Steven Winter Associates, Inc. 293 Route 18 South Telephone (866) 676-1972
Building System Consultants East Brunswick, NJ 08816 Web: www.swinter.com

March 24th, 2010

Local Government Energy Program
Energy Audit Final Report

Township of Lower
Department of Public Works Garage
771 Seashore Road
Erma, NJ 08204

Project Number: LGEA31

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INTRODUCTION

As an approved energy consulting firm under the Local Government Energy Audit Program (LGEA), Steven Winter Associates, Inc. (SWA) was selected to perform an energy audit and assessment for the Township of Lower. The audit included a review of the Township of Lower Municipal Building, Planning and Zoning Annex, Recreation Building, Millman Senior Center, Municipal Building, Department of Public Works Administrative Offices and Department of Public Works Garage. The buildings are located in Erma and Villas, NJ. A separate energy audit report is issued for each of the referenced buildings.

This report addresses the Department of Public Works Garage located at 771 Seashore Road, Erma, NJ. The current conditions and energy-related information were collected in order to analyze and suggest the implementation of building improvements and energy conservation measures.

The Department of Public Works Garage located at 771 Seashore Road was opened in 1982. It is a single story free standing building with approximately 7,500 square feet of conditioned space and is part of a complex that also includes the Department of Public Works office building. The building is home to maintenance garages, repair shops and storage for the town's road signs. There are approximately 10 full time employees working in the building at any given time and they work a standard 40 hour work week Monday through Friday. Access is restricted to authorized personnel only as the facility is not open to the public.

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

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

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

EXECUTIVE SUMMARY

The energy audit performed by Steven Winter Associates (SWA) encompasses the Public Works Garage located at 771 Seashore Road, Erma, NJ. It is a single story free standing building with approximately 7,500 square feet of conditioned space and is part of a complex that also includes the Department of Public Works office building. The building itself is home to maintenance garages, repair shops and storage for the towns road signs.

Based on the field visit performed by the SWA staff on November 10, 2009 and the results of a comprehensive energy analysis, this report describes the site's current conditions and recommendations for improvements. Suggestions for measures related to energy conservation and improved comfort are provided in the scope of work. Energy and resource savings are estimated for each measure that results in a reduction of heating, cooling, and electric usage.

Existing conditions

From November 2008 through October 2009, the period of analysis for this audit, the building consumed 96,755 kWh or $15,686 worth of electricity at an approximate rate of $0.162/kWh and 6,976 therms or $10,923 worth of natural gas at an approximate rate of $1.566/therm. The joint energy consumption for the building, including both electricity and fossil fuel was 834 MMBtus of energy that cost a total of $26,609.

SWA has entered energy information about the garage in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. Currently, the building receives is not eligible for a performance rating due to its classification as a public works building which means that it is still ineligible for Energy Star. SWA encourages the Township of Lower to continue entering utility data in *Energy Star Portfolio Manager* in order to track weather normalized source energy use over time.

The Site Energy Use Intensity is 137.0 kBtu/sq ft yr compared to the national average of a vehicle service building consuming 104.0 kBtu/sq ft yr. The DPW Garage shows a high energy use intensity since the building has a high energy usage for a relatively small floor area. The Portfolio Manager generates a generic national average based on a small sample size. For other-type buildings that are not eligible for a Performance Rating, the national average is often not accurate based on the limited sample size used for comparison. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 3.6 kBtu/sqft yr, with an additional 4.1 kBtu/sq ft yr from the recommended ECMs and 0.7 kBtu/sq ft yr from the recommended End of Life Cycle ECMs.

Implementing this report's recommendations will reduce use by approximately 8.4 kBtu/ft^2yr, which would decrease the building's energy use intensity to 128.6 kBtu/ft^2yr.

Recommendations

The Department of Public Works Garage currently contains a large garage area with a small attached office area. The garage area is heated completely by 5 new Reznor gas-fired units and is currently not cooled. The office area contains one small gas-fired wall-mounted heater and an older window AC unit. SWA recommends a package of measures that reduce lighting usage, replaces the existing window AC unit and also replaces the electric domestic hot water heater with a gas-fired unit. Due to the size of the building and the limited HVAC system, there are few improvements that cost-effective improvements that can be recommended for the building. SWA proposes that

the Township of Lower consider adding insulation to the entire shell of the building if any major renovation occurs.

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

Category I Recommendations: Capital Improvement Measures

- Insulate original exterior wall
- Insulate original roof surfaces
- Install operable interior shading devices on windows

Category II Recommendations: Operations and Maintenance

- Regularly inspect existing exterior walls
- Regularly inspect existing roof
- Replace or repair damaged window units
- Regularly inspect existing roof
- Install airtight gaskets around window air conditioning unit and install insulated hood during winter
- Repair/replace damaged door units
- Regularly inspect and maintain all exterior doors
- Provide weather stripping/air sealing
- Provide water efficient fixtures and controls
- Use Energy Star labeled appliances

Category III Recommendations: Energy Conservation Measures

At this time, SWA highly recommends a total of **1** Energy Conservation Measure (ECM) for The Department of Public Works Garage as summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$1,000**. SWA estimates a first year savings of **$904** with a simple payback of **1.1 years**. SWA also recommends **1** ECM with a 5-10 year payback as summarized in Table 2 and **3** End of Life Cycle ECMs.

The implementation of all the recommended ECMs would reduce the building electric usage by 12,567 kWh annually, or 11% of the building's current electric consumption. Due to the conversion of the electric hot water unit to a gas-fired unit, gas usage will increase slightly, however the increase in natural gas is offset by an equivalent reduction in electrical usage. SWA estimates that implementing these ECMs will reduce the carbon footprint of The Department of Public Works Garage by **22,171 lbs of CO_2**, which is equivalent to removing approximately 1 car from the roads each year or avoiding the need of 53 trees to absorb the annual CO_2 produced. SWA also recommends that Township of Lower contacts third party energy suppliers in order to negotiate a lower electricity rate. Comparing the current electric rate to average utility rates of similar type buildings in New Jersey, it may be possible to save up to $0.190/kWh, which would have equated to $2,167 for the past 12 months. It may also be possible to save up to $.016/therm in natural gas costs, which would have equated to $112 for the past 12 months.

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

conservation project. A new NJ Clean Power program, Direct Install could also assist to cover up to 80% of the capital investment.

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

Table 1 - Highly Recommended 0-5 Year Payback ECMs																			
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Install 5 new exterior CFL fixtures	RS Means	1,000	0	1,000	4,993	0.5	0	3.6	60	904	5	4,116	1.1	312	62	86	3,116	8,940
	TOTALS		**1,000**	**0**	**1,000**	**4,993**	**0.5**	**0**	**3.6**	**60**	**904**	**-**	**4,116**	**1.1**	**-**	**-**	**-**	**3,116**	**8,940**

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

Table 2 - Recommended 5-10 Year Payback ECMs																		
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
2	Install 59 new T8 fluorescent fixtures with electronic ballasts	RS Means	14,824	885	13,939	5,763	1.2	0	4.1	510	1,484	15	17,462	9.4	25	2	7	3,523	10,319
	TOTALS		**14,824**	**885**	**13,939**	**5,763**	**1.2**	**0**	**4.1**	**510**	**1,484**	**-**	**17,462**	**9.4**	**-**	**-**	**-**	**3,523**	**10,319**

Table 3 - Recommended End of Life Cycle ECMs																			
ECM #	ECM description	source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime energy cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3	Replace window AC unit with Energy Star model	RS Means	851	92	759	381	0.1	0	0.3	10	74	10	628	10.2	-17	-2	5	116	682
4	Replace electric DHW heater with natural gas unit	RS Means	1,350	50	1,300	879	0.2	-30	0.0	10	112	10	942	11.7	-28	-3	-3	-358	1,243
5	Install 4 new Pulse Start Metal Halide fixtures	RS Means	3,221	100	3,121	551	0.1	0	0.4	14	107	15	1,260	29.1	-60	-4	-7	-1,861	987
	TOTALS		**5,422**	**242**	**5,180**	**1,811**	**0.4**	**-30**	**0.7**	**34**	**293**	**-**	**2,831**	**17.7**	**-**	**-**	**-**	**-2,102**	**2,912**

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

1. HISTORIC ENERGY CONSUMPTION

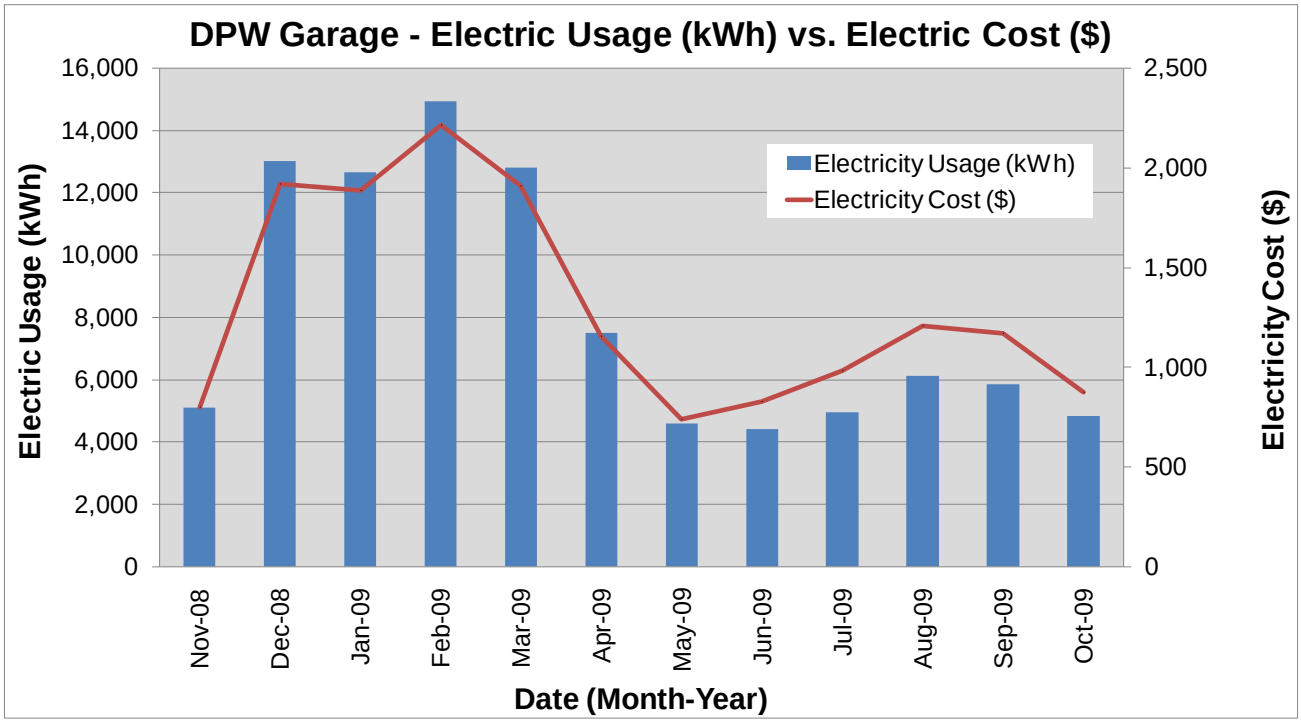
1.1. Energy usage, load profiles and cost analysis

SWA analyzed utility bills from **November 2008 through October 2009** (period of analysis) that were received from the utility companies supplying the Department of Public Works Garage with electric and natural gas.

Electricity - The Department of Public Works Garage buys electricity from Atlantic City Electric at **an average rate of $0.162/kWh** based on 12 months of utility bills from November 2008 to October 2009. They purchased **approximately 96,755 kWh or $15,686 worth of electricity** in the previous year and are currently charged for demand (kW) which has been factored into each monthly bill. The building had an average monthly demand of **12.8 kW** and an annual peak demand of **19.2 kW.**

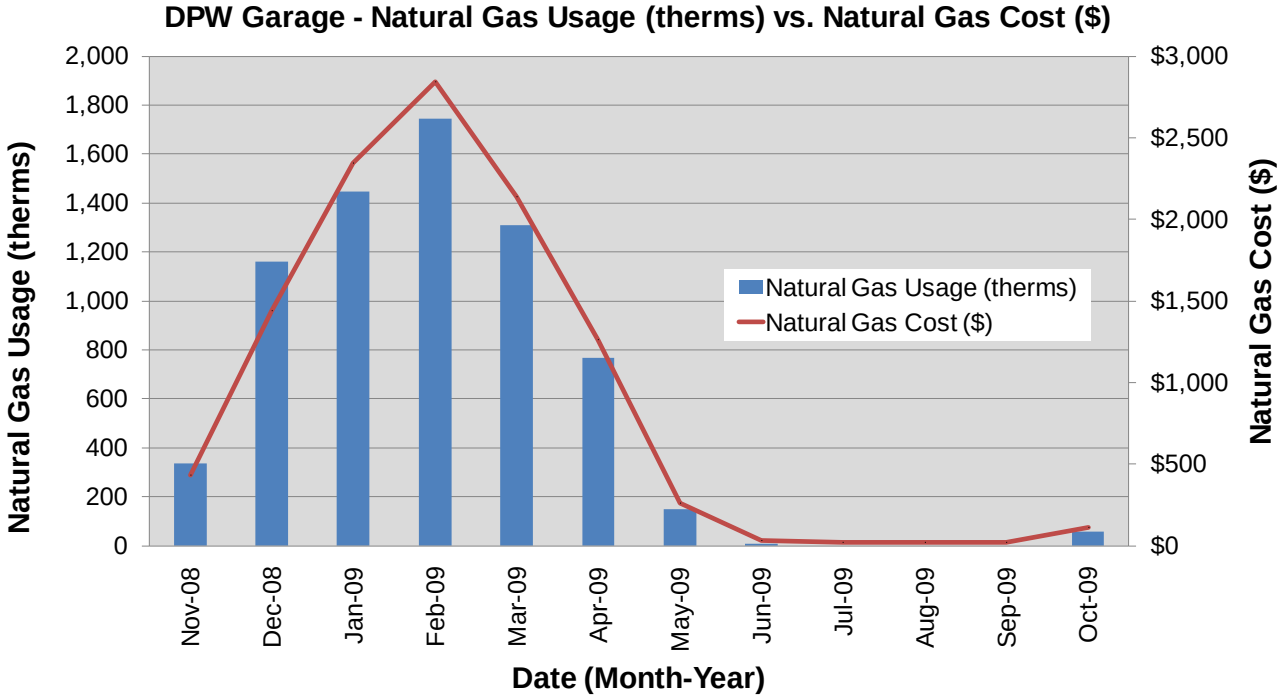
Natural gas – The Department of Public Works Garage is currently served by one meter for natural gas. They currently buy natural gas from South Jersey Natural Gas which acts as the transportation company and energy supplier at **an average aggregated rate of $1.566/therm** and purchased **approximately 6,976 therms or $10,932 worth of natural gas** in the 12 months from November 2008 to October 2009.

The following chart shows electricity use versus cost for the Department of Public Works Garage based on utility bills for the 12 month period of November 2008 to October 2009.

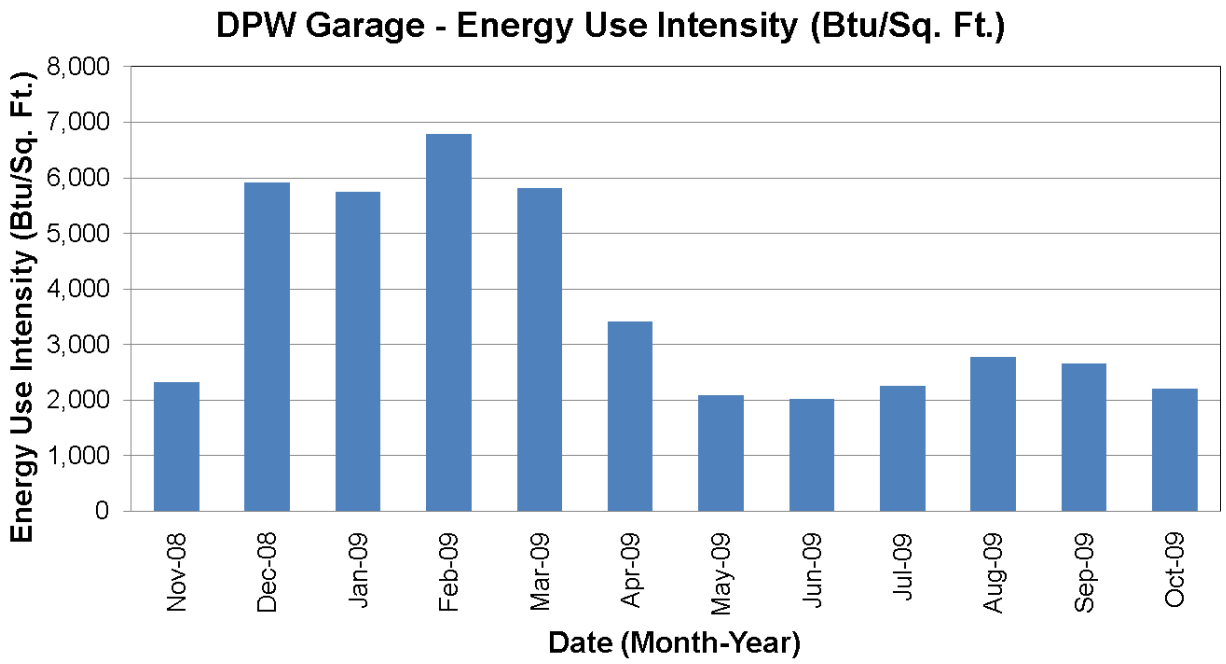


Electricity use follows a trend that is expected for this building because of its heating and cooling systems with usage peaking during the winter and the summer. The cost of electricity fluctuates as expected with usage peaking in the winter.

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

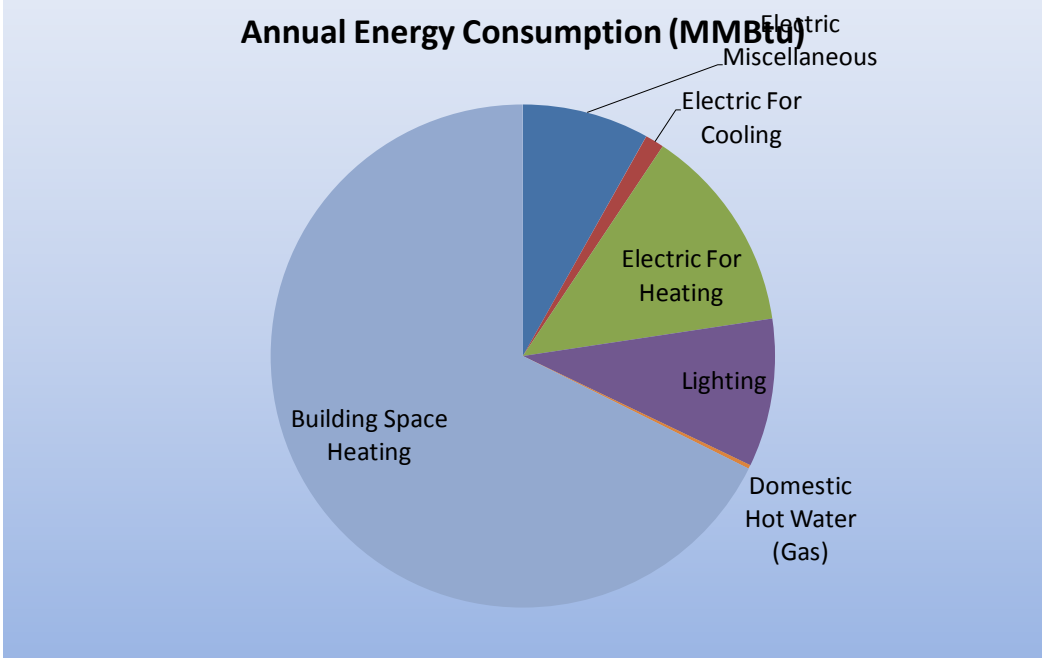


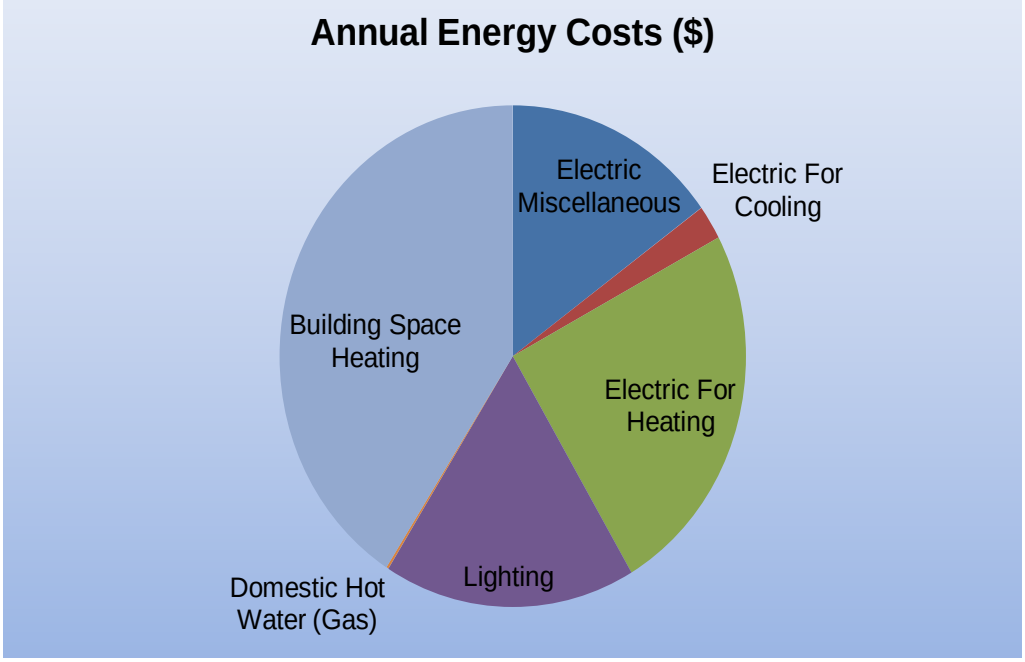
The following chart shows electric consumption in Btu/sq ft for The Department of Public Works Garage based on utility bills for the 12 month period of November 2008 to October 2009.



The following table and chart pies show energy use for the Department of Public Works Garage based on utility bills for the 12 month period of November 2008 to October 2009. Note: Electrical cost at $48/MMBtu of energy is almost more than 3 times as expensive to use as typical natural gas at $16/MMBtu.

Nov. 2008 - Oct. 2009 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	84	8%	$3,978	15%	48
Electric For Cooling	12	1%	$588	2%	48
Electric For Heating	136	13%	$6,481	24%	48
Lighting	98	9%	$4,639	17%	48
Domestic Hot Water (Gas)	3	0%	$39	0%	16
Building Space Heating	695	68%	$10,884	41%	16
Totals	1,028		$26,609	100%	26
Total Electric Usage	330	32%	$15,686	59%	48
Total Gas Usage	698	68%	$10,923	41%	16
Totals	1,028	100%	$26,609	100%	26

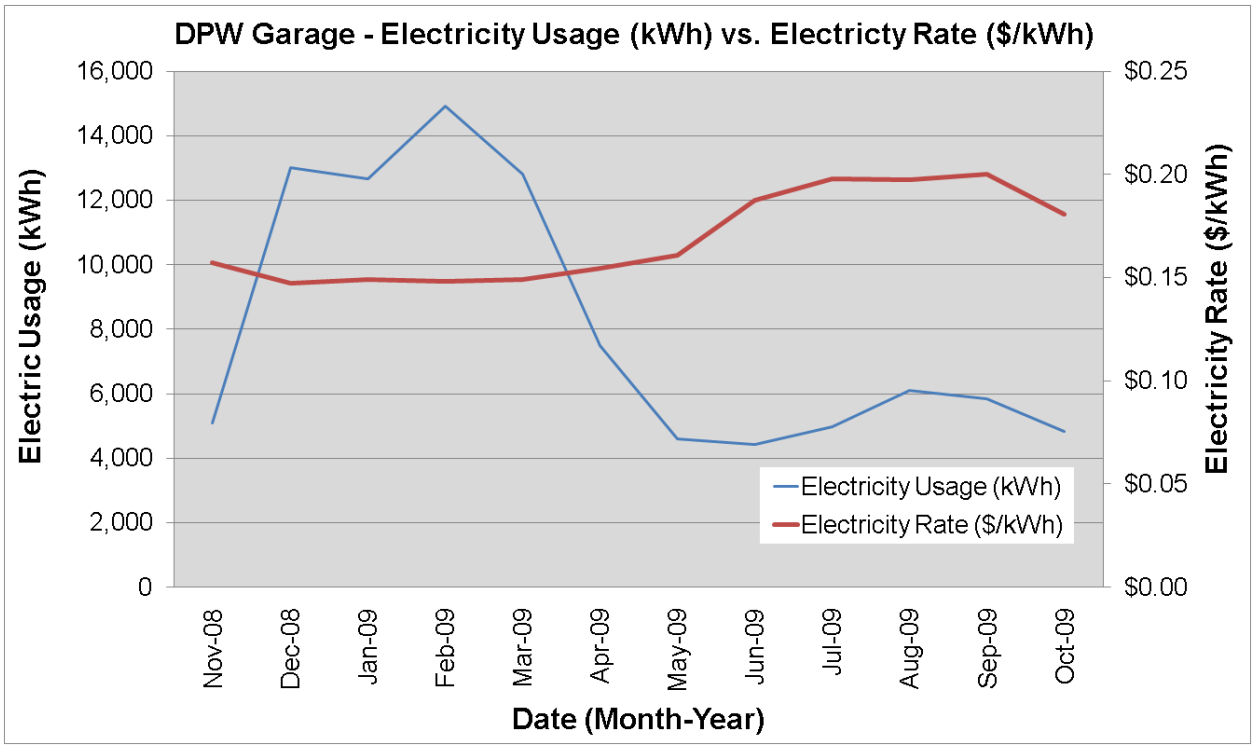




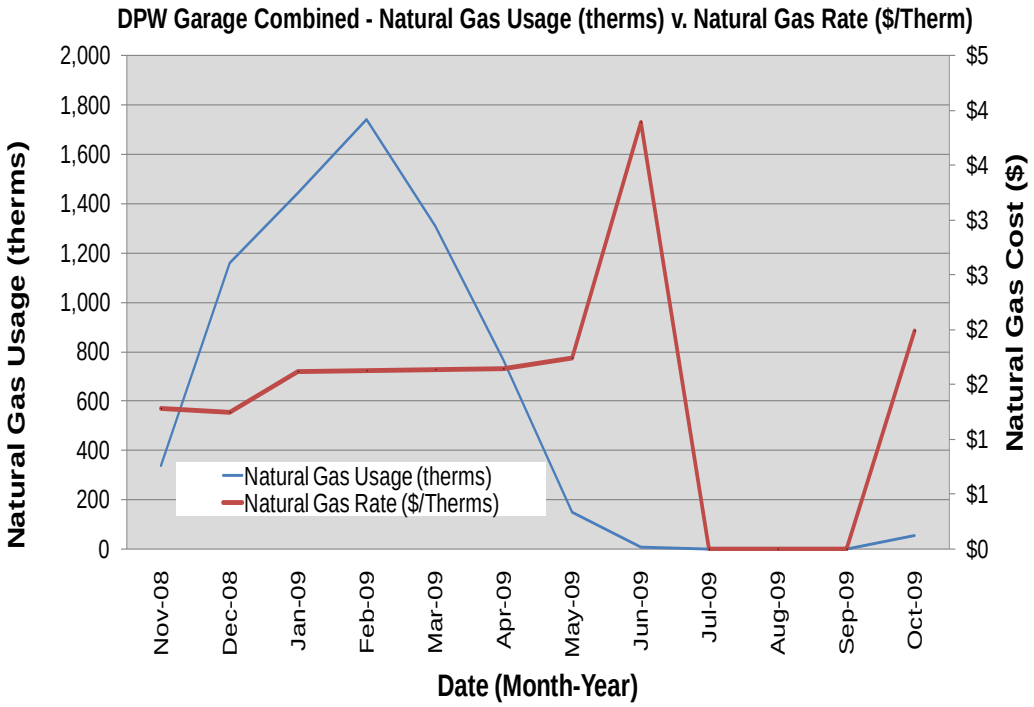
1.2. Utility rate analysis

The Department of Public Works Garage currently purchases electricity from Atlantic City Electric at a general service market rate for electricity use (kWh) including a separate (kW) demand charge that is factored into each monthly bill. The Department of Public Works Garage currently pays an average rate of approximately $0.162/kWh based on the 12 months of utility bills of November 2008 to October 2009. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. The electric rate does not

show large fluctuations throughout the year except for an anticipated rise in the summer time. Based on these observations this appears to be the appropriate rate for the building.



The Department of Public Works Garage currently purchases natural gas from the South Jersey Gas Company which acts as the transportation company and energy supplier at a general service market rate for natural gas (therms). There is one gas meter that provides natural gas service to the DPW Garage building currently. The average aggregated rate (supply and transport) for the meter is approximately $1.566/therm based on 12 months of utility bills November 2008 to October 2009. The suppliers' general service rate for natural gas charges a market-rate price based on use and the buildings billing does not breakdown demand costs for all periods. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the natural gas prices increase during the summer months when natural gas is only used by the hot water boilers. The high gas price per therm fluctuations in the summer may be due to low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months.



1.3. Energy benchmarking

SWA has entered energy information about the garage in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. Currently, the building receives is not eligible for a performance rating due to its classification as a public works building which means that it is still ineligible for Energy Star. SWA encourages the Township of Lower to continue entering utility data in *Energy Star Portfolio Manager* in order to track weather normalized source energy use over time.

The Site Energy Use Intensity is 137.0 kBtu/sq ft yr compared to the national average of a vehicle service building consuming 104.0 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 3.6 kBtu/sqft yr, with an additional 4.1 kBtu/sq ft yr from the recommended ECMs and 0.7 kBtu/sq ft yr from the recommended End of Life Cycle ECMs.

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

Username: LowerTownship
Password: LOWER

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

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Township of Lower - Public Works Garage

Building ID: 1933196
For 12-month Period Ending: September 30, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: March 03, 2010

Facility	Facility Owner	Primary Contact for this Facility
Township of Lower - Public Works Garage 711 Seashore Road Cape May, NJ 08204	Township of Lower 2600 Bayshore Road Villas, NJ 08251	Margaret Vitelli 2600 Bayshore Road Villas, NJ 08251

Year Built: 1982
Gross Floor Area (ft²): 7,500

Energy Performance Rating[2] (1-100) N/A

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	330,155
Natural Gas (kBtu)[4]	695,028
Total Energy (kBtu)	1,025,183
Energy Intensity[5]	
Site (kBtu/ft²/yr)	137
Source (kBtu/ft²/yr)	244
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	87
Electric Distribution Utility	
Pepco - Atlantic City Electric Co	
National Average Comparison	
National Average Site EUI	77
National Average Source EUI	150
% Difference from National Average Source EUI	63%
Building Type	Service (Vehicle Repair/Service, Postal Service)

Stamp of Certifying Professional

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

Certifying Professional
N/A

Meets Industry Standards[6] **for Indoor Environmental Conditions:**	
Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

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

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The free standing single story (slab on grade), 7,500 square feet Department of Public Works Garage is located in a complex that also house the Department of Public Works Office Building. It houses maintenance garages, repair shops and storage for the town's road signs.

Partial West Façade

Partial South Façade

2.2. Building Occupancy Profiles

is the building is occupied by approximately 10 employees from 7:30 AM to 3:30 PM on weekdays. Access is restricted to authorized personnel only as the facility is not open to the public.

2.3. Building Envelope

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/ outside & no/ low wind) no exterior envelope infrared (IR) images were taken during the field audit. Thermal imaging/ infrared (IR) technology helps to identify energy compromising problem areas in a non-invasive way.

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 and thermal analysis, as far as accessibility and weather conditions allowed at the time of the field audit.

2.3.1. Exterior Walls

The exterior wall envelope is mostly constructed of a vertical aluminum panel sidewall system with 0 inches of detectable/ assumed insulation. The interior is exposed aluminum sidewalls.

Note: Wall insulation levels could visually be verified in the field by non-destructive methods.

During the field audit exterior and interior wall surfaces were inspected. They were found/ reported to be in overall good/ age appropriate condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues detected on all facades.

The following are examples of the typical exterior wall:

Typically found aluminum exterior walls

In light of the exterior wall conditions mentioned above SWA has the following recommendations, which may be described, quantified and categorized further in the *Executive Summary*:

1. Insulate original and uninsulated exterior wall sections during the next major building renovation.

2. Regularly inspect the existing exterior wall with a focus on the condition of the aluminum panels and any signs of water damage or outside air infiltration.

2.3.2. Roof

The building's roof is predominantly a medium-pitch shed type over a metal roof deck with a standing-seam aluminum finish. It is original/ has never been replaced. No insulation was observed in either the ceiling or roof.

Note: Roof insulation levels could visually be verified in the field by non-destructive methods.

During the field audit roofs, related flashing, gutters and downspouts were inspected. They were found/ reported to be in overall good/ age appropriate condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues detected on all roof areas.

The following is an example of the typical roof surfaces:

In light of the exterior wall conditions mentioned above SWA has the following recommendations, which may be described, quantified and categorized further in the *Executive Summary*:

1. Insulate original and uninsulated roof/ ceiling sections during the next major building renovation. SWA suggests applying spray-foam and/ or rigid foam board insulation (R-30 min.) under and/ or on top of the metal decking surface.

2. SWA recommends biannual maintenance inspections with a focus on the drainage, penetrations, flashing and seams of the roof.

2.3.3. Base

The building's base is composed of a 6" concrete 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. Overall, the base was found/ reported to be in good condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues neither visible on the interior nor exterior.

2.3.4. Windows

The building contains basically one type of window.

1. Slider type windows with an insulated aluminum frame clear double glazing and no interior or exterior shading devices. The windows are located on the west and east facade and are original/ have never been replaced

Windows, shading devices, sills, related flashing and caulking were inspected from the exterior and interior as far as accessibility allowed. Based on signs of moisture, air-leakage and other energy compromising issues, overall the windows were found and/or reported to

be in poor condition with numerous signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific window problem spots and areas were identified:

Damaged/ aged window frame and air-leakage at sleeved wall air-conditioning units

In light of the exterior wall conditions mentioned above SWA has the following recommendations, which may be described, quantified and categorized further in the *Executive Summary*:

1. Install operable interior shading devices on windows

2. Replace or repair damaged window units and frames

3. Openings around window/ sleeved air conditioning units need airtight gaskets/ sealants for optimal all year performance. Insulated hoods should be installed during winter months if removing the units is not an option.

4. Regularly inspect all exterior windows with a focus on damaged frames, water damage, properly operating hardware and airtight seals.

2.3.5. Exterior doors

The building contains two different types of exterior doors..

1. Metal framed solid metal type exterior doors. They are located throughout the building and are original/ have never been replaced.
2. Aluminum framed overhead aluminum type exterior doors with tempered glass panels. They are located throughout the building and are original/ have never been replaced.

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

The following specific door problem spots and typical doors were identified:

Missing/ worn weather stripping and damaged/ warped/ aged door frame

In light of the exterior wall conditions mentioned above SWA has the following recommendations, which may be described, quantified and categorized further in the *Executive Summary*:

1. Replace/ repair and maintain broken/ non-closing/ damaged door units.

2. Install/ replace/ maintain weather stripping around all exterior doors and roof hatches.

3. Regularly inspect and maintain all exterior doors with a focus on the condition of weather-stripping, properly closing hardware, warped or damaged frames, water damage and outdoor air infiltration.

2.3.6. Building air-tightness

Overall the field auditors found the building to be not adequately air-tight with numerous areas of suggested improvements, as described in more detail earlier in this chapter.

In addition to all the above mentioned findings SWA recommends air sealing, caulking and/ or insulating around all structural members, recessed lighting fixtures, and electrical boxes that are part of or penetrate the exterior envelope and where air-leakage can occur.

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

2.4. HVAC Systems

The Department of Public Works Garage consists of a garage area with a small office area that forms a connection to the DPW Administrative Offices. The Garage contains 5 newer, gas-fired unit heaters and the small office area contains one gas-fired vented wall heater.

The garage area of the building is not cooled, however there is one window AC unit for the small office area.

2.4.1. Heating

The garage area of the building contains 5 Reznor gas-fired unit heaters that provide convective heating to the entire garage. These units were installed in October 2007 and were observed to be in good, age-appropriate condition. These units are each controlled by manual thermostats located on the walls of the garage. Building staff noted that temperatures are turned down at night or when the garage does not call for heating.

The DPW Garage building contains one small office area that forms a connection to the DPW Administrative offices. This small office contains one ComfortGlow vented-gas wall heater. This unit observed to be in good condition however temperature is controlled by a dial located on the unit. Building staff noted that this unit is operated minimally when staff members are located inside of the office.

Based on billing analysis, it appears that there is electrical usage associated with heating during the winter time. At the time of the audit, no electrical heaters were present. It may be possible that employees bring their own plug-in electric heaters during the winter time to use when working in the garage.

2.4.2. Cooling

The garage areas of the building are not cooled. The small office area, mentioned above in Section 2.4.1 Heating, contains one window AC units. This unit was observed to be in deteriorating condition that is no longer performing efficiently and does not form a proper seal to the window/wall that it is mounted in. SWA recommends replacing this window AC unit with a newer, Energy Start rate unit. The new unit should be mounted properly to prevent infiltration between the unit and the mounting. The unit should also be covered with an insulated hood during the winter to prevent heat transfer out of the building through the units vents.

2.4.3. Ventilation

The building uses convective heating and does not bring fresh air into the building via the heating system. The small office area contains a single window AC unit that introduces a minimal amount of fresh air into the building. The building relies mostly on natural ventilation from the garage doors that are constantly operated to introduce fresh air into the building. The fresh air is also induced to the garage areas from exhaust fans located in the side walls.

2.4.4. Domestic Hot Water

There is one Reliance electric water heater located in the building with a storage capacity of 19.9 gallons. This unit still has approximately 20% of its useful life, however SWA recommends upgrading this unit to a gas-fired unit for cost savings.

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting – The Garage contains mostly inefficient lighting. There are primarily inefficient lighting fixtures such as the existing 4' and 8' T12 fixtures with magnetic ballasts. There are also some HID (High intensity discharge) fixtures installed in the form of metal halides that SWA recommends replacing with pulse start metal halide fixtures. SWA recommends replacing the T12 lights with T8 electronic ballast feature. See attached lighting schedule in Appendix A for a complete lighting inventory throughout the building and estimated power consumption.

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

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be 250 W mercury vapor fixtures that SWA recommends replacing with CFL's.

2.5.2. Appliances

SWA performed a basic survey of appliances installed at The Department of Public Works Garage and has determined that it would be cost-effective to replace all existing refrigerators with comparable Energy Star qualified units. Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. For example, Energy Star refrigerators use as little as 315 kWh / yr. When compared to the average electrical consumption of older equipment, Energy Star equipment results in a large savings. Building management should select Energy Star label appliances and equipment when replacing: refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

Computers left on in the building consume a lot of energy. A typical desk top computer uses 65 to 250 watts and uses the same amount of energy when the screen saver is left on. Televisions in meeting areas use approximately 3-5 watts of electricity when turned off. SWA recommends all computers and all appliances (other than refrigerators and freezers) be plugged into power strips and turned off each evening just as the lights are turned off. The Department of Public Works Garage computers are generally programmed for the power save mode, to shut down after a period of time that they have not been used.

2.5.3. Elevators

The Department of Public Works Garage does not have any elevators installed on the premises.

2.5.4. Process and others electrical systems

Currently, there are no process or other electrical systems located within the building.

3. EQUIPMENT LIST

Inventory

Building System	Description	Physical Location	Make/ Model	Fuel	Space served	Date Installed	Estimated Remaining useful life %
Heating	ComfortGlow vented gas wall heater for garage office, 18,000 BTUH input, Assumed 80% efficiency, controlled by dial on unit, non-programmable thermostat	Office in Garage Area	ComfortGlow, Model #CGN18TA, Serial #1665084	Natural Gas	Office in Garage Area	1995	40%
Heating	UH-1; Reznor gas-fired unit heater, convective heater, 250,000 BTUH input, 207,500 BTUH output, 83% thermal efficiency	Garage Ceiling	Reznor, Model #UDA P250, Serial #BGE79Y3N68558X	Natural Gas	Garage Areas	2007	88%
Heating	UH-2; Reznor gas-fired unit heater, convective heater, 250,000 BTUH input, 207,500 BTUH output, 83% thermal efficiency	Garage Ceiling	Reznor, Model #UDA P250, Serial #BGE79Y3N68521X	Natural Gas	Garage Areas	2007	88%
Heating	UH-3; Reznor gas-fired unit heater, convective heater, 250,000 BTUH input, 207,500 BTUH output, 83% thermal efficiency	Garage Ceiling	Reznor, Model #UDA P250, Serial #BGE79Y3N6B568X	Natural Gas	Garage Areas	2007	88%
Heating	UH-4; Reznor gas-fired unit heater, convective heater, 250,000 BTUH input, 207,500 BTUH output, 83% thermal efficiency	Garage Ceiling	Reznor, Model #UDA P250, Serial #BGE79Y3N68578X	Natural Gas	Garage Areas	2007	88%
Heating	UH-5; Reznor gas-fired unit heater, convective heater, 100,000 BTUH input, 87,150 BTUH output, 87.2% thermal efficiency	Garage Ceiling	Reznor, Model #UDA P100, Serial #BGE79Y2N63966X	Natural Gas	Garage Areas	2007	88%
Cooling	One window AC units, no nameplate info available, deteriorating condition, not efficient	Office window	No nameplate info	Electricity	Office area	1995	10%
Domestic Hot Water	Reliance electric domestic hot water heater, 19.9 gallon storage capacity, Lower Element 1650W, Total 1650W	Lofted area in garage	Reliance, Model #5 20 10M5970 K, Serial #H97810334	Electricity	All areas	2002	20%
Lighting	See Appendix A	-	-	-	-	-	-

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

4. ENERGY CONSERVATION MEASURES

Based on the assessment of The Department of Public Works Garage, SWA has separated the investment opportunities into three recommended categories:

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

Category I Recommendations: Capital Improvements

- Insulate original exterior wall – The exterior walls are constructed mostly of a vertical aluminum panel sidewall system with no insulation installed. Due to installed costs and the amount of disruption to the building when adding insulation, it would not be cost-effective to install insulation based on energy savings alone. SWA recommends that insulation with an equivalent insulation value of R-19 is added to the exterior walls during any major building construction.

- Insulate original roof surfaces – The building's roof is predominantly a medium-pitch shed type roof over metal decking with a standing-seam aluminum finish. The roof is original, has never been replaced and contains no insulation. Due to installed costs and the amount of disruption to the building when adding insulation, it would not be cost-effective to install insulation based on energy savings alone. SWA recommends that insulation with an equivalent insulation value of R-19 is added to the roof during any major building construction

- Install operable interior shading devices on windows – The windows were observed to be slider-type windows with an insulated aluminum frame, clear double-glazing and no interior shading devices. SWA recommends adding interior shades to aid in preventing excessive heat from sunlight from entering the building.

Category II Recommendations: Operations and Maintenance

- Regularly inspect existing exterior walls – The exterior walls were observed to have some signs of water damage and penetrations that allowed air infiltration in the building shell. SWA recommends regular inspections of the exterior wall system as part of a preventative maintenance plan. Any deficiencies should be repaired immediately to prevent further air infiltration or possible water damage.

- Regularly inspect existing roof – As part of a preventative maintenance plan, SWA recommends that inspections are conducted on a bi-annual basis to check the roof for any signs of structural weakness or signs of water damage.

- Replace or repair damaged window units – There were several windows that were observed to have damaged window units and frames. These units were observed to allow air to infiltrate the building shell as well as showed signs of water damage. These windows should be replaced or repaired immediately.

- Regularly inspect existing roof – As part of a preventative maintenance plan, SWA recommends that inspections are conducted on a bi-annual basis to check the windows for inefficiencies such as air infiltration or signs of water damage.

- Install airtight gaskets around window air conditioning unit and install insulated hood during winter – The building contained a window AC unit that did not form proper seals to the window that it was mounted in. SWA recommends adding gaskets to form a tight seal to prevent air infiltration and moisture damage. In addition, this unit was observed to be left in the window during the winter months. SWA recommends installing an insulated hood that covers the unit during the winter. Window AC units contain vents that allow air and heat to constantly pass through them. Installing a winter hood will help thermally protect the building during winter months.

- Repair/replace damaged door units – There were several exterior doors located throughout the building that were damage around the perimeter of the door and the frame. These damaged doors allow unwanted air and moisture into the building. These doors should be replaced immediately.

- Regularly inspect and maintain all exterior doors – SWA recommends bi-annual maintenance inspections of all exterior doors to prevent deficiencies that allow air and moisture infiltration.

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

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

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

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1	Install 5 new exterior CFL fixtures
	Description of Recommended 5-10 Year Payback ECMs
2	Install 59 new T8 fluorescent fixtures with electronic ballasts
	Description of Recommended End of Life Cycle ECMs
3	Replace window AC unit with Energy Star model
4	Replace electric DHW heater with natural gas unit
5	Install 4 new Pulse Start Metal Halide fixtures

ECM#1: *Install 5 new exterior CFL fixtures*

Description:
The DPW Garage building contains 5 HID multi-vapor light bulbs used for exterior lighting that are inefficient and should be replaced. SWA recommends replacing the above mentioned bulbs with Compact Fluorescent Lamps (CFLs) that have an equivalent light output. Since the application is for exterior lighting, the proposed bulbs should be reflective CFLs. Typically, CFL replacement bulbs will have the same light output while consuming 2/3 less power. See Appendix A for complete lighting schedule and analysis.

Installation cost:
Estimated installed cost: $1,000
Source of cost estimate: RS *Means; Published and established costs*

Economics:

ECM #	ECM description	Source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1	Install 5 new exterior CFL fixtures	RS Means	1,000	0	1,000	4,993	1.0	0	2.3	60	869	5	4,344	1.2	334%	67%	83	2,957	6,841

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

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

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

ECM#2: *Install 59 new T8 fluorescent fixtures with electronic ballasts*

Description:
The DPW Garage currently contains 59 inefficient T12 fluorescent fixtures with magnetic ballasts. SWA recommends replacing each one of these T12 fixtures with equivalent T8 fluorescent fixtures with electronic ballasts. Typically, T8 fluorescent fixtures with electronic ballasts use 30% less energy than equivalent T12 fixtures with magnetic ballasts. In addition, there will be operating cost savings associated with each bulb since CFLs have a longer rated lifetime than incandescent bulbs. See Appendix A for complete lighting schedule and analysis.

Installation cost:
Estimated installed cost: $13,939
Source of cost estimate: RS *Means; Published and established costs*

Economics:

ECM #	ECM description	Source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
2	Install 59 new T8 fluorescent fixtures with electronic ballasts	RS Means	14,824	885	13,939	5,763	1.2	0	2.6	510	1,444	15	21,655	9.7	55%	4%	6	3,049	7,896

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

Rebates / financial incentives:
NJ Clean Energy Prescriptive Lighting – T-5 and T8 lamps with electronic ballast in existing facilities ($15 per fixture)
Maximum incentive amount is $885.

Options for funding ECM:

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

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

ECM#3: *Replace window AC unit with Energy Star model*

Description:
The DPW Garage currently contains one window AC unit in the office are portion of the building. This unit was observed in deteriorating condition. The unit did not contain nameplate information but energy information has been derived from utility bills. SWA recommends replacing the existing unit with an equivalent Energy Star unit.

Installation cost:
Estimated installed cost: $759
Source of cost estimate: RS *Means; Published and established costs*

Economics:

ECM #	ECM description	Source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1 st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
3	Replace window AC unit with Energy Star model	RS Means	851	92	759	381	0.1	0	0.2	10	72	10	717	10.6	-6%	-1%	5	85	522

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Cooling usage has been derived from utility bills. SWA assumes that an Energy Star model will result in a 10% reduction of current cooling costs.

Rebates / financial incentives:
NJ Clean Energy, Electric Unitary HVAC – 1 ton window AC unit ($92 per ton)
Maximum incentive amount is $92.

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

ECM#4: *Replace electric DHW heater with natural gas unit*

Description:
The DPW Garage currently contains one Reliance electric domestic hot water (DHW) heater. SWA recommends that this unit is upgraded to a gas-fired unit. Gas-fired units are cost-effective since they use a cheaper fuel source and also result in a smaller carbon footprint. SWA recommends that a natural gas-fired, sealed combustion domestic hot water with a minimum efficiency of 85% is installed.

Installation cost:
Estimated installed cost: $759
Source of cost estimate: RS *Means; Published and established costs*

Economics:

ECM #	ECM description	Source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
4	Replace electric DHW heater with natural gas unit	RS Means	1,350	50	1,300	879	0.2	-30	0	10	105	10	1,054	12.3	-19%	-2%	3	-60	1,204

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Domestic Hot Water usage has been calculated from nameplate information and also derived from utility bills. SWA assumes that electricity savings will equal natural gas savings in MMBTUs, however there will be a cost savings associated by upgrading to a cheaper fuel.

Rebates / financial incentives:
NJ Clean Energy, Gas hot water heating, units >50 gallons ($50 per unit)
Maximum incentive amount is $50

Options for funding ECM:

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

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

ECM#5: *Install 4 new Pulse Start Metal Halide fixtures*

Description:
The DPW Garage currently contains 4 exterior Probe Start Metal Halide fixtures. Probe Start Metal Halide fixtures are typically installed at high wattages since they degrade over time. Installing Pulse Start Metal Halide fixtures allows a lower wattage fixture to be used and provide a better quality light since the light does not degrade over time. In addition, Pulse Start Metal Halide lamps last longer, saving money by requiring less lamp changes over time. See Appendix A for complete lighting schedule and analysis.

Installation cost:
Estimated installed cost: $3,121
Source of cost estimate: RS *Means; Published and established costs*

Economics:

ECM #	ECM description	Source	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand r eduction/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 r eturn, %	net present value, $	CO_2 reduced, lbs/yr
5	Install 4 new Pulse Start Metal Halide fixtures	RS Means	3,221	100	3,121	551	0.1	0	0.3	14	103	15	1,549	30.2	-50%	-3%	-8	-1,905	755

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

Rebates / financial incentives:
NJ Clean Energy Prescriptive Lighting – Metal Halide with Pulse Start ($25 per fixture)
Maximum incentive amount is $100.

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

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

5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

5.1. Existing systems

There aren't currently any existing renewable energy systems.

5.2. Wind

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

5.3. Solar Photovoltaic

A Solar Photovoltaic array is not recommended for this building based on available area with an unobstructed South-South West exposure.

5.4. Solar Thermal Collectors

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

5.5. Combined Heat and Power

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

5.6. Geothermal

Geothermal is not applicable for this building because the HVAC equipment is not hot water-based.

6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

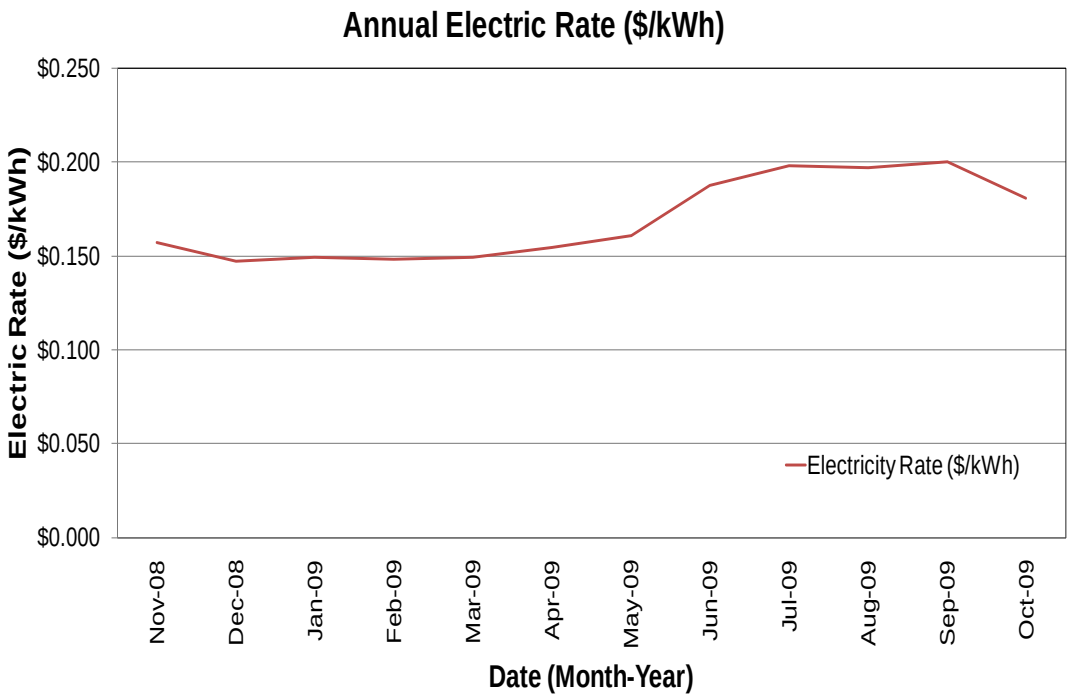
6.1. Energy Purchasing

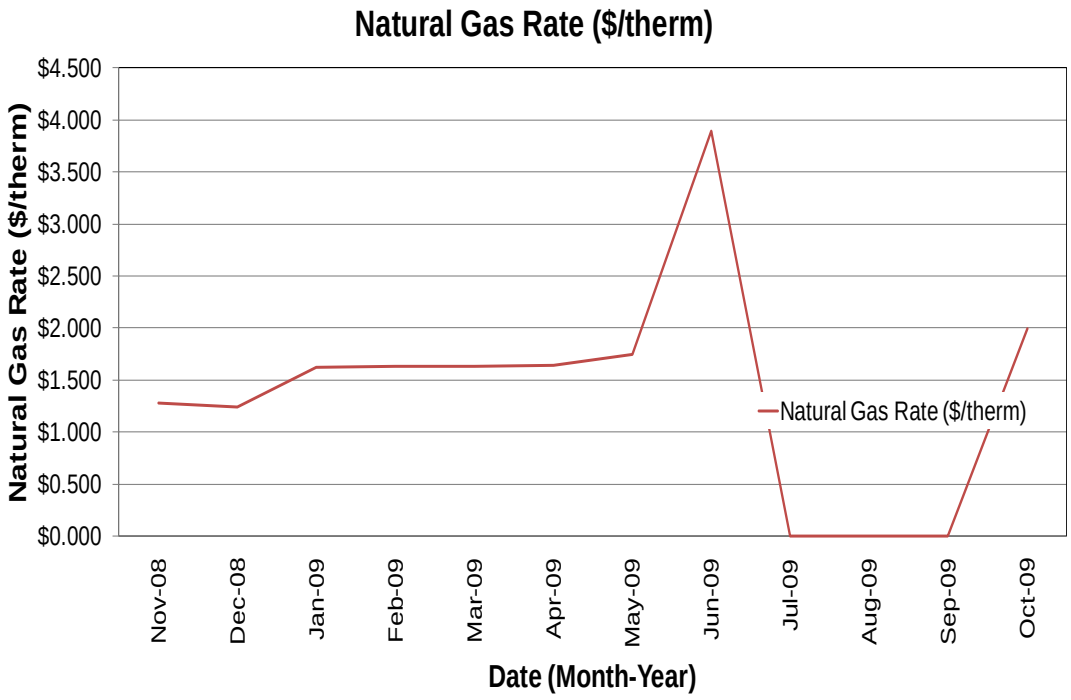
The Department of Public Works Garage receives electricity purchased via three incoming meters directly from Atlantic City Electric without an ESCO. An Energy Services Company (ESCO) is a consultancy group that engages in a performance based contract with a client firm to implement measures which reduce energy consumption and costs in a technically and financially viable manner. SWA analyzed the utility rate for electricity supply over an extended period. Electric bill analysis shows fluctuations of 26% over the 12 month period between November, 2008 and October, 2009.

The Department of Public Works Garage receives natural gas via one incoming meter from the South Jersey Gas Company which acts as the transportation company and energy supplier. Natural gas bill analysis shows fluctuations up to 68% over the 12 month period between November, 2008 and October, 2009. The high gas price per therm fluctuations in the summer

may be due to low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months.

Currently, New Jersey commercial buildings of similar type pay $0.150/kWh for electricity and $1.55/therm for natural gas. Currently, the electricity rate for the garage is $0.162/kWh, which means there is a potential cost savings of $1,161per year. The current natural gas rate for The Department of Public Works Garage is $1.566/therm which means there is a potential cost savings of $112 per year. Although a large cost savings potential for electricity exists, this involves contacting third party suppliers and negotiating utility rates. SWA recommends that the Township of Lower further explore opportunities of purchasing electricity from third party energy suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for The Department of Public Works Garage. Appendix B contains a complete list of third party energy suppliers for the Township of Lower service area. The Township of Lower may want to consider partnering with other school districts, municipalities, townships and communities to aggregate a substantial electric and natural gas use for better leveraging in negotiations with ESCOs and of improving the pricing structures. This sort of activity is happening in many parts of the country and in New Jersey.


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


Natural Gas Rate ($/therm)
$4.500
$4.000
$3.500
$3.000
$2.500
$2.000
$1.500
$1.000
$0.500
$0.000
Natural Gas Rate ($/therm)
Natural Gas Rate ($/therm)
Nov-08
Dec-08
Jan-09
Feb-09
Mar-09
Apr-09
May-09
Jun-09
Jul-09
Aug-09
Sep-09
Oct-09
Date (Month-Year)

6.2. Energy Procurement strategies

Also, The Department of Public Works Garage would not be eligible for enrollment in a Demand Response Program, because there isn't the capability at this time to shed a minimum of 150 kW electric demand when requested by the utility during peak demand periods, which is the typical threshold for considering this option.

7. METHOD OF ANALYSIS

7.1. Assumptions and tools

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

7.2. Disclaimer

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

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

Appendix A: Lighting Study of the Department of Public Works Garage

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	Kitchen	Parabolic	M	8'T12	1	2	80	S	8	261	24	184	384	T8	Parabolic	8'T8	E	S	1	2	59	8	261	13	131	274	111	0	111
2	1	Office	Parabolic	M	8'T12	2	2	80	S	8	261	24	368	768	T8	Parabolic	8'T8	E	S	2	2	59	8	261	13	262	547	221	0	221
3	1	Storage Room	Parabolic	M	8'T12	4	2	80	S	2	261	24	736	384	T8	Parabolic	8'T8	E	S	4	2	59	2	261	13	524	274	111	0	111
4	1	Garage Bay 1	Parabolic	M	8'T12	26	2	80	S	8	261	24	4,784	9,989	T8	Parabolic	8'T8	E	S	26	2	59	8	261	13	3406	7112	2877	0	2877
5	1	Garage Bay 1	Parabolic	M	4'T12	2	2	40	S	8	261	15	190	397	T8	Parabolic	4'T8	E	S	2	2	32	8	261	6	140	292	104	0	104
6	1	Bathroom Men	Parabolic	M	8'T12	2	2	80	S	8	261	24	368	768	T8	Parabolic	8'T8	E	S	2	2	59	8	261	13	262	547	221	0	221
7	1	Garage Bay 2	Parabolic	M	8'T12	17	2	80	S	8	261	24	3,128	6,531	T8	Parabolic	8'T8	E	S	17	2	59	8	261	13	2227	4650	1881	0	1881
8	1	Mechanical Room	Parabolic	M	8'T12	1	2	80	S	2	261	24	184	96	T8	Parabolic	8'T8	E	S	1	2	59	2	261	13	131	68	28	0	28
9	1	Garage Bay 1	Exit Sign	N	LED	1	1	5	N	24	261	1	6	38	N/A	Exit Sign	LED	N	N	1	1	5	24	261	1	6	38	0	0	0
10	1	Garage Bay 2	Exit Sign	N	LED	1	1	5	N	24	261	1	6	38	N/A	Exit Sign	LED	N	N	1	1	5	24	261	1	6	38	0	0	0
11	1	Garage Bay 3	Parabolic	M	4'T12	4	2	40	S	8	261	15	380	793	T8	Parabolic	4'T8	E	S	4	2	32	8	261	6	280	585	209	0	209
12	1	Garage Bay 3	HID	M	MH	4	1	150	S	8	261	38	752	1,570	PSMH	HID	PSMH	M	S	4	1	100	8	261	22	488	1019	551	0	551
13	Ext	Exterior	HID	N	MV	5	1	250	T	12	365	63	1,565	6,855	CFL	Screw-in	CFL	N	T	5	1	85	12	365	0	425	1862	4993	0	4993
Totals:						**70**	**22**	**1,050**				**301**	**12,651**	**28,612**						**70**	**22**	**672**			**127**	**8,288**	**17,304**	**11,308**	**0**	**11,308**

Appendix B: Third Party Energy Suppliers (ESCOs)

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

Third Party Electric Suppliers for Atlantic City Electric Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
American Powernet Management, LP 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 www.americanpowernet.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
ConEdison Solutions 535 State Highway 38 Cherry Hill, NJ 08002	(888) 665-0955 www.conedsolutions.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
Strategic Energy, LLC 55 Madison Avenue, Suite 400 Morristown, NJ 07960	(888) 925-9115 www.sel.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 South Jersey Gas 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
Great Eastern Energy 116 Village Riva, Suite 200 Princeton, NJ 08540	(888) 651-4121 www.greateastern.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
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
Woodruff Energy 73 Water Street Bridgeton, NJ 08302	(800) 557-1121 www.woodruffenergy.com

Appendix C: Glossary and Method of Calculations

Glossary of ECM Terms

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

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

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

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

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

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

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

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

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

Calculation References

ECM = Energy Conservation Measure
AOCS = Annual Operating Cost Savings
AECS = Annual Energy Cost Savings

LOCS = Lifetime Operating Cost Savings
LECS = Lifetime Energy Cost Savings
LCS = Lifetime Cost Savings

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

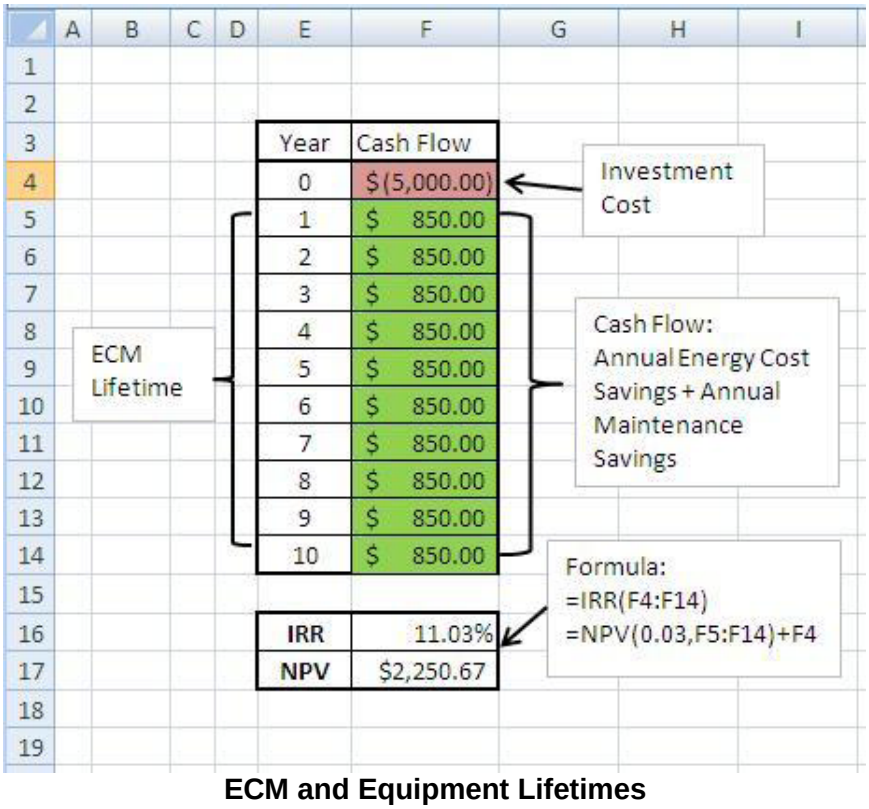
Net ECM Cost = Total ECM Cost – Incentive
LECS = AECS X ECM Lifetime
AOCS = LOCS / ECM Lifetime
LCS = LOCS+LECS

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

Simple Payback = Net ECM Cost / (AECS + AOCS)
Lifetime ROI = (LECS + LOCS – Net ECM Cost) / Net ECM Cost
Annual ROI = (Lifetime ROI / Lifetime) = (AECS + OCS) / Net ECM Cost – 1 / Lifetime
It is easiest to calculate the NPV and IRR using a spreadsheet program like Excel.

Excel NPV and IRR Calculation

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



ECM and Equipment Lifetimes

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

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

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

NJCEP C & I Lifetimes

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