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Local Government Energy Program
Energy Audit Final Report

Hardyston Township Board of Education

Hardyston Township Elementary School
50 Route 23
Franklin, NJ 07416

Project Number: LGEA82

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EXECUTIVE SUMMARY

The Hardyston Township Elementary School is a single-story building with no basement comprising a total conditioned floor area of 65,150 square feet. The original structure was built in 1958, and there have been major renovations or additions occurring in 1962, 1964, 1970, 1978, and 1994. The following chart provides a comparison of the current building energy usage based on the period from October 2009 through September 2010 with the proposed energy usage resulting from the installation of recommended Energy Conservation Measures (ECMs) excluding any renewable energy:

Table 1: State of Building—Energy Usage

	Electric Usage (kWh/yr)	Gas Usage (therms/yr)	Current Annual Cost of Energy ($)	Site Energy Use Intensity (kBtu/sq ft /yr)	Source Energy Use Intensity (kBtu/sq ft /yr)	Joint Energy Consumption (MMBtu/yr)
Current	255,532	54,561	$110,850	97.1	8,624,811	6,328
Proposed	224,484	49,446	$95,754	87.7	7,735,433	5,711
Savings	31,048	5,115	$15,097*	9.5	889,378	617
% Savings	12.2%	9.4%	13.6%	9.8%	10.3%	9.8%
Proposed Renewable Energy	35,400	0	$27,136	1.9	1.9	121
*Includes operation and maintenance savings; **Includes SRECS						

There may be energy procurement opportunities for the Hardyston Township Elementary School to reduce annual electricity utility costs, which are $5,960 higher, when compared to the average estimated NJ commercial utility rates.

SWA has also entered energy information about the Hardyston Township Elementary School in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager Energy benchmarking system. This facility is categorized as a K-12 School space type. The Hardyston Township Elementary School has a national energy performance rating of 50. The Site Energy Use Intensity is 97 kBtu/sqft/yr compared to the national average of a K-12 School building consuming 97 kBtu/sqft/yr.

Based on the current state of the building and its energy use, SWA recommends implementing various energy conservation measures from the savings detailed in Table 1. The measures are categorized by payback period in Table 2 below:

Table 2: Energy Conservation Measure Recommendations

ECMs	First Year Savings ($)	Simple Payback Period	Initial Investment ($)	CO2 Savings (lbs/yr)
0-5 Year	$4,712	1.7	$8,084	32,457
5-10 Year	$7,059	5.6	$39,515	51,369
>10 year	$3,325	15.2	$50,468	28,146
Total	$15,097	6.5	$98,067	111,972
Proposed Renewable Energy	$27,136	6.9	$187,500	63,384

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 9 cars from the roads each year or avoiding the need of 273 trees to absorb the annual CO_2 generated.

Further Recommendations: Other recommendations to increase building efficiency pertaining to capital improvements and operations and maintenance are (with additional information in the Proposed Further Recommendations section):

- Capital Investment opportunities – measures that would contribute to reducing energy usage but require significant capital resources as well as long-term financial planning
    - Install premium motors when replacements are required
    - Insect nesting should be removed to avoid damage of exterior wall surfaces
    - Replace broken/deteriorated bricks and re-point cracked mortar joints.

- Repair/ patch roof leakage area on Annex.
- Add insulation to ineffectively and under-insulated Wing D ceiling.
- Replace all original, single-glazed windows and frames with historically and architecturally accurate low-E, double glazed type
- Replace 12 Trane Unit Ventilators in Wing D
- Slope roof surface to drain effectively at time of reroofing
- Replace all original, single-glazed windows and frames
- Repair ceiling in Boiler Room and ensure the space is fire rated.

- Operation and Maintenance (O&M) measures that would contribute to reducing energy usage at low cost – not cost
    - Repair/patch ceiling insulation which is sagging or uneven in from Wings B and C.
    - Repair white roof finish damaged due to slip guards
    - Install/replace and maintain weather-stripping around all exterior doors and roof hatches

The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for the Hardyston Township Elementary School. Based on the requirements of the LGEA program, the Hardyston Township Elementary School must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The Hardyston Township Elementary School should spend a minimum of $3,202.50 (or 25% of $12,810) worth of ECMs, net of other NJCEP incentives, to fulfill the obligations.

Financial Incentives and Other Program Opportunities

The table below summarizes the recommended next steps that the Hardyston Township can take to achieve greater energy efficiency and reduce operating expenses.

Recommended ECMs	Incentive Program (Appendix F for details)
Install (29) Occupancy Sensors	Smart Start, Direct Install
Install (17) New CFL fixtures	Direct Install
Replace 3 Packaged AC Units with High Efficiency	Smart Start, Direct Install
Replace Gym & All-Purpose Rm AHUs	Smart Start, Direct Install
Install Shell & Tube Heat Exchanger	NA
Install Programmable Thermostats	Direct Install
Install 30.0 kW PV System	Renewable Energy Incentive Program

There are various incentive programs that the Hardyston Township could apply to lower the installed ECM costs. SWA recommends the following programs, contingent upon available funding:

- **Direct Install 2011 Program**: Commercial buildings can receive up to 60% of installed cost of energy saving upgrades.
- **Smart Start**: Most of energy savings equipment and design measures have moderate incentives under this program.
- **Renewable Energy Incentive Program**: Receive up to $0.80/Watt toward installation cost for PV panels upon available funding. For each 1,000 kWh generated by PV renewable energy, receive a credit between $475 and $600. Also, receive up to $3.20/kWh toward installation cost for a Wind System.
- **Utility Sponsored Programs**: See available programs with NJ Natural Gas http://www.njng.com/save-energy-money/special_offers.asp and JCP&L http://www.firstenergycorp.com/Residential_and_Business/Products_and_Services/index.html
- **Energy Efficiency and Conservation Block Grant Rebate Program**: Provides up to $20,000 per local government toward energy saving measures; http://njcleanenergy.com/EECBG

Please refer to Appendix F for further details.

INTRODUCTION

Launched in 2008, the Local Government Energy Audit (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 up to 100% of the cost of the audit. The Board of Public Utilities (BPUs) Office of Clean Energy has assigned TRC Energy Services to administer the Program.

Steven Winter Associates, Inc. (SWA) is a 38-year-old architectural/engineering research and consulting firm, with specialized expertise in green technologies and procedures that improve the safety, performance, and cost effectiveness of buildings. SWA has a long-standing commitment to creating energy-efficient, cost-saving and resource-conserving buildings. As consultants on the built environment, SWA works closely with architects, developers, builders, and local, state, and federal agencies to develop and apply sustainable, 'whole building' strategies in a wide variety of building types: commercial, residential, educational and institutional.

SWA performed an energy audit and assessment for the Hardyston Township Elementary School at 50 Route 23, Franklin, NJ 07416. The process of the audit included facility visits on October 27, 2010 and November 2, 2010, benchmarking and energy bills analysis, assessment of existing conditions, energy modeling, energy conservation measures and other recommendations for improvements. The scope of work includes providing a summary of current building conditions, current operating costs, potential savings, and investment costs to achieve these savings. The facility description includes energy usage, occupancy profiles and current building systems along with a detailed inventory of building energy systems, recommendations for improvement and recommendations for energy purchasing and procurement strategies.

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

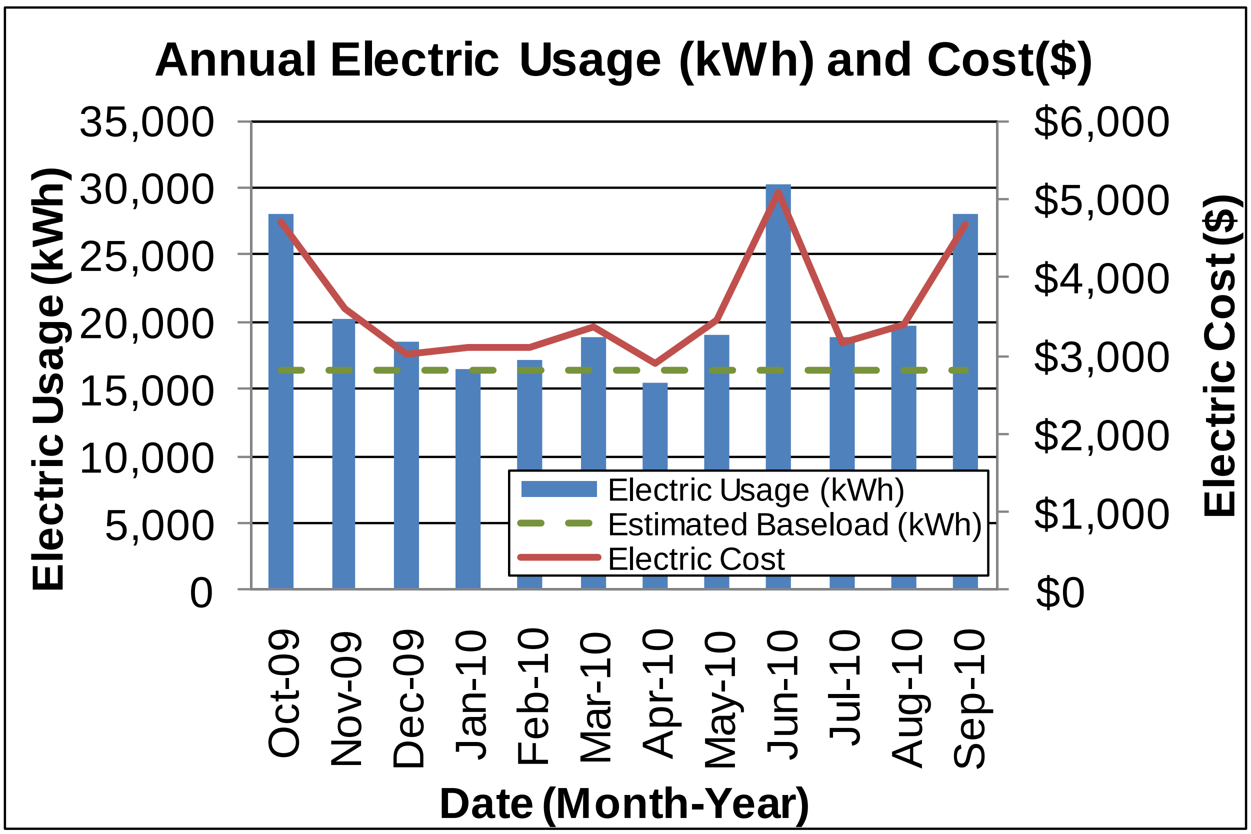
HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

SWA reviewed utility bills from November 2008 through September 2010 that were received from the Hardyston Township Board of Education. A 12 month period of analysis from October 2009 through September 2010 was used for all calculations and for purposes of benchmarking the building.

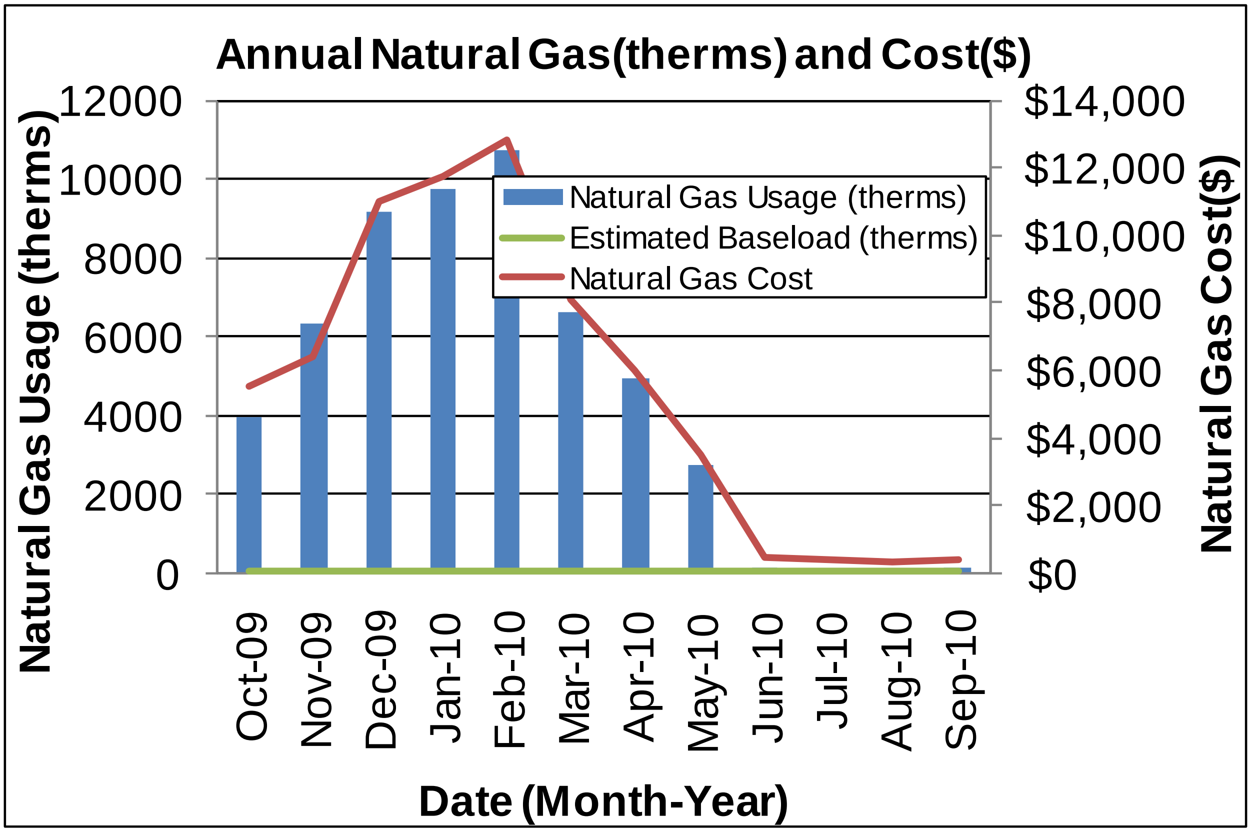
Electricity - The Hardyston Township Elementary School is currently served by two electric meters, one being in the Annex. The Hardyston Township Elementary School currently buys electricity supplied by South Jersey Energy and delivered by JCP&L, at **an average aggregated rate of $0.173/kWh** and consumed **approximately 255,532 kWh, or $44,289 worth of electricity,** in the previous year. The average monthly demand was 105.0 kW and the annual peak demand was 121.95 kW.

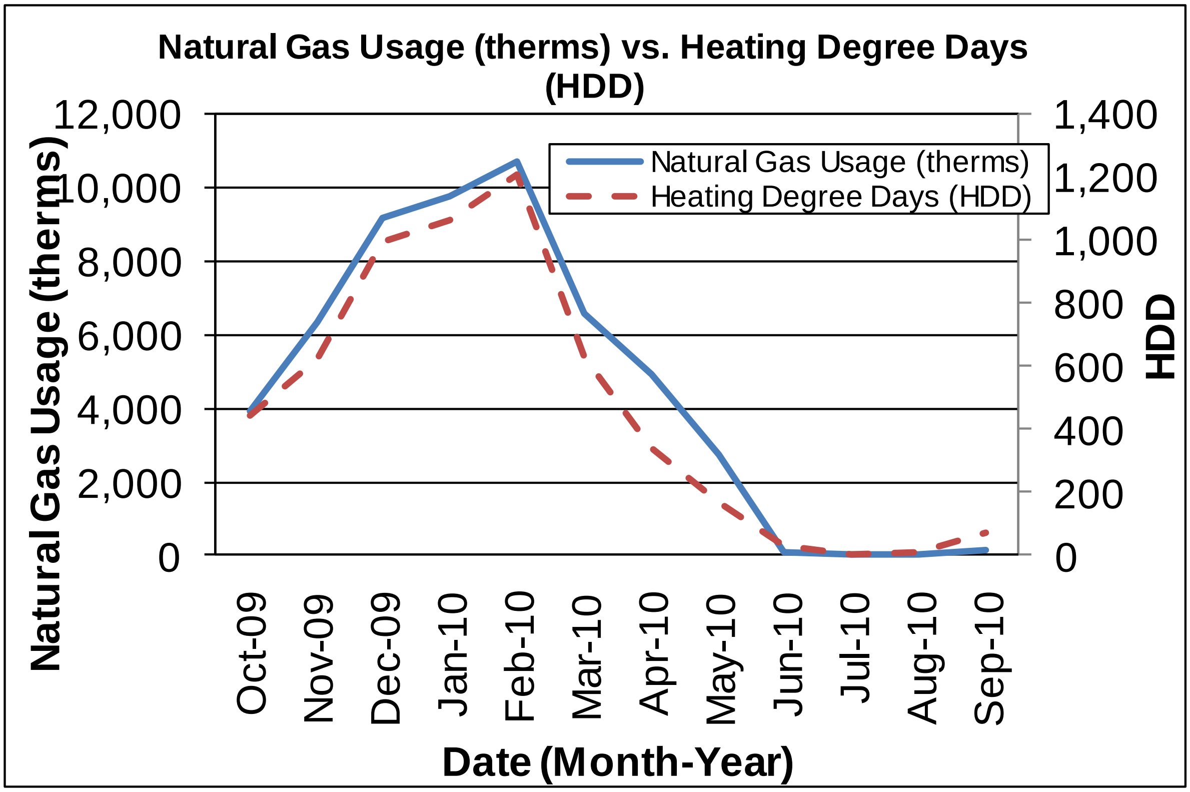
The chart below shows the monthly electric usage and costs. The dashed green line represents the approximate baseload or minimum electric usage required to operate the Hardyston Township Elementary School.



Natural gas - The Hardyston Township Elementary School is currently served by two meters for natural gas, one being in the Annex. The Hardyston Township Elementary School currently buys natural gas from Elizabethtown Gas Co. at **an average aggregated rate of $1.220/therm** and consumed **approximately 54,561, or $66,561 worth of natural gas,** in the previous year.

The chart below shows the monthly natural gas usage and costs. The green line represents the approximate baseload or minimum natural gas usage required to operate the Hardyston Township Elementary School.

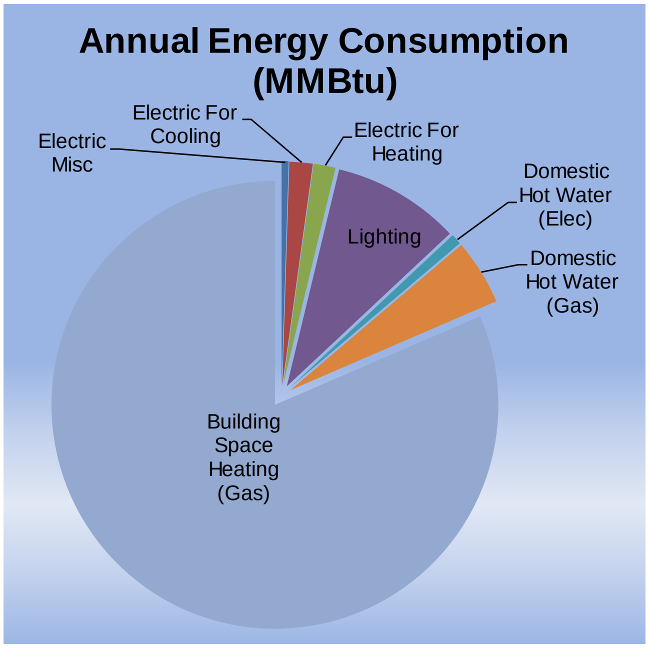


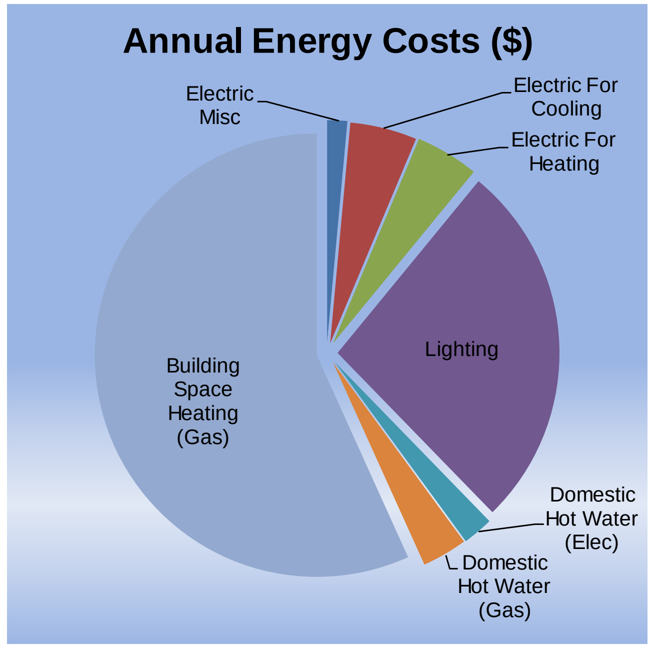


The chart above shows the monthly natural gas usage along with the heating degree days or HDD. Heating degree days is the difference of the average daily temperature and a base temperature, on a particular day. The heating degree days are zero for the days when the average temperature exceeds the base temperature. SWA's analysis used a base temperature of 65 degrees Fahrenheit.

The following graphs, pie charts, and table show energy use for the Hardyston Elementary School based on utility bills for the 12 month period. Note: electrical cost at $51/MMBtu of energy is over 4 times as expensive as natural gas at $12/MMBtu.

Annual Energy Consumption / Costs					
	MMBtu	**% MMBtu**	**$**	**% $**	**$/MMBtu**
Electric Misc	32	1%	$1,616	1%	51
Electric For Cooling	106	2%	$5,397	5%	51
Electric For Heating	100	2%	$5,103	5%	51
Lighting	585	9%	$29,710	27%	51
Domestic Hot Water (Elec)	49	1%	$2,464	2%	51
Domestic Hot Water (Gas)	299	5%	$3,651	3%	12
Building Space Heating (Gas)	5,157	81%	$62,910	57%	12
Totals	6,328	100%	$110,850	100%	
Total Electric Usage	872	14%	$44,289	40%	51
Total Gas Usage	5,456	86%	$66,561	60%	12
Totals	6,328	100%	$110,850	100%	

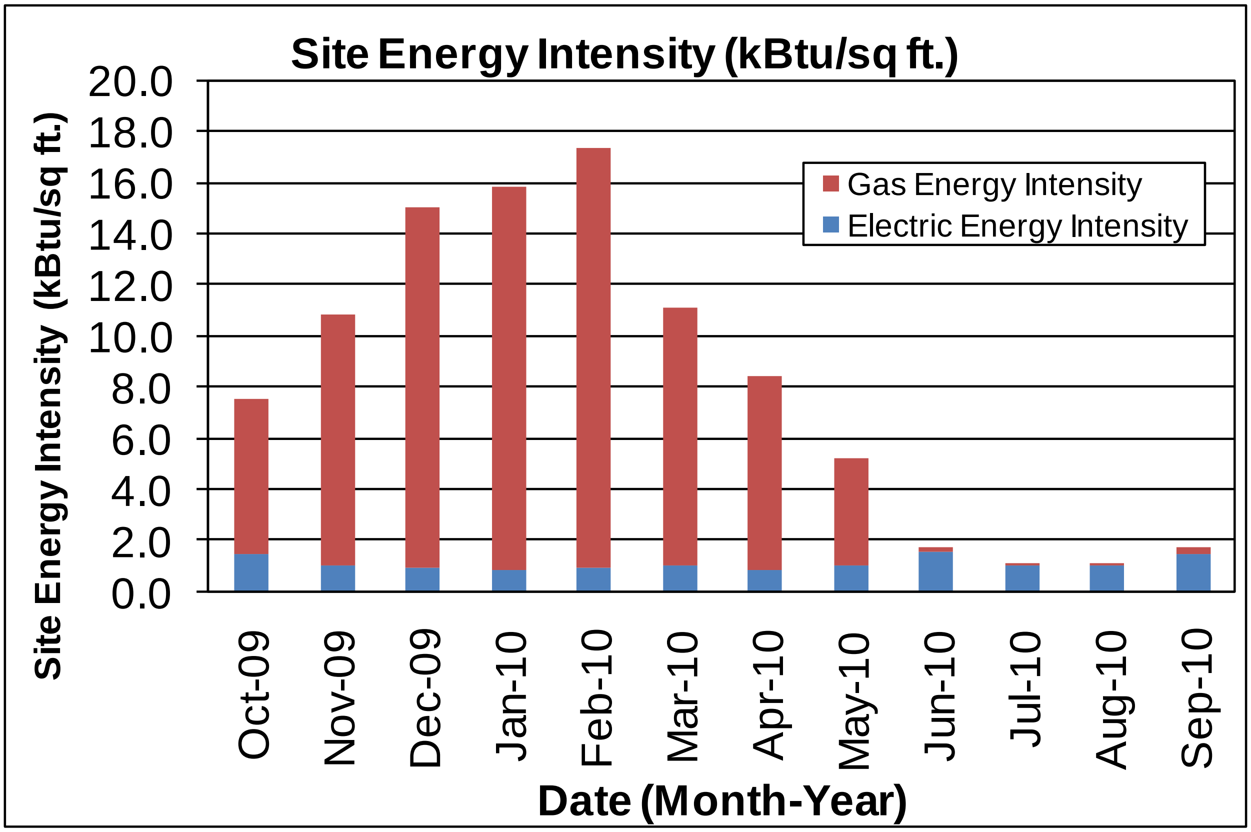




Energy benchmarking

SWA has entered energy information about the Hardyston Township Elementary School in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Portfolio Manager energy benchmarking system. This facility is categorized as a K-12 School space type. The Hardyston Township Elementary School has a national energy performance rating of 50. The Site Energy Use Intensity is 97 kBtu/sqft/yr compared to the national average of a K-12 School building consuming 97 kBtu/sqft/yr. See ECM section for guidance on how to improve the building's rating.

Due to the nature of its calculation based upon a survey of existing buildings of varying usage, the national average for K-12 School space types is very subjective, and is not an absolute bellwether for gauging performance. Additionally, should the Hardyston Township desire to reach this average there are other large scale and financially less advantageous improvements that can be made, such as envelope window, door and insulation upgrades that would help the building reach this goal.



Per the LGEA program requirements, SWA has assisted the Hardyston Township Board of Education to create an ENERGY STAR® Portfolio Manager account and share the Hardyston Township Elementary School facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager Account information with the Hardyston Township (user name of “hardystontwpboe” with a password of “hardystontwpboe”) and TRC Energy Services (user name of “TRC-LGEA”).

Tariff analysis

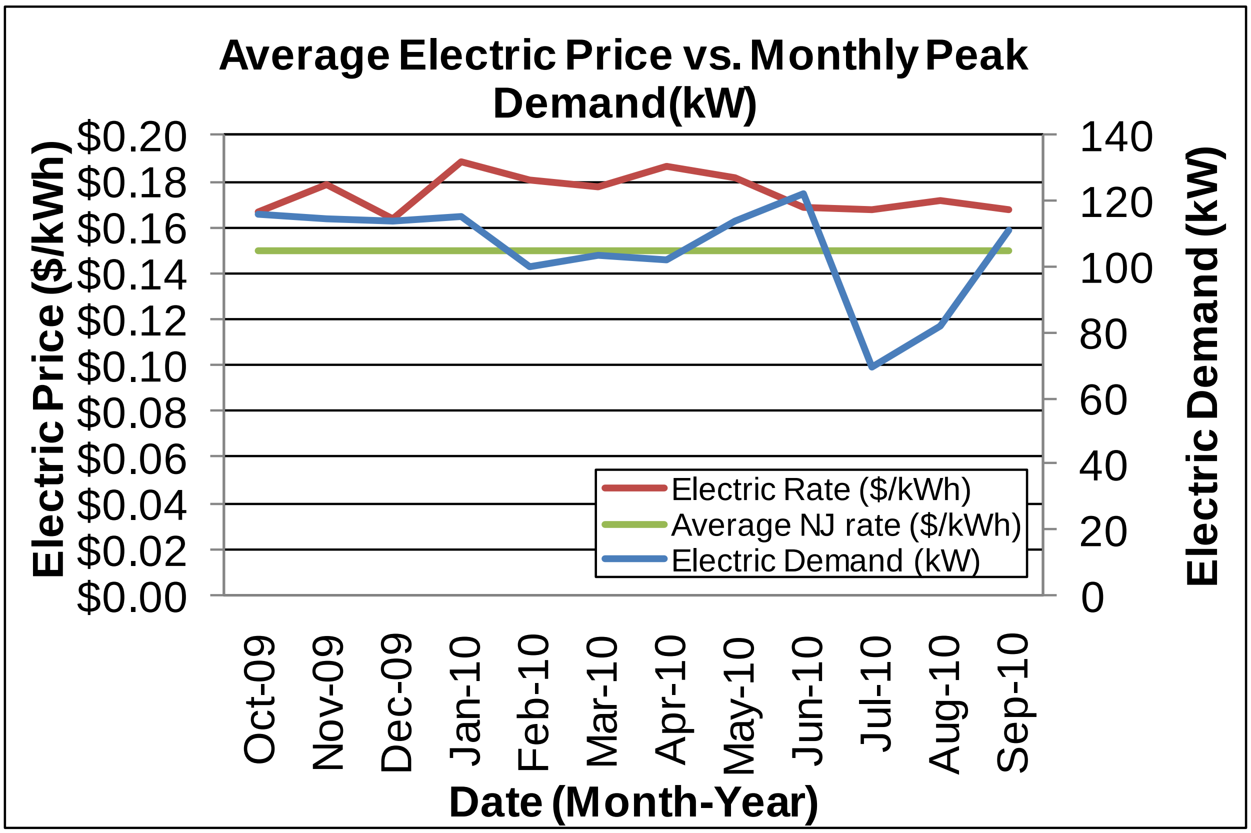
Tariff analysis can help determine if the Hardyston Township is paying the lowest rate possible for electric and gas service. Tariffs are typically assigned to buildings based on size and building type. Rate fluctuations are expected during periods of peak usage. Natural gas prices often increase during winter months since large volumes of natural gas is needed for heating equipment. Similarly, electricity prices often increase during the summer months when additional electricity is needed for cooling equipment.

As part of the utility bill analysis, SWA evaluated the current utility rates and tariffs for the Hardyston Township Elementary School. The Hardyston Township Elementary School is currently paying a general service rate for natural gas including fixed costs such as meter reading charges. The electric use for the building is direct-metered and purchased at a general service rate with an additional charge for electrical demand factored into each monthly bill. The general service rate is a market-rate based on electric usage and electric demand. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year.

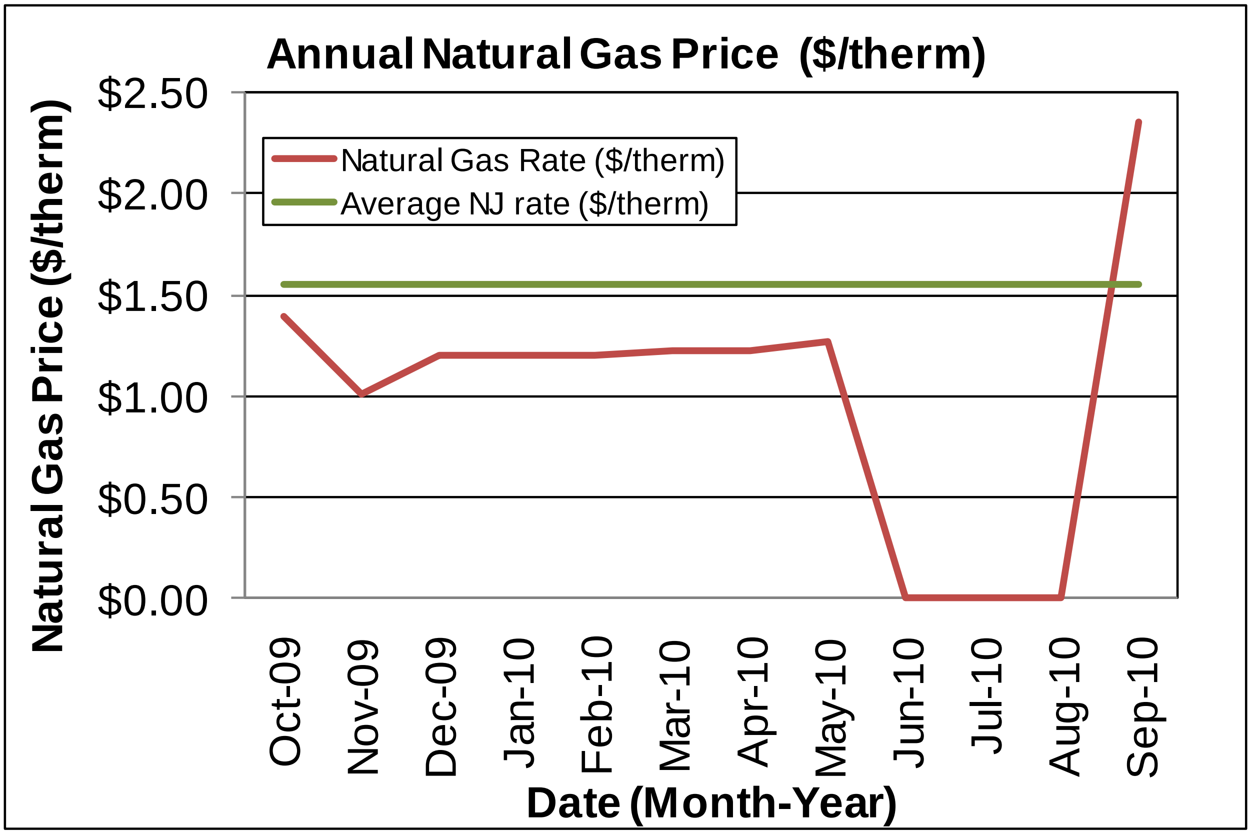
Energy Procurement strategies

Billing analysis was conducted using an average aggregated rate which is estimated based on the total cost divided by the total energy usage for each utility over a 12 month period. Average aggregated rates do not separate demand charges from usage, and instead provide a metric of inclusive cost per unit of energy. Average aggregated rates are used in order to equitably compare building utility rates to average utility rates throughout the state of New Jersey.

The average estimated NJ commercial utility rates for electric are $0.150/kWh, while Hardyston Township Elementary School pays a rate of $0.173/kWh. The Hardyston Township Elementary School annual electric utility costs are $5,960 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 14% over the most recent 12 month period.



The average estimated NJ commercial utility rates for gas are $1.550/therm, while Hardyston Township Elementary School pays a rate of $1.220/therm. Natural gas bill analysis shows fluctuations up to 90% over the most recent 12 month period.



Utility rate fluctuations may have been caused by adjustments between estimated and actual meter readings; others may be due to unusual high and recent escalating energy costs. The unusual trend in the graph above is due to base gas charges in the summer months. For visual purposes, the data points were set to zero.

SWA recommends that the Hardyston Township Elementary School further explore opportunities of purchasing both natural gas and electricity from third-party suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Hardyston Township Elementary School. Appendix C contains a complete list of third-party energy suppliers for the Hardyston Township service area.

EXISTING FACILITY AND SYSTEMS DESCRIPTION

This section gives an overview of the current state of the facility and systems. Please refer to the Proposed Further Recommendations section for recommendations for improvement.

Based on visits from SWA on Tuesday, November 02, 2010, the following data was collected and analyzed.

Building Characteristics

The single-story (slab on grade), 65,150 square feet Hardyston Township Elementary School was originally constructed in 1958 with additions/alterations completed in 1962, 1964, 1970, 1991, 1994, 1992 and 2002. It houses private offices, administration offices, classrooms, gymnasium, teachers lounge, mechanical rooms, cafeteria/all-purpose room, media center and kitchen.


Front Façade


Partial Right Side Façade Courtyard


Partial Left Side Façade


Right Side Façade and Connection to Annex

Building Occupancy Profiles

The building is primarily occupied weekdays during the school year by approximately 35 teachers, 17 staff and 485 students from 8:00 am to 4:00 pm and between 5 and 10 staff from 4:00 pm to 11:00 pm. During July the Annex classrooms and speech room operate from 8:00 am to 2:00 pm. Weekdays during school year, other than Wednesday, the annex classrooms are used in evenings.

Building Envelope

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/outside and no/low wind), no exterior envelope infrared (IR) images were taken during the field audit.

General Note: All findings and recommendations on the exterior envelope (base, walls, roofs, doors and windows) are based on the energy auditors' experience and expertise, on construction document reviews (if available) and on detailed visual analysis, as far as accessibility and weather conditions allowed at the time of the field audit.

Exterior Walls

The exterior wall envelope is mostly constructed of brick veneer, over concrete block with no visible insulation. The Annex is constructed of brick veneer over concrete block with 2 inches of assumed insulation. The interior is mostly painted CMU (Concrete Masonry Unit) and painted gypsum wallboard.

Note: Wall insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall acceptable, age-appropriate condition with numerous signs of uncontrolled moisture, air-leakage and other energy-compromising issues detected on all facades.

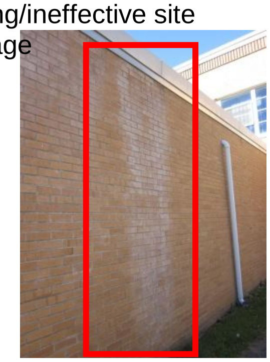
The following specific exterior wall problem spots and areas were identified:

Cracked/aged caulk

Signs of water damage at perimeter walls due to missing/ineffective site drainage

Insect nesting in exterior wall cracks and cavities

Signs of uncontrolled roof water runoff on walls due to missing/defective roof flashing



Efflorescence on brick and masonry walls indicate moisture presence within the wall cavity.

Insect nesting in exterior wall cracks and cavities

Un-caulked/un-sealed exterior wall penetrations

Deteriorating exterior wall finishes

Insect nesting in exterior wall cracks and cavities

Cracked/deteriorated bricks and mortar joints

Cracked/deteriorated mortar joints

Roof

There are three main types of roofs. The main roof is predominantly a flat, no parapet type over steel decking, with a dark-colored EPDM single membrane finish. It was replaced approximately 8 years ago. For most of the building four to eight inches of fiberglass batt ceiling insulation were found and there was no detectable roof insulation. Each hallway had ceiling insulation except the ceiling of D Wing.

Other parts of the building are also covered by a flat, no parapet type roof over steel decking with a dark colored EPDM single membrane finish. Four to eight inches of ceiling insulation was found and there was no detectable roof insulation. This roof was replaced approximately 20 years ago.

The Annex building was installed in 1994 and the roof is original, flat type over steel decking with a dark-colored EPDM single membrane finish with an assumed 4 inches of ceiling insulation. There was a leak reported in the roof, into Classroom 35.

There is one small pitched roof section covering the walk-in refrigerator/freezer with asphalt shingles and no detectable insulation.

Note: Roof insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction. Ceiling insulation levels were visually confirmed in Wings B, C and D.
Roofs, related flashing, gutters and downspouts were inspected during the field audit. They were reported to be in overall acceptable, age-appropriate condition, with some signs of uncontrolled moisture, air-leakage and other energy-compromising issues mostly detected on flat roof areas.

The following specific roof problem spots were identified:


Signs of standing water/pooling


Delaminating roof membrane/patches due to slip guard tearing


Leak in Room 35 from roof


Missing ceiling insulation in D Wing


Damaged exterior trim


Sagging roof soffit


Clogged gutters


Sagging attic insulation found

Base

The building's base is composed of a slab-on-grade floor with a perimeter foundation and no detectable slab edge/perimeter insulation.

Slab/perimeter insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.

The building's base and its perimeter were inspected for signs of uncontrolled moisture or water presence and other energy-compromising issues. Overall the base was reported to be in good condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

Windows

The building contains several different types of windows:

1. Double-hung type windows with an insulated aluminum frame, clear double glazing and interior roller blinds. The windows are located in Wings A and B and were replaced approximately 10 years ago.
2. Fixed type windows with an insulated aluminum frame, tinted double glazing and no interior or exterior shading devices. The windows are located in the front entrance and were replaced approximately 10 years ago.
3. Fixed type windows with a non-insulated aluminum frame, clear single glazing and interior drapes. The windows are located in the second story level of the gymnasium and are original.
4. Double-hung type windows with a non-insulated aluminum frame, clear single glazing and interior roller blinds. The windows are located in Wing D and are original.
5. Slider type windows with an insulated aluminum frame; clear double glazing and interior mini blinds. The windows are located in the Annex and are original.

Windows, shading devices, sills, related flashing and caulking were inspected as far as accessibility allowed for signs of moisture, air-leakage and other energy compromising issues. Overall, the windows were found to be in acceptable condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific window problem spots were identified:

Single-glazed window with ineffective frame

Single-glazed window with ineffective frame

Cracked or aged caulk around frame/sill on the exterior

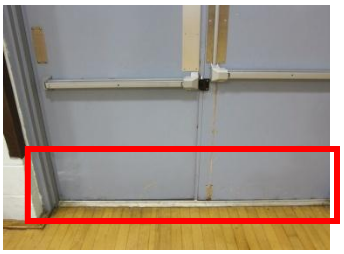
Exterior doors

The building contains several different types of exterior doors:

1. Glass with aluminum/steel frame type exterior doors. They are located in the front of the building and Wing A and were replaced approximately 10 years ago.
2. Fiberglass with aluminum frame type exterior doors. They are located in the rear of the building and were replaced approximately 10 years ago.
3. Aluminum type exterior doors. They are located in the rear of the building and are original.
4. Glass with aluminum/steel frame type exterior doors. They are located in the Annex and are original.

All exterior doors, thresholds, related flashing, caulking and weather-stripping were inspected for signs of moisture, air-leakage and other energy-compromising issues. Overall, the doors were found to be in acceptable condition with some signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific door problem spots were identified:



Missing/worn weather-stripping

Missing/worn weather-stripping

Missing/worn weather-stripping

Building air-tightness

Overall the field auditors found the building to be reasonably air-tight with several areas of suggested improvements, as described in more detail earlier in this chapter.

The air tightness of buildings helps maximize all other implemented energy measures and investments, and minimizes potentially costly long-term maintenance, repair and replacement expenses.

Mechanical Systems

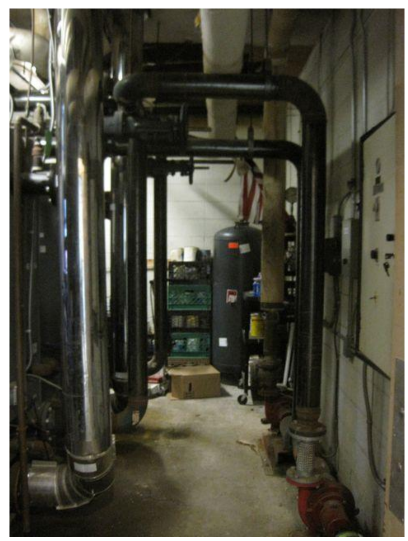
Heating Ventilation Air Conditioning

The Hardyston Township Elementary School has heating and ventilation for all occupied spaces and cooling for a few offices. During the field visit there was no major comfort issues reported although the heating system is nearly all controlled manually and therefore temperatures vary significantly throughout the building.

Equipment

Most of the Elementary School is heated only, except for some offices that also have cooling. The Annex has both heating and cooling and independent equipment. In 1998, a Cogeneration Unit was added to provide partial electric generation and supplement the hot water system. A comprehensive Equipment List can be found in Appendix A.

The Hardyston Township Elementary School main heat source is two Aerco condensing boilers sized for 200 MBTU each with up to 94% thermal efficiency. The boilers provide hot water for heating all parts of the building except the Annex. The boilers were installed in 2000 and appear in good operating condition.



Aerco 200 MBTU Condensing Boilers; Stainless Steel Flue Piping

It was observed that many of the piping elbows in the Boiler Room have asbestos insulation and many piping sections have missing insulation. The Elementary School would benefit from a complete asbestos abatement and re-insulation of all hot water piping as per Mechanical Code. Also, behind the boilers a section of ceiling is missing, exposing the wood beams and should be repaired. Mechanical rooms with combustion equipment must be in a fire-rated mechanical room as per code.

Uninsulated Hot Water Piping; Exposed Ceiling in Boiler Room

The Tecogen Generator (CoGen) is sized for 75.0 kW and 4.0 therms of hot water, with 83% electrical efficiency. Based on quarterly meter readings, the generator operated for 3,532 hours from 7/15/2009 to 7/15/2010. Assuming the average output was 70% of rated capacity after efficiency losses, the generator provided approximately 60% of the annual electric load for the building.

The generator has several pieces of supporting equipment. A water-based coolant loop draws heat from the generator to an Air Cooler on the roof.

75.0 kW CoGeneration Unit; Air-Cooler on Roof for CoGen Coolant Water

When the building is in heating mode, the water loop is diverted from the cooler to a Plate and Frame heat exchanger which transfers heat from the CoGen coolant loop to the hot water supply system. The heat exchanger and ¾ HP distribution pump were installed in 2009 and appear in good condition.

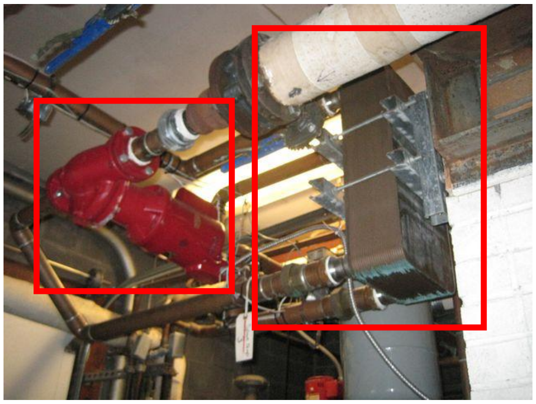
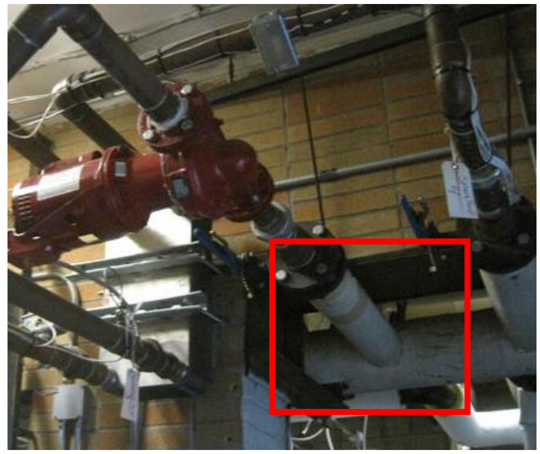



Plate and Frame Heat Exchanger & Pump; Heat Exchanger Piped to Hot Water header

The hot water system provides heat to all areas through several different types of equipment. Each classroom has through-the-wall Unit Ventilators (UV's) for heating. The majority of the classrooms have McQuay UVs which were installed during a 2002 upgrade. The classrooms in D Wing have the older Trane UVs which were installed in 1978. The UVs draw in outside air, then the hot water coils heat the air and finally several fans blow the hot air into the classrooms. The UVs have a manual dial to control fan speed and are typically set to the "low" setting.


Trane Unit Ventilator, Typical D Wing; McQuay Unit Ventilator, Typical

Outside Air intake for Unit Ventilators

The All Purpose Room and Gymnasium each have two ceiling mounted Air Handling Units (AHUs) providing heat. They are Nesbitt units with hot water coils and motorized Outside Air and Return Air dampers. The All Purpose Room AHU's are over 50 years old and the Gymnasium units are 40 years old, both well beyond their useful life. Motors, belts and filters have been replaced throughout the life of the equipment as needed.

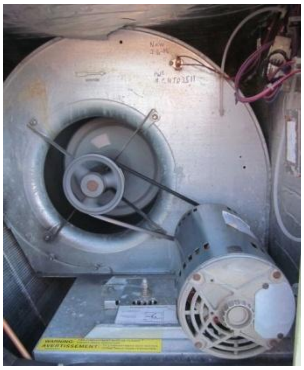
The building also has supplemental hot water heating through hot water Radiators, Fan Coil Units, Unit Heaters and Cabinet Unit Heaters. The Media Center has perimeter hot water fin tube radiators to offset envelope heat loss. Each entrance and exit of the building has ceiling hung or wall mounted hot water cabinet unit heaters. There are also fan coil units in the locker rooms, which are primarily used for storage. The mechanical rooms have hot water unit heaters.

Cabinet Unit Heater at Building Entrance

Because of the distance between the Boiler Room and the new Annex, it was more practical to have an independent HVAC system for the Annex classrooms. Packaged rooftop units (RTU) are installed outside the building and contain a burner which provides heat to intake air through the combustion of natural gas. The RTUs also contain a direct expansion (DX) system for cooling, made up of an evaporator, condenser and refrigerant loop; the refrigerant absorbs heat from intake air at the evaporator coil and transfers the heat to the atmosphere using the condenser.

Each of the four classrooms in the Annex section of the building have a dedicated Trane Gas-Fired RTU sized for 150 MBH at 80% thermal efficiency and 4 tons cooling at 13 SEER efficiency. The RTUs have 90%- 95% remaining operating life and appear in good condition. The Annex also has electric infrared heaters in the ceiling of each entrance vestibule.

The Media Center is both cooled and heated by a Trane RTU with 10 tons cooling and 200,000 Btu/hr heating capacity and has 65% remaining useful life.

Four Gas-Fired Rooftop Units; RTU supply fan and motor

The following spaces in the Elementary school building have dedicated packaged Air Conditioning Units: Computer Lab, Copy Room, Main Office and Teaches Lounge. The original AC Unit which served the Main Office was replaced in 2004 with a new AC unit in 2004, yet the original unit remains on the roof and should be removed. The packaged AC units have a condenser section, an evaporator section and an air supply fan. R-22 refrigerant circulates between the evaporator and condenser section of the unit to cool and dehumidify a mixture of return air and outside air. The Teachers' Lounge is served by a Trane unit with 2.0 tons cooling capacity. The Copy Room and Main Office are cooled by Lennox packaged units sized for 2.5 Tons at 9.2 SEER and 5.0 Tons at 9.5 SEER respectively. The units have a range of 20% and 76% remaining useful life and appear in acceptable condition although the units are operating at a low rated efficiency; due to federal regulations, the minimum efficiency of AC units available today is 13.0 SEER.

Main Office RTU Cooling Only and Abandoned Unit; Teachers Lounge RTU Cooling Only

The various spaces of the building are provided ventilation by direct outside air intake at each Unit Ventilator. The UV's have an automatic damper which modulates the amount of air that is drawn from outside air and return air. Each classroom also has an exhaust grill which collects air in the above ceiling air plenum and from there, three rooftop exhaust fans are designed to draw the exhaust air out of the building. Based on staff reports however, many of the rooftop fans are not operating properly.

The rooftop units and packaged AC units serving the Annex, Media Center, Gymnasium, All-Purpose Room, Copy Room, Main Office and Teachers Lounge have outside air intake dampers as well as natural purge dampers.

The bathrooms have a dedicated or shared exhaust fan on the roof. The kitchen has a large exhaust fan on the roof. Most fans had missing nameplates and appeared to be in poor condition. Staff reported that several of the fans do not operate. There are also large natural ventilation grills along the roofs so that air can escape that collected in the ceiling spaces. In general, the building exhaust fans have an estimated 10% useful operating life left and appear in poor operating condition.

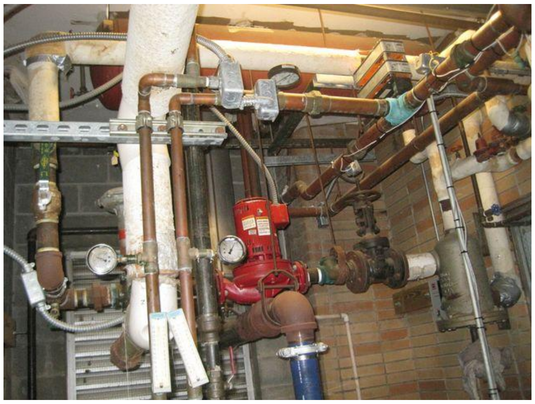
Typical Rooftop Exhaust Fans

Exhaust Dampers on Gym Roof

Distribution Systems

The Hardyston Township Elementary School does not have a ducted air supply system since most of the building is heated through individual Unit Ventilators. The Annex has dedicated RTUs for each classroom with a constant volume air supply system with manual volume dampers for air balancing.

The hot water heating system includes several pumps to serve hot water to UV's, unit heaters, heating coils and radiators throughout the building. There are three constant speed distribution pumps to supply hot water to each section of the building sized between 1.5 HP and 2.0 HP at approximately 82.5% efficiency. There are also two boiler feed pumps in the boiler room sized for 2.0 HP each and 84% efficiency. Most of the motors have been replaced within the past ten years and appear in acceptable condition.



C Wing Hot Water Distribution Pump

Controls

The vast majority of the heating and cooling equipment is controlled by local manual thermostats. Each Unit Ventilator operates to maintain a local adjustable manual thermostat as well as a manual fan speed control dial which is normally set to "low" speed. Manual thermostats must be reset for each operating condition by hand, and do not allow for evening or weekend set backs. Based on staff reports, many of the manual thermostats do not operate properly and there is limited temperature control. All motorized dampers and valves operate through pneumatic controls.

Air Compressor for Pneumatic Valves

Some equipment is controlled by programmable thermostats which are monitored through the Building Management System (BMS) by Automated Logic Corporation (ALC). The following equipment is tied to the BMS: RTU's serving Annex Classrooms 35 through 38, Gymnasium AHU's, and All Purpose Room AHU's. The BMS allows operators to set up equipment operation based on occupancy schedules and evening setbacks to minimize energy use. There is a 3˚F deadband built into the thermostats which indicates that the heating and cooling equipment will not operate when the space is within that temperature range.

Manual thermostats for Unit Ventilators, Typical; Programmable thermostat for Annex RTUs

Domestic Hot Water

The domestic hot water (DHW) for the Hardyston Township Elementary School is provided by two natural gas heaters, a Bradford White heater with 250 MBH and 50 gallons storage and a Bock heater with 237 MBH and 100 gallons storage. There are also three Bradford White electric hot water heaters in different sections of the building sized for approximately 4,500 kW each. The initial intent was to use the 250 MBH heater for the locker room showers; however, the locker rooms are now used for storage. Therefore, the existing units are grossly oversized. The natural gas units have approximately 50% remaining useful life and appear in acceptable condition.

Two Natural Gas Heaters with Storage

Electric Hot Water Heaters in Janitor Closets

Since Hardyston Township has well water, there is a domestic cold water jockey pump and storage tank which maintain 65.0 psig water pressure for the building. Since the Annex is on the far end of the building, a secondary booster pump and storage tank is installed in a janitor’s closet in B Wing to provide the Annex domestic cold water.

Main Cold Water Storage (left) and Annex Storage (right)

Electrical systems

Lighting

See attached lighting schedule in Appendix B for a complete inventory of lighting throughout the building including estimated power consumption and proposed lighting recommendations.

As of **July 1, 2010** magnetic ballasts most commonly used for the operation of T12 lamps will no longer be produced for commercial and industrial applications. Also, many T12 lamps will be phased out of production starting July 2012.

Interior Lighting - The Hardyston Township Elementary School currently contains mostly T8 light fixtures and wall sconces with self-ballast bulbs. Based on measurements of lighting levels for each space, there are no vastly over-illuminated areas.


T8 linear fluorescent fixtures seen in the hallways, classrooms and offices

Exit Lights - Exit signs were found to be Incandescent and LED types.

Incandescent exit signs were found in older parts of the building, while LED exit signs were found in the Annex

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a mix of Metal Halide lamp fixtures. Exterior lighting is controlled by photocell/timers.


Metal Halide fixtures seen throughout the exterior of the building

Appliances and process

SWA has conducted a general survey of larger, installed equipment. Appliances and other miscellaneous equipment account for a significant portion of electrical usage within the building. Typically, appliances are referred to as “plug-load” equipment, since they are not inherent to the building’s systems, but rather plug into an electrical outlet. Equipment such as process motors, computers, computer servers, radio and dispatch equipment, refrigerators, vending machines and printers all create an electrical load on the building that is hard to separate out from the rest of the building’s energy usage based on utility analysis.


Walk in Freezer Cooler (left) and Freezer Condensing unit outside (right)

Elevators

The Hardyston Township Elementary School is a single-story building and does not have an installed elevator.

Other electrical systems

There are not currently any other significant energy-impacting electrical systems installed at the Hardyston Township Elementary School other than a 75.0 kW Co Generation Unit as described in the Mechanical Systems section of the report.

RENEWABLE AND DISTRIBUTED ENERGY MEASURES

Renewable energy is defined as any power source generated from sources which are naturally replenished, such as sunlight, wind and geothermal. Technology for renewable energy is improving and the cost of installation is decreasing due to both demand and the availability of government-sponsored funding. Renewable energy reduces the need for using either electricity or fossil fuel, therefore lowering costs by reducing the amount of energy purchased from the utility company. Solar photovoltaic panels and wind turbines use natural resources to generate electricity. Geothermal systems offset the thermal loads in a building by using water stored in the ground as either a heat sink or heat source. Cogeneration or Combined Heat and Power (CHP) allows for heat recovery during electricity generation.

Existing systems

Currently there are no renewable energy systems installed in the building.

Evaluated Systems

Solar Photovoltaic

Photovoltaic panels convert light energy received from the sun into a usable form of electricity. Panels can be connected into arrays and mounted directly onto building roofs, as well as installed onto built canopies over areas such as parking lots, building roofs or other open areas. Electricity generated from photovoltaic panels is generally sold back to the utility company through a net meter. Net-metering allows the utility to record the amount of electricity generated in order to pay credits to the consumer that can offset usage and demand costs on the electric bill. In addition to generation credits, there are incentives available called Solar Renewable Energy Credits (SRECs) that are subsidized by the state government. Specifically, the New Jersey State government pays a market-rate SREC to facilities that generate electricity in an effort to meet state-wide renewable energy requirements.

Based on utility analysis and a study of roof conditions, the Hardyston Township Elementary School is a good candidate for a 30 kW Solar Panel installation. See ECM# 7 for details.

Solar Thermal Collectors

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

Wind

The Hardyston Township Elementary School is not a good candidate for wind power generation due to insufficient wind conditions in this area of New Jersey.

Geothermal

The Hardyston Township Elementary School is not a good candidate for geothermal installation since it would require replacement of the entire existing HVAC system, of which major components still have between 50% and 90% remaining useful life.

Combined Heat and Power

The Hardyston Township Elementary School has a 75.0 kW Cogeneration unit installed to supplement the building electric and hot water usage. Based on meter readings and an assumed output of 70% capacity after efficiency losses, the unit provides approximately 60% of the electrical capacity for the building.

PROPOSED ENERGY CONSERVATION MEASURES

Energy Conservation Measures (ECMs) are recommendations determined for the building based on improvements over current building conditions. ECMs have been determined for the building based on installed cost, as well as energy and cost-savings opportunities.

Recommendations: Energy Conservation Measures

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1	Upgrade (17) Incandescent to CFL
2	New T8 fixtures to be installed with incentives
3	Replace (6) incandescent Exit signs with LED type
4	Install Shell & Tube Heat Exchanger for DHW
	Description of Recommended 5-10 Year Payback ECMs
5	Upgrade thermostats to programmable
6	Upgrade (16) High Pressure Sodium fixtures to pulse start MH
7	Install 30 kW PV rooftop system
8	Install 29 occupancy sensors
	Description of Recommended >10 Year Payback ECMs
9	Replace Gym and All-Purpose Room AHUs & Implement DCV
10	Replace Three Packaged AC Units with High Efficiency

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

In order to clearly present the overall energy opportunities for the building and ease the decision of which ECM to implement, SWA calculated each ECM independently and did not incorporate slight/potential overlaps between some of the listed ECMs (i.e. lighting change influence on heating/cooling.

ECM#1: Upgrade (17) Incandescent Flood Light Fixtures to CFLs

During the field audit, SWA completed a building lighting inventory (see Appendix B). The existing lighting also contains inefficient incandescent lamps. SWA recommends that each incandescent lamp is replaced with a more efficient, Compact Fluorescent Lamp (CFL). CFLs are capable of providing equivalent or better light output while using less power when compared to incandescent, halogen and Metal Halide fixtures. CFL bulbs produce the same lumen output with less wattage than incandescent bulbs and last up to five times longer. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: $155 (includes $68 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

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
155	1,396	0	0	0.1	60	301	5	1,507	0.5	875	175	194	1,180	2,499

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 – Direct Install program (Up to 60% of installed cost)

Please see Appendix F for more information on Incentive Programs.

ECM#2: Replace (24) Metal Halide Fixtures with New T8 fixtures

During the field audit, SWA completed a building interior as well as exterior lighting inventory (see Appendix B). The existing Hardyston Township Middle School lighting consists of 24 probe start metal halide fixtures. SWA recommends replacing the interior higher wattage probe start metal halide fixtures with fluorescent lamps and electronic ballasts which offer the advantages of standard PSMH lamps, but minimize the disadvantages. They produce higher light output both initially and over time, operate more efficiently, produce whiter light, and turn on and re-strike faster. Due to these characteristics, SWA recommends replacing each PSMH fixture with an 8-lamp 4'T8 fixture. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor. (Add any ECM specifics)

Installation cost:
Net estimated installed cost: $4,243 (includes $2,280 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

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
4,243	10,301	2	0	0.5	1,258	3,040	15	45,605	1.4	975	65	72	30,555	18,444

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 – SmartStart –T8 fixtures with electronic ballasts ($10 per fixture)- Maximum incentive amount is $240.
- NJ Clean Energy – Direct Install program (Up to 60% of installed cost)

Please see Appendix F for more information on Incentive Programs.

ECM#3: Replace (6) Incandescent Exit Signs with LED Type

During the field audit, SWA completed a building lighting inventory (see Appendix B). SWA observed that the building contains a number of incandescent Exit signs. SWA recommends replacing these with LED type. Replacing existing Exit signs with LED Exit signs can result in lower kilowatt-hour consumption, as well as lower maintenance costs. Since Exit signs operate 24 hours per day, they can consume large amounts of energy. In addition, older Exit signs require frequent maintenance due to the short life span of the lamps that light them. LED Exit sign last at least 5 years. In addition, LED Exit signs offer better fire code compliance because they are maintenance free in excess of 5 years. LED Exit signs are usually brighter than comparable incandescent or fluorescent signs, and have a greater contrast with their background due to the monochromatic nature of the light that LEDs emit. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: $843 (includes $432 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

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
843	1,813	0	0	0.1	184	456	15	6,837	1.8	711	47	54	4,380	3,247

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 - SmartStart - LED Exit signs ($20 per Exit Sign) - Maximum incentive is $40.
- NJ Clean Energy – Direct Install program (Up to 60% of installed cost)

Please see Appendix F for more information on Incentive Programs.

ECM#4: Install Shell & Tube Heat Exchanger for DHW

There are currently five different domestic hot water heaters serving the domestic hot water needs of the Elementary School, two natural gas heaters, and three small electric heaters. The heater serving the Gymnasium was originally installed to provide hot water for Locker Room showers. The Locker Rooms have since been converted to storage areas, and the showers are not used. Therefore the Bradford White heater is grossly oversized at 80 gallons storage and 250,000 Btu/hr which only serves a few sinks. The heater operates to maintain 80 gallons of 120 deg F hot water at all times. The heater is installed in the Boiler Room next to the Aerco Condensing Boilers. The boilers have a combined heating capacity of 4,270,000 Btu/hr and therefore have ample spare capacity.

SWA recommends installing a Shell and Tube water-to-water Heat Exchanger to heat the 80 gallon storage tank. During the winter when the boiler is running, the heat exchanger will transfer heat from the boiler loop to the water in the storage tank. Then in the summer, when the boilers are not operating, an automatic control valve will isolate the heat exchanger and the heater will function as intended. Since the Co-Generation system has a Plate and Frame heat exchanger, there may be times when the boilers are not operating but the waste heat from the Co-Generator can be used with the proposed Heat Exchanger as well. The calculation below assumes a conservative savings of 50% of the gas usage for the Bradford White 250 MBH heater.

Installation cost:

Estimated installed cost: $2,844 (includes $950 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

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
2,844	0	0	750	1.2	0	915	13	11,894	3.1	318	24	31	6,554	8,267

Assumptions: SWA assumed a conservative 50% reduction in the domestic hot water gas usage for the heater serving the Gymnasium.

Rebates/financial incentives:

- None at this time

Please see Appendix F for more information on Incentive Programs.

ECM#5: Upgrade thermostats to programmable and Tie to BMS

During the field audit, SWA completed a building HVAC controls analysis and observed spaces in the building where temperature is manually controlled without setbacks to reduce energy consumption during unoccupied periods of time, such as evenings and weekends. Programmable thermostats offer an easy way to save energy when correctly used. By turning the thermostat setback 8 to 10 degrees F for eight hours at a stretch (at night), the heating bill can be reduced substantially (by a minimum of 10% per year). The savings from using a programmable thermostat is greater in milder climates than in more extreme climates.

SWA recommends upgrading the 45 Unit Ventilator manual thermostats to programmable thermostats. Since a Building Management System is already in place, SWA also recommends that the thermostats be tied to the BMS so that the schedules can be changed and adjusted remotely. Staff reports that several of the manual thermostats are not operating properly and therefore the upgrade can be an opportunity to have more control and better serve the students and teachers.

The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor. The financial calculations below are for converting 45 manual thermostats to a programmable type. It is assumed that there will be evening setbacks for 10 hours a day for which the setpoint adjusts from 70 deg to 62 deg in the winter.

Installation cost:

Estimated installed cost: $2,844 (includes $950 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

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
22,515	0	0	2,728	4.2	1,167	4,495	12	53,937	5.0	140	12	17	21,023	30,071

Assumptions: SWA calculated the savings for this measure based on an evening setback from 70°F to 62°F in the winter for at least 10 hours a day for the estimated heating load for the 45 unit ventilators. Additional savings can be expected by including weekend setbacks, although this was not taken into account for this calculation as a conservative measure.

Rebates/financial incentives:

- NJ Clean Energy – Direct Install program (Up to 60% of installed cost for the programmable thermostats)

Please see Appendix F for more information on Incentive Programs.

ECM#6: Upgrade (16) Metal Halide (MH) Fixtures to Pulse Start MH

During the field audit, SWA completed a building interior as well as exterior lighting inventory (see Appendix B). The existing exterior lighting contains standard probe start Metal Halide (MH) lamps. SWA recommends replacing the higher wattage MH fixtures with pulse start MH lamps which offer the advantages of standard probe start MH lamps, but minimize the disadvantages. They produce higher light output both initially and over time, operate more efficiently, produce whiter light, and turn on and re-strike faster. Due to these characteristics, energy savings can be realized via one-to-one substitution of lower-wattage systems, or by taking advantage of higher light output and reducing the number of fixtures required in the space. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: $11,200 (includes $2,400 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

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
11,200	8,410	2	0	0.4	507	1,962	15	29,423	5.7	163	11	15	11,513	15,057

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

Rebates/financial incentives:

- NJ Clean Energy - Smart Start - Pulse Start Metal Halide Fixtures ($25 per fixture) - Maximum incentive is $125.
- NJ Clean Energy – Direct Install program (Up to 60% of installed cost)

Please see Appendix F for more information on Incentive Programs.

ECM#7: Install a 30 kW Solar Photovoltaic System

Currently, the building does not use any renewable energy systems. Renewable energy systems such as photovoltaic (PV) panels can be mounted on the building roof facing south which 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, electric demand at a power station is high, due to the amount of air conditioners, lights, and other equipment being used within the region. Demand charges increase to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems offset the amount of electricity used by a building and help to reduce the building's electric demand, resulting in a higher cost savings. Installing a PV system will offset electric demand and reduce annual electric consumption, while utilizing available state incentives. PV systems are modular and readily allow for future expansions.

The size of the system was determined considering the available roof surface area, without compromising service space for roof equipment and safety, as well as the facilities' annual base load and mode of operation. A PV system could be installed on a portion of the roof with panels facing south. A commercial multi-crystalline 230 watt panel has 17.5 square feet of surface area (providing 13.1 watts per square foot). A 30 kW system needs approximately 130 panels which would take up 2,288 square feet.

A PV system would reduce the building's electric load and allow more capacity for surrounding buildings as well as serve as an example of energy efficiency for the community. The building is not eligible for a residential 30% federal tax credit. The building owner may want to 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. Typically, a major utility provides the ability to buy SREC's at $600/MWh or best market offer. However, this option is not available from the local utility. Please see below for more information.

Please note that this analysis did not consider the structural capability of the existing building to support the above recommended system. SWA recommends that the Hardyston Township Middle School contract with a structural engineer to determine if additional building structure is required to support the recommended system and what costs would be associated with incorporating the additional supports prior to system installation. Should additional costs be identified, the Hardyston Township Middle School should include these costs in the financial analysis of the project, as well as any roof covering and insulation upgrades.

Installation cost:

Estimated installed cost: $187,500 (includes $120,000 of labor)
Source of cost estimate: Similar projects

Economics (with 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
187,500	35,400	30	0	1.9	0	27,136	25	678,391	7	262	10	12	159,018	63,384

Cash flow:

Annual Solar PV Cost Savings Breakdown				
Rated Capacity (kW)	30.0			
Rated Capacity (kWh)	35,400			
Annual Capacity Loss	0%			
Year	kWh Capacity	Installed Cost	Incentives	Electric Savings ($)
0		$210,000	$22,500	
1	35,400		$21,000	$6,136
2	35,400		$21,000	$6,136
3	35,400		$21,000	$6,136
4	35,400		$21,000	$6,136
5	35,400		$21,000	$6,136
6	35,400		$21,000	$6,136
7	35,400		$21,000	$6,136
8	35,400		$21,000	$6,136
9	35,400		$21,000	$6,136
10	35,400		$21,000	$6,136
11	35,400		$21,000	$6,136
12	35,400		$21,000	$6,136
13	35,400		$21,000	$6,136
14	35,400		$21,000	$6,136
15	35,400		$21,000	$6,136
16	35,400		$0	$6,136
17	35,400		$0	$6,136
18	35,400		$0	$6,136
19	35,400		$0	$6,136
20	35,400		$0	$6,136
21	35,400		$0	$6,136
22	35,400		$0	$6,136
23	35,400		$0	$6,136
24	35,400		$0	$6,136
25	35,400		$0	$6,136
	kWh	Cost	Saving	
Lifetime Total	**885,000**	**($210,000)**	**$337,500**	**$153,391**

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

Rebates/financial incentives:

NJ Clean Energy - Renewable Energy Incentive Program, Incentive based on $0.75 / watt Solar PV application for systems 30 kW or less. Incentive amount for this application is $22,500 for the proposed option. http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program

NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1,000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. A total annual SREC credit of $21,000 has been incorporated in the above costs however it requires proof of performance, application approval and negotiations with the utility.

Options for funding ECM:

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

Please see Appendix F for more information on Incentive Programs.

ECM#8: Install (29) Occupancy Sensors

During the field audit, SWA completed a building lighting inventory (see Appendix B). SWA observed that the existing lighting has minimal to no control via occupancy sensors. SWA identified a number of areas that could benefit from the installation of occupancy sensors. SWA recommends installing occupancy sensors in areas that are occupied only part of the day and the payback on savings is justified. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion is detected within a set time period. Advance micro-phonic lighting sensors include sound detection as a means to control lighting operation. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: $5,800 (includes $1,740 of labor)
Source of cost estimate: Similar projects

Economics (with 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
5,800	3,486	0.7	0	0.2	0	603	15	9,045	9.6	56	3.7	6.1	1,255	6,241

Assumptions: SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis.

Rebates/financial incentives:

- NJ Clean Energy - SmartStart - Wall-mounted occupancy sensors ($20 per occupancy sensor) - Maximum incentive amount is $60.
- NJ Clean Energy – Direct Install program (Up to 60% of installed cost)

Please see Appendix F for more information on Incentive Programs.

ECM#9: Replace Gym and All-Purpose Room AHUs & Implement DCV

The Gymnasium and All Purpose Room are heated by two Nesbitt Air Handling Units (AHUs) which are 30 or more years old and well beyond their useful operating life. Each AHU has automated Outside Air and Return Air dampers, a hot water coil and a supply fan. The units should be replaced in kind with AHUs having high efficiency motors. In addition, the AHUs are currently controlled by a programmable thermostat and monitored through the Building Management System (BMS) which should remain. The operating cost can be further reduced by implementing Demand Control Ventilation.

Demand controlled ventilation (DCV) is the process of automatically modulating the rate of outdoor air supply (i.e., rate of ventilation) as the "demand" or need for ventilation varies. The objective is to keep ventilation rates at or above design specifications and code requirements and also to save energy by avoiding excessive ventilation rates, as energy is normally required to heat the ventilation air supplied to buildings. The need for ventilation is increased when the rate of air pollutant generation from indoor sources is high. People and their activities are among the important indoor pollutant sources and in many indoor spaces occupant density is highly variable. Thus, DCV is most often implemented in spaces with sometimes high and temporally variable occupant density, for example Gymnasiums. In the usual application of DCV, ventilation rates are automatically modulated based on measured indoor concentrations of carbon dioxide (CO2), as CO2 is emitted by people as a metabolic by product and more easily measured than other air pollutants resulting from occupancy. When the indoor occupant density is increased, the indoor concentration of CO2 increases, unless the ventilation rate also increases. Carbon dioxide is not generally considered a directly harmful air pollutant at the concentrations found indoors - rather the concentration of CO2 is considered a proxy for the concentration of a variety of other odorous or potentially harmful pollutants emitted by people or their activities. A typical DCV system is designed to modulate ventilation rates over time so that indoor carbon dioxide concentrations do not exceed a set point, or target, value. The set point CO2 concentration is typically between 800 and 1000 parts per million with outside CO2 levels typically at low concentrations of around 400 to 450 ppm.

Building codes require that a minimum amount of fresh air be provided to ensure adequate air quality. To comply, ventilation systems often operate at a fixed rate based on an assumed occupancy (e.g., 15 cfm per person multiplied by the maximum design occupancy). The result is there often is much more fresh air coming into buildings than is necessary. The outside air must be conditioned, resulting in higher energy consumption and costs than is necessary with appropriate ventilation. ANSI/ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality, sets minimum ventilation rates and other requirements for commercial and institutional buildings, besides state and local building codes.

SWA recommends replacing the four AHUs in the building, two serving the Gymnasium and two serving the All Purpose Room with high efficiency units. SWA also recommends installing CO2 sensors for Demand Control Ventilation (DCV) which can be monitored through the BMS. Savings calculations assume a 10% electric savings due to motor upgrades, and 15% electrical and thermal savings for the reduction in operating hours through DCV.

Installation cost:

Estimated installed cost: $29,080 (includes $8,724 of labor)
Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

Economics:

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
29,080	1,421	0.0	1,637	2.6	350	2,593	12	31,117	11.2	7	0.6	1.1	-3,463	20,586

Assumptions: SWA assumed that the two spaces use 20% of the buildings total heating usage and 20% of the heating electrical consumption.

Rebates/financial incentives:

- NJ Clean Energy – Direct Install program (Up to 60% of installed cost for the DCV system and motor upgrades)

Please see Appendix F for more information on Incentive Programs.

ECM#10: Replace Three Packaged AC Units with High Efficiency

During the field audit, SWA inspected old Packaged AC Units which were not Energy Star rated. SWA recommends the replacement of existing old and inefficient AC Units. There are three Packaged AC Units on the roof serving the Copy Room, Teachers Lounge and Main Office with rated efficiencies of 9.45 SEER or less. Even if the air conditioner is only 10 years old, savings may be 20%–40% of the cooling energy costs by replacing it with a newer, more efficient model. Proper sizing and installation are key elements in determining air conditioner efficiency. Too large a unit will not adequately remove humidity. Too small a unit will not be able to attain a comfortable temperature on the hottest days. Improper unit location, lack of insulation, and improper duct installation can greatly diminish efficiency.

The minimum efficiency allowed by federal regulation today is 13.0 SEER. Look for the ENERGY STAR® label for central air conditioners with SEER ratings of 13 or greater, but consider using air conditioning equipment with higher SEER ratings for greater savings. SEER 13 is 30% more efficient than the previous minimum SEER of 10. The "lifespan" of a central air conditioner is about 15 to 20 years. SWA recommends replacing the Packaged AC Units on the roof for those with 14.0 SEER. More information can be found in the “Products” section of the Energy Star website at: http://www.energystar.gov. The high installation cost can be offset by applying for the Direct Install Program.

SWA recommends replacing the three Packaged AC Units, two 3 ton Units and one 5 ton Unit, with Energy Star Rated Units with a rated efficiency of 14.0 SEER or higher.

Installation cost:

Estimated installed cost: $21,388 (includes $6,800 of labor)
Source of cost estimate: Similar projects

Economics (with 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
21,388	4,222	0.1	0	0.2	0	732	15	10,976	29.2	-49	-3.2	-7.4	-12,381	7,559

Assumptions: SWA calculated the savings for this measure based on efficiency improvement from 9 SEER to 14 SEER for 1007 peak operating hours for the three AC units.

Rebates/financial incentives:

- NJ Clean Energy - SmartStart – Packaged Terminal AC Units <5.4 tons and 14.0 SEER - $92/ton - Maximum incentive amount is $1,012.
- NJ Clean Energy – Direct Install program (Up to 60% of installed cost)

Please see Appendix F for more information on Incentive Programs.

PROPOSED FURTHER RECOMMENDATIONS

Capital Improvements

Capital Improvements are recommendations for the building that may not be cost-effective at the current time, but that could yield a significant long-term payback. These recommendations should typically be considered as part of a long-term capital improvement plan. Capital improvements should be considered if additional funds are made available, or if the installed costs can be shared with other improvements, such as major building renovations. SWA recommends the following capital improvements for the Hardyston Township Elementary School:

- Install premium motors when replacements are required - Select NEMA Premium motors when replacing motors that have reached the end of their useful operating lives. Several rooftop exhaust fans with ½ HP or less were not operating properly. All non-functioning exhaust fans should be inspected and motors should be replaced with premium efficiency types. Payback for motors of 1.0 HP or less typically have a payback in excess of 15 years; however have a low upfront cost of $500 or less per installation.

- The 12 Trane Unit Ventilators in Wing D are over 20 years old and should be replaced with high efficiency types and controlled by programmable thermostats.

- Insect nesting should be removed to avoid damage of exterior wall surfaces.

- Replace broken/deteriorated bricks and re-point cracked mortar joints.

- Slope roof surface to drain effectively at time of reroofing.

- Repair/ patch roof leakage area on Annex.

- Add insulation to ineffectively and under-insulated Wing D ceiling.

- Replace all original, single-glazed windows and frames with historically and architecturally accurate low-E, double glazed type.

- Repair ceiling in Boiler Room and ensure the space is fire rated.

Operations and Maintenance

Operations and Maintenance measures consist of low/no cost measures that are within the capability of the current building staff to handle. These measures typically require little investment, and they yield a short payback period. These measures involve equipment settings or staff operations that, when implemented, will reduce energy consumption or costs.

- Inspect and replace cracked/ineffective caulk.

- Install/repair and maintain gutters, downspouts and downspout deflectors to minimize uncontrolled roof water run-off causing exterior wall damage.

- Clean gutters and downspouts.

- Efflorescence-coated brick and masonry materials need to dry out, and possible cause of water infiltration into wall cavities should be investigated.
- Repair white roof finish damaged due to slip guards.
- Repair/patch ceiling insulation which is sagging or uneven in from Wings B and C.
- Install/replace and maintain weather-stripping around all exterior doors and roof hatches.
- Remove abandoned AC Unit on roof which formerly provided cooling for the Main Office.
- 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 repair water leaks are a low-cost way to save water and energy. Retrofitting with more efficient water-consumption fixtures/appliances will reduce energy consumption for water heating, while also decreasing water/sewer bills.
- SWA recommends that the building considers purchasing the most energy-efficient equipment, including ENERGY STAR® labeled appliances, when equipment is installed or replaced. More information can be found in the "Products" section of the ENERGY STAR® website at: http://www.energystar.gov.
- Use smart power electric strips - in conjunction with occupancy sensors to power down computer equipment when left unattended for extended periods of time.
- Create an energy educational program - that teaches how to minimize energy use. The U.S. Department of Energy offers free information for hosting energy efficiency educational programs and plans. For more information please visit: http://www1.eere.energy.gov/education/.

Note: The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for Hardyston Township. Based on the requirements of the LGEA program, Hardyston Township must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The minimum amount to be spent, net of other NJCEP incentives, is $3,202.

APPENDIX A: EQUIPMENT LIST

Inventory

Building System	Description	Model #	Fuel	Location	Space Served	Date Installed	Estimated Remaining Useful Life %
Air Compressor	Air Compressor for Pneumatic controls, 3.0 HP, 1765 RPM, 86.5% Eff	Cat# C4T-36 6, M#1089-A9389, Dayton M# 27W34	Electric	Mechanical Rm	Pneumatic Controls	1990	33%
Co Generation	Cogeneration Module, 75 kW, 90 kVa, 0.83 PF, 1830 RPM, 4.0 Therms of hot water	Tecogen M# CM75, S#00572	Natural Gas	Boiler Room	All Areas	1998	60%
Co Generation	Coolant Circulation Pump for CoGen 1/2 HP, 3450 RPM	Marathon P#M99129, M#60E56C34D 55100	Electric	Boiler Room	CoGen	1998	0%
Cogeneration	Cogen Air Cooler, Two (2) motors, 1.0 HP,	Witt, M3FSS-202AVD-12, S#211052-0101E03	Electric	Boiler Room	Cogen	2000	50%
Controls	Manual thermostats for each unit ventilator,	Honeywell	NA	Classrooms	Classrooms	1978	0%
Controls	Automated Logic Thermostats, with manual occupancy override and +/- 2 deg F setpoint adjustment range	Automated Login	Electric	Annex	Annex RTU's	2003	65%
Cooling	Cooling Rooftop unit, 0.25 HP Evap, 0.25 HP Condenser Fan, 1-Stage Cooling, R-22, 2 Ton	Trane M#TCA024S2D N1P, S#5609B10049	Electric	Roof	Teachers Lounge	2010	100%
Cooling	Cooling Rooftop unit, 1/6 HP Condenser Fan, Blower Fan 1/3 HP, 1-Stage Cooling, R-22, 29,000 Btu/hr (2.4 T) cooling, 9.20 SEER, 8.5 EER, 3,410 watts	Lennox M#CHA16H-311-1P, S#5490G034	Electric	Roof	Copy Room	1990	20%
Cooling	Cooling Packaged Unit, R-22, 3/4 HP Blower, 1/4 HP Condenser Fan, 58,500 Btuh (4.8 T) Cooling, 9.45 SEER, 8.80 EER, 6,650 Watts	Lennox M#CHA16H-653-5Y, S35698G06024	Electric	Roof	Main Office	1998	52%
Domestic Cold Water	Jockey Pump and tank for Cold Water to B Wing and Annex, 3/4 HP, 3450 RPM, Tank Rated for 38 to 125 Psi	AO Smith M#C48A94A06, S#8B00, Well-X-Trol by Amtrol Tank M#WX-350	Electric	B Wing Closet	Annex	1990	0%

Building System	Description	Model #	Fuel	Location	Space Served	Date Installed	Estimated Remaining Useful Life %
Domestic Cold Water	Domestic Water Storage Tank, Pressure 125 Psi Max at 650 degF, maintains 65 psig cold water; Served by well-water	Nat'l BD#38657	NA	Mechanical Rm	All Areas	2000	50%
Domestic Hot Water	Hot water Heater 80.0 gal, 250,000 Btu/hr, recovery 227.3 gal/hr, with back draft damper, designed to serve gym locker rooms which are no longer used	Bradford White, M#D80T2503NA, S#TJ6703207	Natural Gas	Boiler Room	Gymnasium, Locker RM and Faculty BR's	1999	45%
Domestic Hot Water	Automatic Storage Water Heater, 30 gal, 2 Elements: 4,500 kW each, energy guide, 4671 kWh annual use estimate	Bradford White, M#M230L6DS, S#CM8604809	Electric	D Wing Janitor Closet	D Wing	2000	0%
Domestic Hot Water	40 Gal Storage, 2 Elements: 4,500 kW each, Energy Guide estimate: 4,773 kWh/year	Bradford White M#M240S6DS-1NCWW, S#CF7907467	Electric	B Wing Closet	B Wing Bathrooms - 17 to 22	2000	50%
Domestic Hot Water	Hot Water Heater 40.0 Gal Storage, 2 Elements: 4500 Watts each, Energy Guide: 4773 kWh/yr	Bradford White M#M240S6DS-1NCWW, S#CF7907534	Electric	Annex Closet	Annex	2000	50%
Domestic Hot Water	Hot Water Heater, 100 Gal Storage, 252 GPH Recovery, 237,000 Btu/hr capacity, 85% Eff., natural draft air damper, Burner 200,000 Btu/hr Min, 400,000 Btu/hr Max	Bock, M#241PG, S#98083205T, Economite Burner M#DS45B	Natural Gas	DHW Room	Kitchen and Classroom 1 through 16	1999	45%
Heating	Two (2) Condensing Hot Water Boilers, 2,135,000 Btu/hr each,	Aerco Benchmark 2.0 S#G-99-0576, 77	Natural Gas	Boiler Room	All Areas	2000	67%
Heating	Two (2) Boiler Feed Pumps, 2.0 H, 1725 RPM, 84.0% Eff.	GE M#5KE49WN8168	Electric	Mechanical Rm	Boiler	2007	85%
Heating	Hot water Distribution Pump, 2.0 HP, 1730 , Full Load Eff. 82.5 %	Marathon Cat# H666, M# 1VN145TTFR5330AD	Electric	Boiler Room	C Wing	1990	0%
Heating	Hot Water Supply Pump for Plant and Frame heat exchanger, 3/4 HP, 1725 RPM	Bell&Gossett P#903582, M#FQh 56A17D60F	Electric	Boiler Room	All Areas	2009	95%

Building System	Description	Model #	Fuel	Location	Space Served	Date Installed	Estimated Remaining Useful Life %
Heating	Plate and Frame Heat Exchanger, 450 Psi allowable, max temp 383 F	API M#05-451144002-0001	NA	Boiler Room	All Areas	2009	95%
Heating	Hot Water Distribution Inline Pump to D Wing 1.5 HP, 1725 RPM,	Marathon P#M99081, S#BVM 56T17D5532B	Electric	Boiler Room	D Wing	1980	0%
Heating	Approx Six (6) ceiling or wall mounted cabinet unit heaters	Nesbitt and Others	Electric	Entrances /Exits	Entrances /Exits	1970's	0%
Heating	Two (2) ceiling mounted Air Handling Units with OA damper, RA damper, supply fan and heating coil	Nesbitt No Access	HW/ Electric	Gymnasiu m - Ceiling Mounted	Gymnasiu m	1970	0%
Heating	Two (2) ceiling mounted Air Handling Units with OA damper, RA damper, supply fan and heating coil	Nesbitt No Access	HW/ Electric	All Purpose Room - Ceiling Mounted	All Purpose Room	1958	0%
Heating	Air Separator 175 Psi at 250 degF,	Thrush M#AAR-O-vent HVR-4, 575814	NA	Boiler Room	Boiler	2010	100%
Heating	Fan Coil Units	NA	Electric	Locker Rooms	Locker Rooms	1980's	0%
Heating	Kitchen Hot Water Unit Heater, No Nameplate Information	NA	Hot Water	Kitchen	Kitchen	1980	0%
Heating	Hot water expansion tank, 125 Psi at 375 degF	Bell & Gossett M#468160, Cat#RL-2.5	NA	Boiler Room	Boiler Rm	1977	0%
Heating/ Ventilation	Approx. (12) Trane Unit Ventilators, with extended hot water radiation, 3 small squirrel-cage fans, hi, med and low fan speed control, 1/4 HP	Trane, M#TUVA12VH1 AS115114G12, S#S78J-14598	Electric	Classroo ms Wing D	Classroo ms Wing D	1978	0%
Heating/ Ventilation	Approx. (23) Unit Ventilators, 750 CFM, with extended hot water radiation, 3 small squirrel-cage fans, hi, med and low fan speed control	McQuay/Herma n-Nelson, IM 725, P#106506101	Electric	Classroo ms Wing A, B	Classroo ms Wing A, B	2002	60%

Building System	Description	Model #	Fuel	Location	Space Served	Date Installed	Estimated Remaining Useful Life %
Heating/Cooling	Two (2) Gas-Fired Rooftop Units, 150,000 Btu/hr Max In, 120,000 Btu/hr Max out, One-Stage Cooling, 48,000 Btu/hr, 13 SEER, 11.5 Eer, 80% thermal Eff., R-22, Comp. Motor 0.5 HP, Condenser Fan Motor 0.25 HP, Exhaust Fan motor 0.75 HP	Lennox, TGA048S2DH, S#5608E16908/ 5608D01314	Electric/Natural Gas	Roof	Classrooms 37 and 38	2008	90%
Heating/Cooling	Two (2) Gas-Fired Rooftop Units, 150,000 Btu/hr Max In, 120,000 Btu/hr Max out, One-Stage Cooling, 48,000 Btu/hr, 13 SEER, 11.5 Eer, 80% thermal Eff., R-22, Comp. Motor 0.5 HP, Condenser Fan Motor 0.25 HP, Exhaust Fan motor 0.75 HP	Lennox, KGA048S4DH S#5610F11108/ 5610F07615	Electric/Natural Gas	Roof	Classrooms 35 and 36	2010	100%
Heating/Cooling	Gas Fired Rooftop Unit, 10 Tons cooling, 0.75HP Condenser, 3.0 HP and 5.0 HP Compressor, Heating In 200,000 Btu/hr, 80% thermal Eff., Air Fan Motor, 3.0 HP, 1725 RPM, motor belt loose and causing vibration	Trane M#YSC120A3RMA, S#331102213L GE Fan Motor, M#5K4	Electric/Natural Gas	Roof	Media Center	2003	65%
Refrigeration	Kitchen Walk-In Refrigerator and Freezer	M#LFE92, S#F49041, 1/20 HP,	Electric	Kitchen	Kitchen	2005/ Freezer 2008	80%
Ventilation	Eight (8) rooftop Exhaust Fans, 1/8 HP, 1550 RPM	Loren Cook, Six Fans M#90C15DH Two Fans M#100C15DH	Electric	Roof	Annex Classrooms	1994	20%
Ventilation	Kitchen Exhaust Fan		Electric	Roof	Kitchen	1990	0%
Lighting	See details - Appendix B	-	Electric	See details - Appendix B	Library	2004	70%

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.

Appendix B: Lighting Study

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	1	Boiler Rm	Ceiling Mounted	E	4'T8	3	2	32	Sw	2	190	5	207	79	N/A	Ceiling Mounted	4'T8	E	Sw	3	2	32	2	190	5	207	79	0	0	0
2	1	Boiler Rm Vestibule	Ceiling Mounted	S	CFL	1	1	13	Sw	2	190	0	13	5	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	2	190	0	13	5	0	0	0
3	1	Locker Room Girls	Recessed	S	CFL	10	2	13	Sw	9	190	0	260	445	C	Recessed	CFL	S	OS	10	2	13	7	190	0	260	333	0	111	111
4	1	Locker Room Girls Bathroom	Recessed	S	CFL	2	2	13	Sw	9	190	0	52	89	C	Recessed	CFL	S	OS	2	2	13	7	190	0	52	67	0	22	22
5	1	Gymnasium	High Bay	S	MH	15	1	400	Sw	9	190	112	7,680	13,133	T8	High Bay	4'T8	E	Sw	15	8	32	9	190	5	3915	6695	6438	0	6438
6	1	Gymnasium	Exit Sign	S	Inc	2	2	20	N	24	365	0	80	701	LEDex	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	604	0	604
7	1	Storage Rm	Ceiling Mounted	E	4'T8	2	2	32	Sw	2	190	5	138	52	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	2	190	5	138	52	0	0	0
8	1	Locker Room Boys	Recessed	S	CFL	11	2	13	Sw	9	190	0	286	489	C	Recessed	CFL	S	OS	11	2	13	7	190	0	286	367	0	122	122
9	1	Locker Room Boys	Exit Sign	S	Inc	1	2	20	N	24	365	0	40	350	LEDex	Exit Sign	LED	S	N	1	1	5	24	365	1	6	48	302	0	302
10	1	Classroom Closet (25)	Parabolic Ceiling Mounted	E	4'T8	1	2	32	Sw	2	190	5	69	26	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	1	2	32	2	190	5	69	26	0	0	0
11	1	Classroom (25)	Parabolic Ceiling Mounted	E	4'T8	28	2	32	Sw	9	190	5	1,932	3,304	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	28	2	32	9	190	5	1932	3304	0	0	0
12	1	Classroom (27)	Parabolic Ceiling Mounted	E	4'T8	21	2	32	Sw	9	190	5	1,449	2,478	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	21	2	32	9	190	5	1449	2478	0	0	0
13	1	Classroom (29)	Parabolic Ceiling Mounted	E	4'T8	21	2	32	Sw	9	190	5	1,449	2,478	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	21	2	32	9	190	5	1449	2478	0	0	0
14	1	Classroom (31)	Parabolic Ceiling Mounted	E	4'T8	21	2	32	Sw	9	190	5	1,449	2,478	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	21	2	32	9	190	5	1449	2478	0	0	0
15	1	Classroom (33)	Parabolic Ceiling Mounted	E	4'T8	21	2	32	Sw	9	190	5	1,449	2,478	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	21	2	32	9	190	5	1449	2478	0	0	0
16	1	Classroom (34)	Parabolic Ceiling Mounted	E	4'T8	21	2	32	Sw	9	190	5	1,449	2,478	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	21	2	32	9	190	5	1449	2478	0	0	0
17	1	Classroom (32)	Parabolic Ceiling Mounted	E	4'T8	21	2	32	Sw	9	190	5	1,449	2,478	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	21	2	32	9	190	5	1449	2478	0	0	0
18	1	Classroom (30)	Parabolic Ceiling Mounted	E	4'T8	21	2	32	Sw	9	190	5	1,449	2,478	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	21	2	32	9	190	5	1449	2478	0	0	0
19	1	Classroom (28)	Parabolic Ceiling Mounted	E	4'T8	21	2	32	Sw	9	190	5	1,449	2,478	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	21	2	32	9	190	5	1449	2478	0	0	0
20	1	Classroom (26)	Parabolic Ceiling Mounted	E	4'T8	21	2	32	Sw	9	190	5	1,449	2,478	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	21	2	32	9	190	5	1449	2478	0	0	0
21	1	Bathroom Girls	Parabolic Ceiling Mounted	E	4'T8	4	1	32	Sw	8	190	5	148	225	C	Parabolic Ceiling Mounted	4'T8	E	OS	4	1	32	6	190	5	148	169	0	56	56
22	1	Storage Rm	Recessed Parabolic	E	4'T8	11	1	32	Sw	2	190	5	407	155	N/A	Recessed Parabolic	4'T8	E	Sw	11	1	32	2	190	5	407	155	0	0	0
23	1	Bathroom Boys	Parabolic Ceiling Mounted	E	4'T8	4	1	32	Sw	8	190	5	148	225	C	Parabolic Ceiling Mounted	4'T8	E	OS	4	1	32	6	190	5	148	169	0	56	56
24	1	Classroom (24)	Recessed Parabolic	E	4'T8	8	4	32	Sw	9	190	5	1,064	1,819	N/A	Recessed Parabolic	4'T8	E	Sw	8	4	32	9	190	5	1064	1819	0	0	0
25	1	Music Classroom (23)	Recessed Parabolic	E	4'T8	10	4	32	Sw	9	190	5	1,330	2,274	N/A	Recessed Parabolic	4'T8	E	Sw	10	4	32	9	190	5	1330	2274	0	0	0

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
26	1	Music Classroom Closet (23)	Ceiling Mounted	S	Inc	1	1	60	Sw	9	190	0	60	103	CFL	Ceiling Mounted	CFL	S	Sw	1	1	20	9	190	0	20	34	68	0	68
27	1	Guidance Counselor	Recessed Parabolic	E	4'T8	4	2	32	Sw	9	190	5	276	472	C	Recessed Parabolic	4'T8	E	OS	4	2	32	7	190	5	276	354	0	118	118
28	1	Vestibule	Recessed Parabolic	E	4'T8 U-Shaped	1	2	32	Sw	9	190	5	69	118	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	1	2	32	9	190	5	69	118	0	0	0
29	1	Bathroom Men	Recessed Parabolic	E	4'T8 U-Shaped	2	2	32	Sw	8	190	5	138	210	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	2	2	32	6	190	5	138	157	0	52	52
30	1	Bathroom Women	Recessed Parabolic	E	4'T8 U-Shaped	2	2	32	Sw	8	190	5	138	210	C	Recessed Parabolic	4'T8 U-Shaped	E	OS	2	2	32	6	190	5	138	157	0	52	52
31	1	Vestibule	Recessed Parabolic	E	4'T8 U-Shaped	1	2	32	Sw	9	190	5	69	118	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	1	2	32	9	190	5	69	118	0	0	0
32	1	Media Center	Recessed Parabolic	E	4'T8	25	4	32	Sw	9	190	5	3,325	5,686	N/A	Recessed Parabolic	4'T8	E	Sw	25	4	32	9	190	5	3325	5686	0	0	0
33	1	Media Center	Exit Sign	S	LED	3	1	5	N	24	365	1	17	145	N/A	Exit Sign	LED	S	N	3	1	5	24	365	1	17	145	0	0	0
34	1	Media Center Office	Recessed Parabolic	E	4'T8	2	4	32	Sw	9	190	5	266	455	C	Recessed Parabolic	4'T8	E	OS	2	4	32	7	190	5	266	341	0	114	114
35	1	Media Center Office	Parabolic Ceiling Mounted	E	4'T8	1	4	32	Sw	9	190	5	133	227	C	Parabolic Ceiling Mounted	4'T8	E	OS	1	4	32	7	190	5	133	171	0	57	57
36	1	Media Center Office Closet	Parabolic Ceiling Mounted	E	2'T8	1	2	17	Sw	2	190	2	36	14	N/A	Parabolic Ceiling Mounted	2'T8	E	Sw	1	2	17	2	190	2	36	14	0	0	0
37	1	Rear Corridor	Recessed Parabolic	E	4'T8	22	4	32	Sw	16	190	5	2,926	8,895	N/A	Recessed Parabolic	4'T8	E	Sw	22	4	32	16	190	5	2926	8895	0	0	0
38	1	Rear Corridor	Exit Sign	S	Inc	3	2	20	N	24	365	0	120	1,051	LEDex	Exit Sign	LED	S	N	3	1	5	24	365	1	17	145	907	0	907
39	1	Rear Corridor	Recessed Parabolic	E	4'T8	8	4	32	Sw	16	190	5	1,064	3,235	N/A	Recessed Parabolic	4'T8	E	Sw	8	4	32	16	190	5	1064	3235	0	0	0
40	1	Court Yard Vestibule	Recessed	S	Inc	1	1	60	Sw	16	190	0	60	182	CFL	Recessed	CFL	S	Sw	1	1	20	16	190	0	20	61	122	0	122
41	1	Speech	Recessed Parabolic	E	4'T8	4	4	32	Sw	9	190	5	532	910	C	Recessed Parabolic	4'T8	E	OS	4	4	32	7	190	5	532	682	0	227	227
42	1	Main Office	Recessed Parabolic	E	4'T8	4	4	32	Sw	9	190	5	532	910	C	Recessed Parabolic	4'T8	E	OS	4	4	32	7	190	5	532	682	0	227	227
43	1	Main Office	Recessed Parabolic	E	4'T8	4	4	32	Sw	9	190	5	532	910	C	Recessed Parabolic	4'T8	E	OS	4	4	32	7	190	5	532	682	0	227	227
44	1	Main Office	Recessed Parabolic	E	4'T8	4	4	32	Sw	9	190	5	532	910	C	Recessed Parabolic	4'T8	E	OS	4	4	32	7	190	5	532	682	0	227	227
45	1	Old Boiler Room	Ceiling Mounted	E	4'T8	1	4	32	Sw	9	190	5	133	227	C	Ceiling Mounted	4'T8	E	OS	1	4	32	7	190	5	133	171	0	57	57
46	1	Old Boiler Room	Ceiling Mounted	E	4'T8	5	2	32	Sw	9	190	5	345	590	C	Ceiling Mounted	4'T8	E	OS	5	2	32	7	190	5	345	442	0	147	147
47	1	Old Boiler Room	Ceiling Mounted	E	4'T8	3	1	32	Sw	9	190	5	111	190	C	Ceiling Mounted	4'T8	E	OS	3	1	32	7	190	5	111	142	0	47	47
48	1	Staff Room	Recessed Parabolic	E	4'T8	10	4	32	Sw	16	190	5	1,330	4,043	C	Recessed Parabolic	4'T8	E	OS	10	4	32	12	190	5	1330	3032	0	1011	1011
49	1	Stage	Parabolic Ceiling Mounted	E	4'T8	4	4	32	Sw	9	190	5	532	910	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	4	4	32	9	190	5	532	910	0	0	0
50	1	Stage	Parabolic Wall Mounted	E	4'T8	1	2	32	Sw	9	190	5	69	118	N/A	Parabolic Wall Mounted	4'T8	E	Sw	1	2	32	9	190	5	69	118	0	0	0
51	1	Stage	Wall Mounted	S	Inc	2	2	60	Sw	9	190	0	240	410	CFL	Wall Mounted	CFL	S	Sw	2	2	20	9	190	0	80	137	274	0	274
52	1	Office	Recessed Parabolic	E	4'T8 U-Shaped	2	2	32	Sw	9	190	5	138	236	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	2	2	32	9	190	5	138	236	0	0	0
53	1	Center Corridor	Recessed Parabolic	E	4'T8	9	3	32	Sw	9	190	5	909	1,554	N/A	Recessed Parabolic	4'T8	E	Sw	9	3	32	9	190	5	909	1554	0	0	0
54	Annex	Vestibule	Recessed Parabolic	E	4'T8 U-Shaped	2	2	32	Sw	16	190	5	138	420	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	2	2	32	16	190	5	138	420	0	0	0
55	Annex	Vestibule	Recessed Parabolic	E	4'T8 U-Shaped	2	2	32	Sw	16	190	5	138	420	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	2	2	32	16	190	5	138	420	0	0	0

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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)
56	Annex	Child Study	Recessed Parabolic	E	4'T8	11	3	32	Sw	9	190	5	1,111	1,900	N/A	Recessed Parabolic	4'T8	E	Sw	11	3	32	9	190	5	1111	1900	0	0	0
57	Annex	Child Study Bathroom	Recessed Parabolic	E	4'T8	1	3	32	Sw	4	190	5	101	77	C	Recessed Parabolic	4'T8	E	OS	1	3	32	3	190	5	101	58	0	19	19
58	Annex	Physical/Occupational Therapy	Recessed Parabolic	E	4'T8	11	3	32	Sw	9	190	5	1,111	1,900	N/A	Recessed Parabolic	4'T8	E	Sw	11	3	32	9	190	5	1111	1900	0	0	0
59	Annex	Pre-School/Disabled	Recessed Parabolic	E	4'T8	10	3	32	Sw	9	190	5	1,010	1,727	N/A	Recessed Parabolic	4'T8	E	Sw	10	3	32	9	190	5	1010	1727	0	0	0
60	Annex	Pre-School/Disabled	Recessed Parabolic	E	4'T8	4	2	32	Sw	9	190	5	276	472	N/A	Recessed Parabolic	4'T8	E	Sw	4	2	32	9	190	5	276	472	0	0	0
61	Annex	Pre-School/Disabled Bathroom	Recessed Parabolic	E	4'T8	1	3	32	Sw	9	190	5	101	173	C	Recessed Parabolic	4'T8	E	OS	1	3	32	7	190	5	101	130	0	43	43
62	Annex	Pre-School/Disabled Closet	Recessed Parabolic	E	2'T8	1	2	17	Sw	9	190	2	36	62	N/A	Recessed Parabolic	2'T8	E	Sw	1	2	17	9	190	2	36	62	0	0	0
63	Annex	MD Class	Recessed Parabolic	E	4'T8	10	3	32	Sw	9	190	5	1,010	1,727	N/A	Recessed Parabolic	4'T8	E	Sw	10	3	32	9	190	5	1010	1727	0	0	0
64	Annex	MD Class Bathroom	Recessed Parabolic	E	4'T8	1	3	32	Sw	9	190	5	101	173	C	Recessed Parabolic	4'T8	E	OS	1	3	32	7	190	5	101	130	0	43	43
65	Annex	MD Class Closet	Recessed Parabolic	E	2'T8	1	2	17	Sw	9	190	2	36	62	N/A	Recessed Parabolic	2'T8	E	Sw	1	2	17	9	190	2	36	62	0	0	0
66	Annex	MD Class Closet	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
67	Annex	MD Class	Recessed Parabolic	E	2'T8	4	2	17	Sw	9	190	2	144	246	N/A	Recessed Parabolic	2'T8	E	Sw	4	2	17	9	190	2	144	246	0	0	0
68	1	Classroom (22)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
69	1	Classroom (21)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
70	1	Classroom (20)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
71	1	Classroom (19)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
72	1	Small Classroom (18A)	Parabolic Ceiling Suspended	E	4'T8	4	2	32	Sw	9	190	5	276	472	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	4	2	32	9	190	5	276	472	0	0	0
73	1	Classroom (18)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
74	1	Classroom (17)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
75	1	Bathroom Boys	Parabolic Ceiling Suspended	E	4'T8	3	2	32	Sw	9	190	5	207	354	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	3	2	32	9	190	5	207	354	0	0	0
76	1	Janitor's Closet	Parabolic Ceiling Suspended	E	4'T8	1	2	32	Sw	2	190	5	69	26	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	1	2	32	2	190	5	69	26	0	0	0
77	1	Classroom (16A)	Parabolic Ceiling Suspended	E	4'T8	3	2	32	Sw	9	190	5	207	354	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	3	2	32	9	190	5	207	354	0	0	0
78	1	Classroom (15)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
79	1	Classroom (14)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
80	1	Classroom (13)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0

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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)
81	1	Classroom (12)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
82	1	Classroom (11)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
83	1	Classroom (10)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
84	1	Classroom (9)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
85	1	Janitor's Closet	Parabolic Ceiling Suspended	E	4'T8	1	1	32	Sw	2	190	5	37	14	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	1	1	32	2	190	5	37	14	0	0	0
86	1	Nurse's Office	Parabolic Ceiling Suspended	E	4'T8	6	2	32	Sw	9	190	5	414	708	C	Parabolic Ceiling Suspended	4'T8	E	OS	6	2	32	7	190	5	414	531	0	177	177
87	1	Bathroom Men	Parabolic Ceiling Suspended	E	4'T8	1	2	32	Sw	4	190	5	69	52	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	1	2	32	4	190	5	69	52	0	0	0
88	1	Bathroom Women	Parabolic Ceiling Suspended	E	4'T8	1	2	32	Sw	4	190	5	69	52	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	1	2	32	4	190	5	69	52	0	0	0
89	1	Bathroom Girls	Parabolic Ceiling Mounted	E	4'T8 U-Shaped	5	2	32	Sw	8	190	5	345	524	C	Parabolic Ceiling Mounted	4'T8 U-Shaped	E	OS	5	2	32	6	190	5	345	393	0	131	131
90	1	Bathroom Boys	Parabolic Ceiling Mounted	E	4'T8 U-Shaped	4	2	32	Sw	8	190	5	276	420	C	Parabolic Ceiling Mounted	4'T8 U-Shaped	E	OS	4	2	32	6	190	5	276	315	0	105	105
91	1	Corridor Rooms 9-22	Recessed Parabolic	E	4'T8	23	2	32	Sw	16	190	5	1,587	4,824	N/A	Recessed Parabolic	4'T8	E	Sw	23	2	32	16	190	5	1587	4824	0	0	0
92	1	Corridor Rooms 9-22	Exit Sign	S	LED	3	1	5	N	24	365	1	17	145	N/A	Exit Sign	LED	S	N	3	1	5	24	365	1	17	145	0	0	0
93	1	Corridor Rooms 9-22	Recessed Parabolic	E	4'T8 U-Shaped	2	2	32	Sw	16	190	5	138	420	N/A	Recessed Parabolic	4'T8 U-Shaped	E	Sw	2	2	32	16	190	5	138	420	0	0	0
94	1	Storage Closet	Ceiling Mounted	E	4'T8 U-Shaped	1	2	32	Sw	2	190	5	69	26	N/A	Ceiling Mounted	4'T8 U-Shaped	E	Sw	1	2	32	2	190	5	69	26	0	0	0
95	1	All Purpose	Exit Sign	S	LED	3	1	5	N	24	360	1	17	143	N/A	Exit Sign	LED	S	N	3	1	5	24	360	1	17	143	0	0	0
96	1	All Purpose	High Bay	S	MH	9	1	400	Sw	9	190	112	4,608	7,880	T8	High Bay	4'T8	E	Sw	9	8	32	9	190	5	2349	4017	3863	0	3863
97	1	Kitchen	Recessed Parabolic	E	4'T8	15	2	32	Sw	12	190	5	1,035	2,360	N/A	Recessed Parabolic	4'T8	E	Sw	15	2	32	12	190	5	1035	2360	0	0	0
98	1	Pantry	Parabolic Ceiling Mounted	E	4'T8	2	2	32	Sw	12	190	5	138	315	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	2	2	32	12	190	5	138	315	0	0	0
99	1	Walk In Refrigerator	Ceiling Mounted	S	Inc	2	1	60	Sw	8	190	0	120	182	CFL	Ceiling Mounted	CFL	S	OS	2	1	20	6	190	0	40	46	122	15	137
100	1	Copy Room	Parabolic Ceiling Suspended	E	4'T8	2	2	32	Sw	10	190	5	138	262	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	2	2	32	10	190	5	138	262	0	0	0
101	1	Server Room Unoccupied	Parabolic Ceiling Suspended	E	4'T8	3	2	32	Sw	8	190	5	207	315	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	3	2	32	8	190	5	207	315	0	0	0
102	1	Classroom (1)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
103	1	Classroom Bathroom (1)	Ceiling Mounted	E	Inc	1	1	40	Sw	6	190	0	40	46	CFL	Ceiling Mounted	CFL	E	Sw	1	1	15	6	190	0	15	17	29	0	29
104	1	Classroom Bathroom (2)	Ceiling Mounted	E	Inc	1	1	40	Sw	6	190	0	40	46	CFL	Ceiling Mounted	CFL	E	Sw	1	1	15	6	190	0	15	17	29	0	29
105	1	Classroom (2)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
106	1	Classroom (3)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
107	1	Classroom Bathroom (3)	Ceiling Mounted	S	Inc	1	1	40	Sw	6	190	0	40	46	CFL	Ceiling Mounted	CFL	S	Sw	1	1	15	6	190	0	15	17	29	0	29
108	1	Classroom Bathroom (4)	Ceiling Mounted	S	Inc	1	1	40	Sw	6	190	0	40	46	CFL	Ceiling Mounted	CFL	S	Sw	1	1	15	6	190	0	15	17	29	0	29
109	1	Classroom (4)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
110	1	Classroom (5)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
111	1	Classroom Bathroom (5)	Ceiling Mounted	S	Inc	1	1	40	Sw	6	190	0	40	46	CFL	Ceiling Mounted	CFL	S	OS	1	1	15	5	190	0	15	13	29	4	33
112	1	Classroom Bathroom (5A)	Ceiling Mounted	S	CFL	1	1	13	Sw	6	190	0	13	15	C	Ceiling Mounted	CFL	S	OS	1	1	13	5	190	0	13	11	0	4	4
113	1	Classroom (5A)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
114	1	Classroom (6)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
115	1	Classroom Bathroom (6)	Ceiling Mounted	S	Inc	1	1	40	Sw	6	190	0	40	46	CFL	Ceiling Mounted	CFL	S	OS	1	1	15	5	190	0	15	13	29	4	33
116	1	Classroom Bathroom (7)	Ceiling Mounted	S	Inc	1	1	60	Sw	6	190	0	60	68	CFL	Ceiling Mounted	CFL	S	OS	1	1	20	5	190	0	20	17	46	6	51
117	1	Classroom (7)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
118	1	Classroom (8)	Parabolic Ceiling Suspended	E	4'T8	14	2	32	Sw	9	190	5	966	1,652	N/A	Parabolic Ceiling Suspended	4'T8	E	Sw	14	2	32	9	190	5	966	1652	0	0	0
119	1	Classroom Bathroom (8)	Ceiling Mounted	S	CFL	1	1	13	Sw	6	190	0	13	15	N/A	Ceiling Mounted	CFL	S	Sw	1	1	13	6	190	0	13	15	0	0	0
120	1	Corridor Rooms 1-8	Recessed Parabolic	E	4'T8	19	2	32	Sw	16	190	5	1,311	3,985	N/A	Recessed Parabolic	4'T8	E	Sw	19	2	32	16	190	5	1311	3985	0	0	0
121	1	Corridor Rooms 1-8	Exit Sign	S	LED	3	1	5	N	24	365	1	17	145	N/A	Exit Sign	LED	S	N	3	1	5	24	365	1	17	145	0	0	0
122	Ext	Exterior	Ceiling Mounted	S	MH	4	1	150	PC	12	365	42	768	3,364	PSMH	Ceiling Mounted	PSMH	S	PC	3	1	100	12	365	20	360	1577	1787	0	1787
123	Ext	Exterior	Wallpack	S	MH	16	1	150	PC	12	365	42	3,072	13,455	PSMH	Wallpack	PSMH	S	PC	13	1	100	12	365	20	1560	6833	6623	0	6623
124	Ext	Exterior	Wall Mounted	S	Inc	2	1	60	PC	12	365	0	120	526	CFL	Wall Mounted	CFL	S	PC	2	1	20	12	365	0	40	175	350	0	350
125	Ext	Exterior	Recessed	S	Inc	1	1	60	PC	12	365	0	60	263	CFL	Recessed	CFL	S	PC	1	1	20	12	365	0	20	88	175	0	175
126	Ext	Exterior	Wall Mounted	S	CFL	1	2	13	PC	12	365	0	26	114	N/A	Wall Mounted	CFL	S	PC	1	2	13	12	365	0	26	114	0	0	0
127	Ext	Exterior	Pole Mounted Off Building	S	MH	3	1	150	PC	12	365	42	576	2,523	MH	Pole Mounted Off Building	MH	S	PC	3	1	150	12	365	42	576	2523	0	0	0
128	Ext	Exterior	Pole Mounted Off Building	S	MH	2	1	150	PC	12	365	42	384	1,682	MH	Pole Mounted Off Building	MH	S	PC	2	1	150	12	365	42	384	1682	0	0	0
129	1	Center Corridor	Parabolic Ceiling Mounted	E	4'T8	2	4	32	Sw	9	190	5	266	455	N/A	Parabolic Ceiling Mounted	4'T8	E	Sw	2	4	32	9	190	5	266	455	0	0	0
130	1	Center Corridor	Recessed	S	Inc	1	1	60	Sw	9	190	0	60	103	CFL	Recessed	CFL	S	Sw	1	1	20	9	190	0	20	34	68	0	68
131	Annex	Physical/Occupational Therapy Bathroom	Recessed Parabolic	E	4'T8	1	3	32	Sw	4	190	5	101	77	N/A	Recessed Parabolic	4'T8	E	Sw	1	3	32	4	190	5	101	77	0	0	0
Totals:						959	269	5,308				863	85,231	171,412						955	280	3,957			606	76,410	146,006	21,920	3,486	25,405

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

Proposed Lighting Summary Table			
Total Gross Floor Area (SF)	65,150		
Average Power Cost ($/kWh)	0.1730		
Exterior Lighting	**Existing**	**Proposed**	**Savings**
Exterior Annual Consumption (kWh)	21,926	12,991	**8,935**
Exterior Power (watts)	5,006	2,966	**2,040**
Total Interior Lighting	**Existing**	**Proposed**	**Savings**
Annual Consumption (kWh)	149,485	133,015	**16,470**
Lighting Power (watts)	80,225	73,444	**6,781**
Lighting Power Density (watts/SF)	1.23	1.13	**0.10**
Estimated Cost of Fixture Replacement ($)	16,441		
Estimated Cost of Controls Improvements ($)	5,800		
Total Consumption Cost Savings ($)	**6,404**		

Legend							
Fixture Type		**Lamp Type**			**Control Type**	**Ballast Type**	**Retrofit Category**
Ceiling Suspended	Recessed	CFL	3'T12	8'T5	Autom. Timer (T)	S (Self)	N/A (None)
Exit Sign	Sconce	Inc	3'T12 U-Shaped	8'T5 U-Shaped	Bi-Level (BL)	E (Electronic)	T8 (Install new T8)
High Bay	Spotlight	LED	3'T5	8'T8	Contact (Ct)	M (Magnetic)	T5 (Install new T5)
Parabolic Ceiling Mounted	Track	HPS	3'T5 U-Shaped	8'T8 U-Shaped	Daylight & Motion (M)		CFL (Install new CFL)
Parabolic Ceiling Suspended	Vanity	MH	3'T8	Circline - T5	Daylight & Switch (DLSw)		LEDex (Install new LED Exit)
Pendant	Wall Mounted	MV	3'T8 U-Shaped	Circline - T8	Daylight Sensor (DL)		LED (Install new LED)
Recessed Parabolic	Wall Suspended	1'T12	4'T5	Circline - T12	Delay Switch (DSw)		D (Delamping)
Ceiling Mounted	Wallpack	1'T12 U-Shaped	4'T5 U-Shaped	Fl.	Dimmer (D)		C (Controls Only)
Chandelier		1'T5	6'T12	Hal	Motion Sensor (MS)		PSMH (Install new Pulse-Start Metal Halide)
Equipment / Fume Hood		1'T5 U-Shaped	6'T12 U-Shaped	Induction	Motion& Switch (MSw)		
Flood		1'T8	6'T5	Infrared	None (N)		
Landscape		1'T8 U-Shaped	6'T5 U-Shaped	LPS	Occupancy Sensor (OS)		
Low Bay		2'T12 U-Shaped	6'T8	Mixed Vapor	Occupancy Sensor - CM (OSCM)		
Parabolic Wall Mounted		2'T5	6'T8 U-Shaped	Neon	Photocell (PC)		
Pole Mounted		2'T5 U-Shaped	8'T12	Quartz Halogen	Switch (Sw)		
Pole Mounted Off Building		2'T8 U-Shaped	8'T12 U-Shaped				

APPENDIX C: UPCOMING EQUIPMENT PHASEOUTS

LIGHTING:

- As of **July 1, 2010** magnetic ballasts most commonly used for the operation of T12 lamps will no longer be produced for commercial and industrial applications.

- As of **January 1, 2012** 100 watt incandescent bulbs will be phased out in accordance with the Energy Independence and Security Act of 2007.

- Starting **July 2012** many non energy saver model T12 lamps will be phased out of production.

- As of **January 1, 2013** 75 watt incandescent bulbs will be phased out in accordance with the Energy Independence and Security Act of 2007.

- As of **January 1, 2014** 60 and 40 watt incandescent bulbs will be phased out in accordance with the Energy Independence and Security Act of 2007.

- Energy Independence and Security Act of 2007 incandescent lamp phase-out exclusions:
  1. Appliance lamp (e.g. refrigerator or oven light)
  2. Black light lamp
  3. Bug lamp
  4. Colored lamp
  5. Infrared lamp
  6. Left-hand thread lamp
  7. Marine lamp
  8. Marine signal service lamp
  9. Mine service lamp
  10. Plant light lamp
  11. Reflector lamp
  12. Rough service lamp
  13. Shatter-resistant lamp (including a shatter-proof lamp and a shatter-protected lamp)
  14. Sign service lamp
  15. Silver bowl lamp
  16. Showcase lamp
  17. 3-way incandescent lamp
  18. Traffic signal lamp
  19. Vibration service lamp
  20. Globe shaped “G” lamp (as defined in ANSI C78.20-2003 and C79.1-2002 with a diameter of 5 inches or more
  21. T shape lamp (as defined in ANSI C78.20-2003 and C79.1-2002) and that uses not more than 40 watts or has a length of more than 10 inches
  22. A B, BA, CA, F, G16-1/2, G-25, G30, S, or M-14 lamp (as defined in ANSI C79.1-2002 and ANSI C78.20-2003) of 40 watts or less
  23. Candelabra incandescent and other lights not having a medium Edison screw base.

- When installing compact fluorescent lamps (CFLs), be advised that they contain a very small amount of mercury sealed within the glass tubing and EPA guidelines concerning cleanup and safe disposal of compact fluorescent light bulbs should be followed. Additionally, all lamps to be disposed should be recycled in accordance with EPA guidelines through state or local government collection or exchange programs instead.

HCFC (Hydrochlorofluorocarbons):

- As of **January 1, 2010,** no production and no importing of R-142b and R-22, except for use in equipment manufactured before January 1, 2010, in accordance with adherence to the Montreal Protocol.

- As of **January 1, 2015,** No production and no importing of any HCFCs, except for use as refrigerants in equipment manufactured before January 1, 2010.

- As of **January 1, 2020** No production and no importing of R-142b and R-22.

APPENDIX D: THIRD PARTY ENERGY SUPPLIERS

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

APPENDIX E: GLOSSARY AND METHOD OF CALCULATIONS

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

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

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

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

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

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

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

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

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

Gas Rate and Electric Rate ($/therm and $/kWh): The gas rate and electric rate used in the financial analysis is the total annual energy cost divided by the total annual energy usage for the 12 month billing period studied. The graphs of the monthly gas and electric rates reflect the total monthly energy costs divided by the monthly usage, and display how the average rate fluctuates throughout the year. The average annual rate is the only rate used in energy savings calculations.

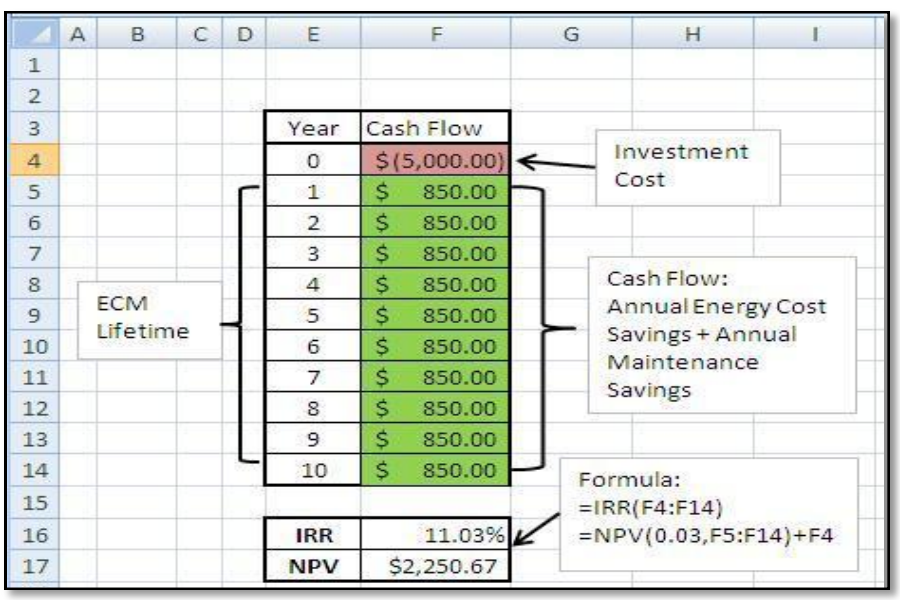
Calculation References

Term	Definition
ECM	Energy Conservation Measure
AOCS	Annual Operating Cost Savings
AECS	Annual Energy Cost Savings
LOCS*	Lifetime Operating Cost Savings
LECS	Lifetime Energy Cost Savings
LCS	Lifetime Cost Savings
NPV	Net Present Value
IRR	Internal Rate of Return
DR	Discount Rate
Net ECM Cost	Total ECM Cost – Incentive
LECS	AECS X ECM Lifetime
AOCS	LOCS / ECM Lifetime
LCS	LOCS+LECS
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)]

* 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).

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:



Solar PV ECM Calculation

There are several components to the calculation:

Costs:	Material of PV system including panels, mounting and net-metering + Labor
Energy Savings:	Reduction of kWh electric cost for life of panel, 25 years
Incentive 1:	NJ Renewable Energy Incentive Program (REIP), for systems of size 50kW or less, $1/Watt incentive subtracted from installation cost
Incentive 2:	Solar Renewable Energy Credits (SRECs) – Market-rate incentive. Calculations assume $600/Megawatt hour consumed per year for a maximum of 15 years; added to annual energy cost savings for a period of 15 years. (Megawatt hour used is rounded to nearest 1,000 kWh)
Assumptions:	A Solar Pathfinder device is used to analyze site shading for the building and determine maximum amount of full load operation based on available sunlight. When the Solar Pathfinder device is not implemented, amount of full load operation based on available sunlight is assumed to be 1,180 hours in New Jersey.

Total lifetime PV energy cost savings =
kWh produced by panel * [$/kWh cost * 25 years + $600/Megawatt hour /1000 * 15 years]

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.

New Jersey Clean Energy Program Commercial Equipment Life Span

Measure	Life Span
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

APPENDIX F: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Hardyston Township BOE - Elementary School

Building ID: 2493543
For 12-month Period Ending: September 30, 2010[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: December 13, 2010

Facility
Hardyston Township BOE - Elementary School
50 Route 23
Franklin, NJ 07416

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1958
Gross Floor Area (ft²): 65,150

Energy Performance Rating[2] (1-100) 50

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	871,951
Natural Gas (kBtu)[4]	5,456,060
Total Energy (kBtu)	6,328,011

Energy Intensity[5]	
Site (kBtu/ft²/yr)	97
Source (kBtu/ft²/yr)	132

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	423

Electric Distribution Utility
FirstEnergy - Jersey Central Power & Lt Co

National Average Comparison	
National Average Site EUI	97
National Average Source EUI	133
% Difference from National Average Source EUI	0%
Building Type	K-12 School

Stamp of Certifying Professional

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

Meets Industry Standards[6] for Indoor Environmental Conditions:

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

Certifying Professional
N/A

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

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

EPA Form 5900-16

APPENDIX G: INCENTIVE PROGRAMS

New Jersey Clean Energy Pay for Performance

The NJ Clean Energy Pay for Performance (P4P) Program relies on a network of Partners who provide technical services to clients. LGEA participating clients who are not receiving Direct Energy Efficiency and Conservation Block Grants are eligible for P4P. SWA is an eligible Partner and can develop an Energy Reduction Plan for each project with a whole-building traditional energy audit, a financial plan for funding the energy measures and an installation construction schedule.

The Energy Reduction Plan must define a comprehensive package of measures capable of reducing a building's energy consumption by 15+%. P4P incentives are awarded upon the satisfactory completion of three program milestones: submittal of an Energy Reduction Plan prepared by an approved Program Partner, installation of the recommended measures, and completion of a Post-Construction Benchmarking Report. The incentives for electricity and natural gas savings will be paid based on actual savings, provided that the minimum 15%performance threshold savings has been achieved.

Energy Provider Incentives

- **Elizabethtown Gas** - Provides matching incentive on gas P4P incentives #2 and #3 up to $25,000 (not to exceed total project cost).

CHP Incentive

- **New Jersey Natural Gas** - Provides matching inventive up to $1mm, requires participation in P4P

For further information, please see: http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance/existing-buildings .

Direct Install 2010 Program*

Direct Install is a division of the New Jersey Clean Energy Programs' Smart Start Buildings. It is a turn-key program for small to mid-sized facilities to aid in upgrading equipment to more efficient types. It is designed to cut overall energy costs by upgrading lighting, HVAC, and other equipment with energy efficient alternatives. The program pays **up to 60%** of the retrofit costs, including equipment cost and installation costs.

Eligibility:

- Existing small and mid-sized commercial and industrial facilities with peak electrical demand **below 200 kW** within 12 months of applying
- Must be located in New Jersey
- Must be served by one of the state's public, regulated or natural gas companies

Energy Provider Incentives

- **Elizabeth Town Gas** - Provides incentive for customer's portion of gas measures up to $25,000, but not to exceed total project cost.

For the most up to date information on contractors in New Jersey who participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/direct-install or visit the utility web sites.

Smart Start

New Jersey's SmartStart Building Program is administered by New Jersey's Office of Clean Energy. The program also offers design support for larger projects and technical assistance for smaller projects. If your project specifications do not fit into anything defined by the program, there are even incentives available for custom projects.

There are a number of improvement options for commercial, industrial, institutional, government, and agricultural projects throughout New Jersey. Alternatives are designed to enhance quality while building in energy efficiency to save money. Project categories included in this program are New Construction and Additions, Renovations, Remodeling and Equipment Replacement.

Energy Provider Incentives

- **South Jersey Gas –** Program to finance projects up to $25,000 not covered by incentive
- **Elizabeth Town Gas**- Will match 100% of Smartstart incentives but not to exceed 100% of project cost
- **New Jersey Natural Gas** – Will match SSB incentives on gas equipment

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings.

Renewable Energy Incentive Program*

The Renewable Energy Incentive Program (REIP) provides incentives that reduce the upfront cost of installing renewable energy systems, including solar, wind, and sustainable biomass. Incentives vary depending upon technology, system size, and building type. Current incentive levels, participation information, and application forms can be found at the website listed below.

Solar Renewable Energy Credits (SRECs) represent all the clean energy benefits of electricity generated from a solar energy system. SRECs can be sold or traded separately from the power, providing owners a source of revenue to help offset the cost of installation. All solar project owners in New Jersey with electric distribution grid-connected systems are eligible to generate SRECs. Each time a system generates 1,000 kWh of electricity an SREC is earned and placed in the customer's account on the web-based SREC tracking system.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/renewable-energy/home/home.

Combined Heat and Power (CHP)

Energy Provider Incentives

- South Jersey Gas - Provides additional incentive of $1.00/watt up to $1,000,000 on top of NJCEP incentive.

- Elizabethtown Gas - Provides additional incentive of 50% of the NJCEP incentive up to $500,000.

Utility Sponsored Programs

Check with your local utility companies for further opportunities that may be available.

Energy Efficiency and Conservation Block Grant Rebate Program

The Energy Efficiency and Conservation Block Grant (EECBG) Rebate Program provides supplemental funding up to $20,000 for eligible New Jersey local government entities to lower the cost of installing energy conservation measures. Funding for the EECBG Rebate Program is provided through the American Recovery and Reinvestment Act (ARRA).

For the most up to date information on how to participate in this program, go to: http://njcleanenergy.com/EECBG.

Other Federal and State Sponsored Programs

Other federal and state sponsored funding opportunities may be available, including BLOCK and R&D grant funding. For more information, please check http://www.dsireusa.org/.

*Subject to availability. Incentive program timelines might not be sufficient to meet the 25% in 12 months spending requirement outlined in the LGEA program.

APPENDIX H: ENERGY CONSERVATION MEASURES

ECM #	ECM description	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	Upgrade (17) Incandescent to CFL	155	none at this time	155	1,396	0	0	0.1	60	301	5	1,507	0.5	875	175	194	1,180	2,499
2	New T8 fixtures to be installed with incentives	4,483	240	4,243	10,301	2	0	0.5	1,258	3,040	15	45,605	1.4	975	65	72	30,555	18,444
3	Replace 6 incandescent/fluorescent Exit signs with LED type	903	60	843	1,813	0	0	0.1	184	456	15	6,837	1.8	711	47	54	4,380	3,247
4	Install Shell & Tube Heat Exchanger for DHW	2,844	0	2,844	0	0	750	1.2	0	915	13	11,894	3.1	318	24	31	6,554	8,267
5	Upgrade thermostats to programmable	22,515	0	22,515	0	0	2,728	4.2	1,167	4,495	12	53,937	5.0	140	12	17	21,023	30,071
6	16 New PSMH fixtures to be installed with incentives	11,600	400	11,200	8,410	2	0	0.4	507	1,962	15	29,423	5.7	163	11	15	11,513	15,057
7	Install 30 kW Solar Photovoltaic system	210,000	22,500	187,500	35,400	30	0	1.9	0	27,136	25	678,391	6.9	262	10	12	159,018	63,384
8	Install 29 occupancy sensors	6,380	580	5,800	3,486	1	0	0.2	0	603	15	9,045	9.6	56	4	6	1,255	6,241
9	Replace Gym and All-Purpose Room AHUs & Implement DCV	29,080	0	29,080	1,421	0	1,637	2.6	350	2,593	12	31,117	11.2	7	1	1	-3,463	20,586
10	Replace Three Packaged AC Units with High Efficiency	22,400	1,012	21,388	4,222	0	0	0.2	0	732	15	10,976	29.2	-49	-3	-7	-12,381	7,559
	TOTALS	**310,359**	**24,792**	**285,567**	**66,448**	**35**	**5,115**	**11.3**	**3,525**	**42,232**		**878,731**		**3,458**	**346**	**396**	**219,634**	**175,356**

APPENDIX I: METHOD OF ANALYSIS

Assumptions and tools

Energy modeling tool:	Established/standard industry assumptions
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

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.