32	8	190	13	282	429	131	0	131
17	1	Office A105	Recessed	N	CFL	2	2	18	S	8	190	0	72	109	N/A	Recessed	CFL	N	S	2	2	18	8	190	0	72	109	0	0	0
18	1	Office A104	Recessed	N	CFL	12	2	18	S	8	190	0	432	657	N/A	Recessed	CFL	N	S	12	2	18	8	190	0	432	657	0	0	0
19	1	Office A104	Recessed	M	4'T12	6	4	40	S	8	190	24	1,104	1,678	T8	Recessed	4'T8	E	S	6	4	32	8	190	13	846	1286	392	0	392
20	1	Office A102	Recessed	M	4'T12	2	4	40	S	8	190	24	368	559	T8	Recessed	4'T8	E	S	2	4	32	8	190	13	282	429	131	0	131
21	1	Meeting Room A102	Screw-in	N	Inc	1	1	150	S	8	190	0	150	228	N/A	Screw-in	CFL	N	S	1	1	150	8	190	0	150	228	0	0	0
22	1	Office A103	Recessed	M	4'T12	3	4	40	S	8	190	24	552	839	T8	Recessed	4'T8	E	S	3	4	32	8	190	13	423	643	196	0	196
23	1	Office A103	Recessed	N	CFL	8	2	18	S	8	190	0	288	438	N/A	Recessed	CFL	N	S	8	2	18	8	190	0	288	438	0	0	0
24	1	Laboratory A119	Recessed	M	4'T12	15	2	40	S	8	190	15	1,425	2,166	T8	Recessed	4'T8	E	S	15	2	32	8	190	6	1050	1596	570	0	570
25	1	Laboratory A120	Recessed	M	4'T12	15	2	40	S	8	190	15	1,425	2,166	T8	Recessed	4'T8	E	S	15	2	32	8	190	6	1050	1596	570	0	570
26	1	Classroom A121	Recessed	M	4'T12	11	2	40	S	8	190	15	1,045	1,588	T8	Recessed	4'T8	E	S	11	2	32	8	190	6	770	1170	418	0	418
27	1	Gymnasium A137	HID	N	MH	24	1	250	S	12	190	63	7,512	17,127	PSMH	HID	PSMH	N	S	24	1	175	12	190	38	5112	11655	5472	0	5472
28	1	Gymnasium A137	Exit Sign	N	LED	4	1	5	N	24	365	1	24	210	N/A	Exit Sign	LED	N	N	4	1	5	24	365	1	24	210	0	0	0
29	1	Meeting Room A115	Exit Sign	N	LED	11	1	5	N	24	365	1	66	578	C	Exit Sign	LED	N	OS	11	1	5	18	365	1	66	434	145	145	145
30	1	Kitchen A140	Recessed	M	4'T12	2	4	40	S	12	190	24	368	839	T8	Recessed	4'T8	E	OS	2	4	32	9	190	13	282	482	357	161	357
31	1	Storage Room A139	Recessed	M	4'T12	2	4	40	S	8	190	24	368	559	T8	Recessed	4'T8	E	OS	2	4	32	6	190	13	282	321	238	107	238
32	1	Kitchen A139	Recessed	N	CFL	2	2	18	S	12	190	0	72	164	N/A	Recessed	CFL	N	S	2	2	18	12	190	0	72	164	0	0	0
33	1	Storage Room A140	Recessed	N	CFL	2	2	18	S	2	190	0	72	27	N/A	Recessed	CFL	N	S	2	2	18	2	190	0	72	27	0	0	0
34	1	Janitor's Closet A123	Parabolic	M	4'T12	1	2	40	S	2	190	15	95	36	T8	Parabolic	4'T8	E	S	1	2	32	2	190	6	70	27	10	0	10
35	1	Men's Locker Room A124	Recessed	M	4'T12	5	2	40	S	8	190	15	475	722	T8	Recessed	4'T8	E	OS	5	2	32	6	190	6	350	399	323	133	323
36	1	Men's Locker Room A125	Recessed	M	4'T12	1	2	40	S	8	190	15	95	144	T8	Recessed	4'T8	E	S	1	2	32	8	190	6	70	106	38	0	38
37	1	Bathroom Men A126	Recessed	M	4'T12	3	2	40	S	8	190	15	285	433	T8	Recessed	4'T8	E	S	3	2	32	8	190	6	210	319	114	0	114
38	1	Vestibule A126	Recessed	M	4'T12	1	2	40	S	12	190	15	95	217	T8	Recessed	4'T8	E	S	1	2	32	12	190	6	70	160	57	0	57
39	1	Bathroom Women A127	Recessed	M	4'T12	3	2	40	S	8	190	15	285	433	T8	Recessed	4'T8	E	S	3	2	32	8	190	6	210	319	114	0	114
40	1	Women's Locker Room A128	Recessed	M	4'T12	1	2	40	S	8	190	15	95	144	T8	Recessed	4'T8	E	S	1	2	32	8	190	6	70	106	38	0	38
41	1	Women's Locker Room A129	Recessed	M	4'T12	5	2	40	S	8	190	15	475	722	T8	Recessed	4'T8	E	OS	5	2	32	6	190	6	350	399	323	133	323
42	1	Storage Room A130	Parabolic	M	4'T12	2	4	40	S	2	190	24	368	140	T8	Parabolic	4'T8	E	S	2	4	32	2	190	13	282	107	33	0	33
43	1	Storage Room A134	Parabolic	M	4'T12	6	4	40	S	2	190	24	1,104	420	T8	Parabolic	4'T8	E	S	6	4	32	2	190	13	846	321	98	0	98
44	1	Mechanical Room A133	Parabolic	M	4'T12	5	4	40	S	2	190	24	920	350	T8	Parabolic	4'T8	E	S	5	4	32	2	190	13	705	268	82	0	82
45	1	Office A132	Recessed	M	4'T12	2	4	40	S	8	190	24	368	559	T8	Recessed	4'T8	E	S	2	4	32	8	190	13	282	429	131	0	131
46	1	Bathroom Men A131	Recessed	M	4'T12	1	2	40	S	8	190	15	95	144	T8	Recessed	4'T8	E	S	1	2	32	8	190	6	70	106	38	0	38
47	1	Storage Room A134	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
48	1	Vestibule A101	Recessed	N	CFL	10	2	18	S	12	190	0	360	821	N/A	Recessed	CFL	N	S	10	2	18	12	190	0	360	821	0	0	0
49	1	Vestibule A101	Exit Sign	N	LED	2	1	5	N	24	365	1	12	105	N/A	Exit Sign	LED	N	N	2	1	5	24	365	1	12	105	0	0	0
50	1	Hallway	Recessed	N	CFL	8	2	18	S	12	190	0	288	657	N/A	Recessed	CFL	N	S	8	2	18	12	190	0	288	657	0	0	0
51	1	Lobby A100	Recessed	N	CFL	30	2	18	S	12	190	0	1,080	2,462	N/A	Recessed	CFL	N	S	30	2	18	12	190	0	1080	2462	0	0	0
52	1	Hallway	Parabolic	M	4'T12	22	1	40	S	12	190	12	1,144	2,608	T8	Parabolic	4'T8	E	S	22	1	32	12	190	3	770	1756	853	0	853
53	1	Lobby A100	Parabolic	M	4'T12	30	1	40	S	12	190	12	1,560	3,557	T8	Parabolic	4'T8	E	S	30	1	32	12	190	3	1050	2394	1163	0	1163

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)
54	1	Lobby A100	Exit Sign	N	LED	4	1	5	N	24	365	1	24	210		N/A	Exit Sign	LED	N	N	4	1	5	24	365	1	24	210		0	0	0
55	1	Lobby A118	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53		N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53		0	0	0
56	1	Staircase A150	Parabolic	M	4'T12	6	1	40	S	12	190	12	312	711		T8	Parabolic	4'T8	E	S	6	1	32	12	190	3	210	479		233	0	233
57	1	Staircase A150	Screw-in	N	CFL	4	2	18	S	12	190	0	144	328		N/A	Screw-in	CFL	N	S	4	2	18	12	190	0	144	328		0	0	0
58	1	Staircase A122	Parabolic	M	4'T12	2	2	40	S	12	190	15	190	433		T8	Parabolic	4'T8	E	S	2	2	32	12	190	6	140	319		114	0	114
59	1	Hallway	Recessed	E	4'T8	6	3	32	S	12	190	10	636	1,450		N/A	Recessed	4'T8	E	S	6	3	32	12	190	10	636	1450		0	0	0
60	1	Hallway	Recessed	E	4'T8	5	4	32	S	12	190	13	705	1,607		N/A	Recessed	4'T8	E	S	5	4	32	12	190	13	705	1607		0	0	0
61	1	Hallway	Parabolic	M	4'T12	24	1	40	N	12	190	12	1,248	2,845		T8	Parabolic	4'T8	E	N	24	1	32	12	190	3	840	1915		930	0	930
62	1	Hallway	Recessed	N	CFL	25	2	18	S	12	190	0	900	2,052		N/A	Recessed	CFL	N	S	25	2	18	12	190	0	900	2052		0	0	0
63	1	Classroom B114	Parabolic	M	4'T12	12	1	40	S	8	190	12	624	948		T8	Parabolic	4'T8	E	S	12	1	32	8	190	3	420	638		310	0	310
64	1	Classroom B101	Recessed	M	4'T12	6	3	40	S	8	190	20	840	1,277		T8	Recessed	4'T8	E	S	6	3	32	8	190	10	636	967		310	0	310
65	1	Classroom B101	Recessed	M	4'T12	8	3	40	S	8	190	20	1,120	1,702		T8	Recessed	4'T8	E	S	8	3	32	8	190	10	848	1289		413	0	413
66	1	Classroom B102	Recessed	M	4'T12	6	3	40	S	8	190	20	840	1,277		T8	Recessed	4'T8	E	S	6	3	32	8	190	10	636	967		310	0	310
67	1	Classroom B102	Recessed	M	4'T12	6	4	40	S	8	190	24	1,104	1,678		T8	Recessed	4'T8	E	S	6	4	32	8	190	13	846	1286		392	0	392
68	1	Classroom B105	Recessed	M	4'T12	10	1	40	S	8	190	12	520	790		T8	Recessed	4'T8	E	S	10	1	32	8	190	3	350	532		258	0	258
69	1	Classroom B119	Recessed	M	4'T12	10	1	40	S	8	190	12	520	790		T8	Recessed	4'T8	E	S	10	1	32	8	190	3	350	532		258	0	258
70	1	Classroom B120	Recessed	M	4'T12	14	3	40	S	8	190	20	1,960	2,979		T8	Recessed	4'T8	E	S	14	3	32	8	190	10	1484	2256		724	0	724
71	1	Classroom B115	Recessed	M	4'T12	15	4	40	S	8	190	24	2,760	4,195		T8	Recessed	4'T8	E	S	15	4	32	8	190	13	2115	3215		980	0	980
72	1	Classroom B115	Exit Sign	N	LED	1	1	5	N	24	190	1	6	27		N/A	Exit Sign	LED	N	N	1	1	5	24	190	1	6	27		0	0	0
73	1	Classroom B113	Recessed	M	4'T12	9	3	40	S	8	190	20	1,260	1,915		T8	Recessed	4'T8	E	S	9	3	32	8	190	10	954	1450		465	0	465
74	1	Bathroom	Recessed	M	4'T12	1	4	40	S	8	190	24	184	280		T8	Recessed	4'T8	E	S	1	4	32	8	190	13	141	214		65	0	65
75	2	Computer Lab A202	Recessed	M	4'T12	17	4	40	S	8	190	24	3,128	4,755		T8	Recessed	4'T8	E	S	17	4	32	8	190	13	2397	3643		1111	0	1111
76	2	Office A201	Recessed	M	4'T12	2	4	40	S	8	190	24	368	559		T8	Recessed	4'T8	E	S	2	4	32	8	190	13	282	429		131	0	131
77	2	Storage Room A217	Recessed	M	4'T12	4	4	40	S	2	190	24	736	280		T8	Recessed	4'T8	E	S	4	4	32	2	190	13	564	214		65	0	65
78	1	Cafeteria A200	Parabolic	M	4'T12	8	2	40	S	12	190	15	760	1,733		T8	Parabolic	4'T8	E	S	8	2	32	12	190	6	560	1277		456	0	456
79	1	Cafeteria A200	Parabolic	M	4'T12	26	4	40	S	12	190	24	4,784	10,908		T8	Parabolic	4'T8	E	S	26	4	32	12	190	13	3666	8358		2549	0	2549
80	1	Cafeteria A200	HID	N	MH	2	1	100	S	12	190	25	250	570		PSMH	HID	PSMH	N	S	2	1	65	12	190	14	158	360		210	0	210
81	1	Staircase A200	HID	N	MH	2	1	100	S	12	190	25	250	570		PSMH	HID	PSMH	N	S	2	1	65	12	190	14	158	360		210	0	210
82	2	Classroom A206	Recessed	M	4'T12	11	4	40	S	8	190	24	2,024	3,076		T8	Recessed	4'T8	E	S	11	4	32	8	190	13	1551	2358		719	0	719
83	2	Classroom A205	Recessed	M	4'T12	11	4	40	S	8	190	24	2,024	3,076		T8	Recessed	4'T8	E	S	11	4	32	8	190	13	1551	2358		719	0	719
84	2	Classroom A204	Recessed	M	4'T12	11	4	40	S	8	190	24	2,024	3,076		T8	Recessed	4'T8	E	S	11	4	32	8	190	13	1551	2358		719	0	719
85	2	Classroom A203	Recessed	M	4'T12	11	4	40	S	8	190	24	2,024	3,076		T8	Recessed	4'T8	E	S	11	4	32	8	190	13	1551	2358		719	0	719
86	2	Janitor's Closet A214	Parabolic	M	4'T12	1	2	40	S	2	190	15	95	36		T8	Parabolic	4'T8	E	S	1	2	32	2	190	6	70	27		10	0	10
87	2	Mechanical Room A212	Parabolic	M	4'T12	5	4	40	OS	2	190	24	920	350		T8	Parabolic	4'T8	E	OS	5	4	32	2	190	13	705	268		82	0	82
88	2	Mechanical Room A213	Parabolic	M	4'T12	1	2	40	OS	2	190	15	95	36		T8	Parabolic	4'T8	E	OS	1	2	32	2	190	6	70	27		10	0	10
89	2	Bathroom Women A211	Recessed	M	4'T12	3	2	40	S	8	190	15	285	433		T8	Recessed	4'T8	E	S	3	2	32	8	190	6	210	319		114	0	114
90	2	Bathroom Men A210	Recessed	M	4'T12	3	2	40	S	8	190	15	285	433		T8	Recessed	4'T8	E	S	3	2	32	8	190	6	210	319		114	0	114
91	2	Bathroom Men A210	Recessed	N	CFL	1	2	18	S	8	190	0	36	55		N/A	Recessed	CFL	N	S	1	2	18	8	190	0	36	55		0	0	0
92	2	Bathroom Men	Recessed	N	CFL	1	2	18	S	8	190	0	36	55		N/A	Recessed	CFL	N	S	1	2	18	8	190	0	36	55		0	0	0
93	2	Electrical Room A208	Parabolic	M	4'T12	1	4	40	S	2	190	24	184	70		T8	Parabolic	4'T8	E	S	1	4	32	2	190	13	141	54		16	0	16
94	2	Electrical Room A207	Parabolic	M	4'T12	4	4	40	S	2	190	24	736	280		T8	Parabolic	4'T8	E	S	4	4	32	2	190	13	564	214		65	0	65
95	2	Hallway	Recessed	E	4'T8	6	3	32	S	12	190	10	636	1,450		N/A	Recessed	4'T8	E	S	6	3	32	12	190	10	636	1450		0	0	0
96	2	Hallway	Recessed	E	4'T8	5	4	32	S	12	190	13	705	1,607		N/A	Recessed	4'T8	E	S	5	4	32	12	190	13	705	1607		0	0	0
97	2	Hallway	Parabolic	M	4'T12	24	1	40	S	12	190	12	1,248	2,845		T8	Parabolic	4'T8	E	S	24	1	32	12	190	3	840	1915		930	0	930
98	2	Hallway	Recessed	N	CFL	25	2	18	S	12	190	0	900	2,052		N/A	Recessed	CFL	N	S	25	2	18	12	190	0	900	2052		0	0	0
99	2	Classroom B212	Recessed	M	4'T12	12	1	40	S	8	190	12	624	948		T8	Recessed	4'T8	E	S	12	1	32	8	190	3	420	638		310	0	310
100	2	Classroom B201	Recessed	M	4'T12	16	3	40	S	8	190	20	2,240	3,405		T8	Recessed	4'T8	E	S	16	3	32	8	190	10	1696	2578		827	0	827
101	2	Classroom B203	Recessed	M	4'T12	12	2	40	S	8	190	15	1,140	1,733		T8	Recessed	4'T8	E	S	12	2	32	8	190	6	840	1277		456	0	456
102	2	Classroom B204	Recessed	M	4'T12	12	2	40	S	8	190	15	1,140	1,733		T8	Recessed	4'T8	E	S	12	2	32	8	190	6	840	1277		456	0	456
103	2	Classroom B205	Recessed	M	4'T12	12	2	40	S	8	190	15	1,140	1,733		T8	Recessed	4'T8	E	S	12	2	32	8	190	6	840	1277		456	0	456
104	2	Classroom B206	Recessed	M	4'T12	12	2	40	S	8	190	15	1,140	1,733		T8	Recessed	4'T8	E	S	12	2	32	8	190	6	840	1277		456	0	456
105	2	Classroom B214	parabolic	M	4'T12	12	1	40	S	8	190	12	624	948		T8	Parabolic	4'T8	E	S	12	1	32	8	190	3	420	638		310	0	310
106	2	Classroom B121	Parabolic	M	4'T12	12	1	40	S	8	190	12	624	948		T8	Parabolic	4'T8	E	S	12	1	32	8	190	3	420	638		310	0	310
107	2	Classroom B217	Recessed	M	4'T12	12	2	40	S	8	190	15	1,140	1,733		T8	Recessed	4'T8	E	S	12	2	32	8	190	6	840	1277		456	0	456

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)
108	2	Classroom B213	Recessed	M	4'T12	6	2	40	S	8	190	15	570	866	T8	Recessed	4'T8	E	S	6	2	32	8	190	6	420	638	228	0	228
109	2	Bathroom Men B211	Screw-in	N	Inc	1	1	100	S	8	190	0	100	152	N/A	Screw-in	CFL	N	S	1	1	100	8	190	0	100	152	0	0	0
110	2	Guidance Office B210	Recessed	E	4'T8	3	1	32	S	8	190	3	105	160	N/A	Recessed	4'T8	E	S	3	1	32	8	190	3	105	160	0	0	0
111	2	Bathroom	Recessed	M	4'T12	2	2	40	S	8	190	15	190	289	T8	Recessed	4'T8	E	S	2	2	32	8	190	6	140	213	76	0	76
112	2	Bathroom	Recessed	M	4'T12	2	2	40	S	8	190	15	190	289	T8	Recessed	4'T8	E	S	2	2	32	8	190	6	140	213	76	0	76
113	1	Meeting Room A115	Exit Sign	N	LED	1	1	5	N	8	190	1	6	9	N/A	Exit Sign	LED	N	N	1	1	5	8	190	1	6	9	0	0	0
114	1	Staircase	Exit Sign	N	LED	1	1	5	N	12	190	1	6	14	N/A	Exit Sign	LED	N	N	1	1	5	12	190	1	6	14	0	0	0
115	1	Staircase	Recessed	N	CFL	1	2	18	S	12	190	0	36	82	N/A	Recessed	CFL	N	S	1	2	18	12	190	0	36	82	0	0	0
116	1	Classroom B118	Recessed	M	4'T12	12	3	40	S	8	190	20	1,680	2,554	T8	Recessed	4'T8	E	S	12	3	32	8	190	10	1272	1933	620	0	620
117	1	Backstage Area B110	Parabolic	M	4'T12	3	1	40	S	2	190	12	156	59	T8	Parabolic	4'T8	E	S	3	1	32	2	190	3	105	40	19	0	19
118	1	Backstage Area B110	Screw-in	N	Inc	2	1	100	S	2	190	0	200	76	N/A	Screw-in	CFL	N	S	2	1	100	2	190	0	200	76	0	0	0
119	1	Auditorium B109	Exit Sign	N	LED	6	1	5	N	2	190	1	36	14	N/A	Exit Sign	LED	N	N	6	1	5	2	190	1	36	14	0	0	0
120	1	Auditorium B109	Screw-in	N	Inc	4	2	60	S	2	190	0	480	182	N/A	Screw-in	CFL	N	S	4	2	60	2	190	0	480	182	0	0	0
121	1	Auditorium B109	Screw-in	N	Inc	6	2	60	S	2	190	0	720	274	N/A	Screw-in	CFL	N	S	6	2	60	2	190	0	720	274	0	0	0
122	1	Auditorium B109	Screw-in	N	Inc	16	2	20	S	2	190	0	640	243	N/A	Screw-in	CFL	N	S	16	2	20	2	190	0	640	243	0	0	0
123	1	Boiler Room	Parabolic	M	4'T12	8	1	40	S	2	190	12	416	158	T8	Parabolic	4'T8	E	S	8	1	32	2	190	3	280	106	52	0	52
124	1	Boiler Room	Parabolic	M	4'T12	4	1	40	S	2	190	12	208	79	T8	Parabolic	4'T8	E	S	4	1	32	2	190	3	140	53	26	0	26
125	1	Classroom B104	Recessed	M	4'T12	8	2	40	S	8	190	15	760	1,155	T8	Recessed	4'T8	E	S	8	2	32	8	190	6	560	851	304	0	304
126	1	Classroom B103	Recessed	M	4'T12	12	3	40	S	8	190	20	1,680	2,554	T8	Recessed	4'T8	E	S	12	3	32	8	190	10	1272	1933	620	0	620
127	1	Classroom B112	Recessed	M	4'T12	2	2	40	S	8	190	15	190	289	T8	Recessed	4'T8	E	S	2	2	32	8	190	6	140	213	76	0	76
128	1	Stock Room	Parabolic	E	4'T8	1	3	32	S	2	190	10	106	40	N/A	Parabolic	4'T8	E	S	1	3	32	2	190	10	106	40	0	0	0
129	1	Janitor's Closet	Screw-in	N	Inc	1	1	100	S	2	190	0	100	38	N/A	Screw-in	CFL	N	S	1	1	100	2	190	0	100	38	0	0	0
130	1	Classroom B121	Parabolic	M	4'T12	24	1	40	S	8	190	12	1,248	1,897	T8	Parabolic	4'T8	E	S	24	1	32	8	190	3	840	1277	620	0	620
131	1	Classroom B121	Exit Sign	N	LED	1	1	5	N	8	190	1	6	9	N/A	Exit Sign	LED	N	N	1	1	5	8	190	1	6	9	0	0	0
132	1	Storage Room	Parabolic	M	4'T12	2	2	40	S	2	190	15	190	72	T8	Parabolic	4'T8	E	S	2	2	32	2	190	6	140	53	19	0	19
133	2	Auditorium B222	Parabolic	M	4'T12	2	2	40	S	2	190	15	190	72	T8	Parabolic	4'T8	E	S	2	2	32	2	190	6	140	53	19	0	19
134	2	Auditorium B222	Parabolic	M	4'T12	2	1	40	S	2	190	12	104	40	T8	Parabolic	4'T8	E	S	2	1	32	2	190	3	70	27	13	0	13
135	2	Storage Room B202	Parabolic	M	4'T12	2	1	40	S	2	190	12	104	40	T8	Parabolic	4'T8	E	S	2	1	32	2	190	3	70	27	13	0	13
136	2	Classroom B207	Recessed	E	4'T8	12	3	32	S	8	190	10	1,272	1,933	N/A	Recessed	4'T8	E	S	12	3	32	8	190	10	1272	1933	0	0	0
137	2	Bathroom Men	Recessed	E	4'T8	6	3	32	S	8	190	10	636	967	C	Recessed	4'T8	E	OS	6	3	32	6	190	10	636	725	242	242	242
138	2	Classroom B208	Recessed	E	4'T8	6	3	32	S	8	190	10	636	967	N/A	Recessed	4'T8	E	S	6	3	32	8	190	10	636	967	0	0	0
139	2	Classroom B209	Recessed	E	4'T8	6	3	32	S	8	190	10	636	967	N/A	Recessed	4'T8	E	S	6	3	32	8	190	10	636	967	0	0	0
140	2	Meeting Room B211	Recessed	E	4'T8	4	3	32	S	2	190	10	424	161	N/A	Recessed	4'T8	E	S	4	3	32	2	190	10	424	161	0	0	0
141	2	Storage Room B211	Screw-in	N	CFL	1	2	18	S	2	190	0	36	14	N/A	Screw-in	CFL	N	S	1	2	18	2	190	0	36	14	0	0	0
142	2	Janitor's Closet	Screw-in	N	CFL	1	2	18	S	2	190	0	36	14	N/A	Screw-in	CFL	N	S	1	2	18	2	190	0	36	14	0	0	0
143	2	Bathroom Women	Recessed	E	4'T8	6	3	32	S	8	190	10	636	967	C	Recessed	4'T8	E	OS	6	3	32	6	190	10	636	725	242	242	242
144	2	Classroom B216	Recessed	E	4'T8	12	3	32	S	8	190	10	1,272	1,933	N/A	Recessed	4'T8	E	S	12	3	32	8	190	10	1272	1933	0	0	0
145	2	Classroom B220	Parabolic	M	4'T12	3	1	40	S	8	190	12	156	237	T8	Parabolic	4'T8	E	S	3	1	32	8	190	3	105	160	78	0	78
146	2	Classroom B217	Recessed	E	4'T8	16	3	32	S	8	190	10	1,696	2,578	N/A	Recessed	4'T8	E	S	16	3	32	8	190	10	1696	2578	0	0	0
147	2	Classroom B218	2'U-shape	E	2'T8	3	2	18	S	8	190	5	123	187	N/A	2'U-shape	2'T8	E	S	3	2	18	8	190	5	123	187	0	0	0
148	2	Classroom B218	Recessed	E	4'T8	8	3	32	S	8	190	10	848	1,289	N/A	Recessed	4'T8	E	S	8	3	32	8	190	10	848	1289	0	0	0
149	2	Bathroom	Recessed	N	CFL	2	1	18	S	8	190	0	36	55	N/A	Recessed	CFL	N	S	2	1	18	8	190	0	36	55	0	0	0
150	2	Bathroom Men	Recessed	E	4'T8	4	3	32	S	8	190	10	424	644	C	Recessed	4'T8	E	OS	4	3	32	6	190	10	424	483	161	161	161
151	2	Bathroom Women	Recessed	E	4'T8	4	3	32	S	8	190	10	424	644	C	Recessed	4'T8	E	OS	4	3	32	6	190	10	424	483	161	161	161
152	2	Classroom B219	Recessed	E	4'T8	8	3	32	S	8	190	10	848	1,289	N/A	Recessed	4'T8	E	S	8	3	32	8	190	10	848	1289	0	0	0
153	PC	Exterior	Exterior	N	HPS	7	1	250	PC	12	365	63	2,191	9,597	PSMH	Exterior	PSMH	N	PC	7	1	175	12	365	38	1491	6531	3066	0	3066
154	PC	Exterior	Exterior	N	HPS	3	2	250	PC	12	365	126	1,878	8,226	PSMH	Exterior	PSMH	N	PC	3	2	175	12	365	76	1278	5598	2628	0	2628
155	Ext	Exterior	Exterior	N	MH	9	1	100	PC	12	365	25	1,125	4,928	PSMH	Exterior	PSMH	N	PC	9	1	65	12	365	14	711	3114	1813	0	1813
156	Ext	Exterior	Exterior	N	CFL	2	2	18	PC	12	365	0	72	315	N/A	Exterior	CFL	N	PC	2	2	18	12	365	0	72	315	0	0	0
157	Ext	Exterior	Exterior	N	Hal	2	1	60	PC	12	365	15	150	657	CFL	Exterior	CFL	N	PC	2	1	20	12	365	0	40	175	482	0	482
158	Ext	Exterior	Exterior	N	Hal	6	1	250	PC	12	365	63	1,878	8,226	CFL	Exterior	CFL	N	PC	6	1	85	12	365	0	510	2234	5992	0	5992
Totals:						1,032	356					2,203	106,449	192,260						1,032	356				32,120	1,109	82,648	142,492	49,767	2,021	49,767

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

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

Third Party Gas Suppliers for NJNG Service Territory	Telephone & Web Site
Cooperative Industries	(800) 628-9427
412-420 Washington Avenue	www.cooperativenet.com
Belleville, NJ 07109	
Direct Energy Services, LLC	(866) 547-2722
120 Wood Avenue, Suite 611	www.directenergy.com
Iselin, NJ 08830	
Gateway Energy Services Corp.	(800) 805-8586
44 Whispering Pines Lane	www.gesc.com
Lakewood, NJ 08701	
UGI Energy Services, Inc.	(856) 273-9995
704 East Main Street, Suite 1	www.ugienergyservices.com
Moorestown, NJ 08057	
Hess Corporation	(800) 437-7872
1 Hess Plaza	www.hess.com
Woodbridge, NJ 07095	
Intelligent Energy	(800) 724-1880
2050 Center Avenue, Suite 500	www.intelligentenergy.org
Fort Lee, NJ 07024	
Metromedia Energy, Inc.	(877) 750-7046
6 Industrial Way	www.metromediaenergy.com
Eatontown, NJ 07724	
MxEnergy, Inc.	(800) 375-1277
510 Thornall Street, Suite 270	www.mxenergy.com
Edison, NJ 08837	
NATGASCO (Mitchell Supreme)	(800) 840-4427
532 Freeman Street	www.natgasco.com
Orange, NJ 07050	
NJ Gas & Electric	(866) 568-0290
1 Bridge Plaza, Fl. 2	www.NewJerseyGasElectric.com
Fort Lee, NJ 07024	
Pepco Energy Services, Inc.	(800) 363-7499
112 Main Street	www.pepco-services.com
Lebanon, NJ 08833	
PPL EnergyPlus, LLC	(800) 281-2000
811 Church Road	www.pplenergyplus.com
Cherry Hill, NJ 08002	
South Jersey Energy Company	(800) 756-3749
One South Jersey Plaza, Route 54	www.southjerseyenergy.com
Folsom, NJ 08037	
Sprague Energy Corp.	(800) 225-1560
12 Ridge Road	www.spragueenergy.com
Chatham Township, NJ 07928	
Woodruff Energy	(800) 557-1121
73 Water Street	www.woodruffenergy.com
Bridgeton, NJ 08302	

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

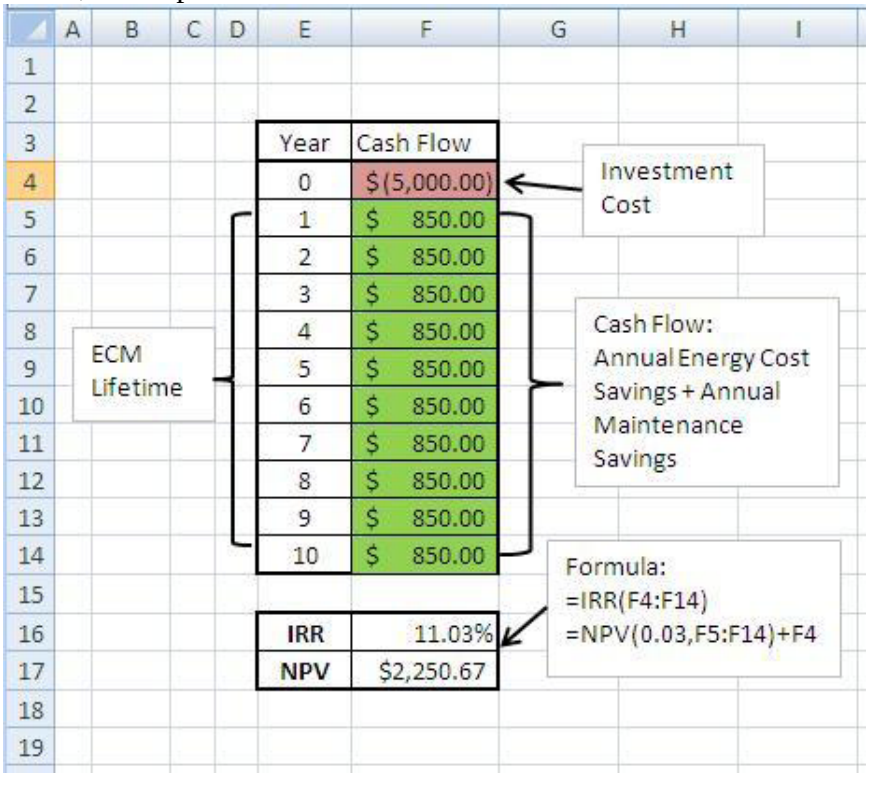
Net ECM Cost = Total ECM Cost – Incentive
LECS = AECS X ECM Lifetime
AOCS = LOCS / ECM Lifetime

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.

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 Gas Furnace — New or Replacement	20
Small Commercial Gas Boiler — New or Replacement	20
Small Commercial Gas DHW — New or Replacement	10
C&I Gas Absorption Chiller — New or Replacement	25
C&I Gas Custom — New or Replacement (Engine Driven Chiller)	25
C&I Gas Custom — New or Replacement (Gas Efficiency Measures)	18
O&M savings	3
Compressed Air (GWh participant)	8