



Steven Winter Associates, Inc.
Building System Consultants

293 Route 18 South
East Brunswick, NJ 08816

Telephone
Web:

(866) 676-1972
www.swinter.com

March 24th, 2010

**Local Government Energy Program
Energy Audit Final Report**

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

Project Number: LGEA31



TABLE OF CONTENTS

INTRODUCTION	3
EXECUTIVE SUMMARY	4
1. HISTORIC ENERGY CONSUMPTION	7
1.1. ENERGY USAGE, LOAD PROFILES AND COST ANALYSIS	7
1.2. UTILITY RATE ANALYSIS	11
1.3. ENERGY BENCHMARKING	12
2. FACILITY AND SYSTEMS DESCRIPTION	14
2.1. BUILDING CHARACTERISTICS.....	14
1.1. BUILDING OCCUPANCY PROFILES	14
1.2. BUILDING ENVELOPE.....	15
2.1.1. EXTERIOR WALLS	15
2.1.2. ROOF.....	15
2.1.3. BASE.....	16
2.1.4. WINDOWS	17
2.1.5. EXTERIOR DOORS	17
2.1.6. BUILDING AIR-TIGHTNESS.....	18
1.3. HVAC SYSTEMS	19
1.3.1. HEATING	19
1.3.2. COOLING.....	19
1.3.3. VENTILATION	19
1.3.4. DOMESTIC HOT WATER	19
1.4. ELECTRICAL SYSTEMS.....	19
1.4.1. LIGHTING	19
1.4.2. APPLIANCES.....	20
1.4.3. ELEVATORS	20
1.4.4. PROCESS AND OTHERS ELECTRICAL SYSTEMS.....	20
2. EQUIPMENT LIST	21
3. ENERGY CONSERVATION MEASURES	22
CATEGORY I RECOMMENDATIONS: CAPITAL IMPROVEMENTS.....	22
CATEGORY II RECOMMENDATIONS: OPERATIONS AND MAINTENANCE	22
CATEGORY III RECOMMENDATIONS: ENERGY CONSERVATION MEASURES.....	22
4. RENEWABLE AND DISTRIBUTED ENERGY MEASURES	26
4.1. EXISTING SYSTEMS	26
4.2. WIND	26
4.3. SOLAR PHOTOVOLTAIC	26
4.4. SOLAR THERMAL COLLECTORS	26
4.5. COMBINED HEAT AND POWER	26
4.6. GEOTHERMAL.....	26
5. ENERGY PURCHASING AND PROCUREMENT STRATEGIES.....	26
5.1. ENERGY PURCHASING	26
5.2. ENERGY PROCUREMENT STRATEGIES.....	28
6. METHOD OF ANALYSIS.....	29
6.1. ASSUMPTIONS AND TOOLS.....	29
6.2. DISCLAIMER.....	29
APPENDIX A: LIGHTING STUDY OF THE DEPARTMENT OF PUBLIC WORKS OFFICE	30
APPENDIX B: THIRD PARTY ENERGY SUPPLIERS (ESCOS).....	31
APPENDIX C: GLOSSARY AND METHOD OF CALCULATIONS.....	33

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 Office 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 Office located at 771 Seashore Road was opened in 1992. It is a single story building with approximately 1,072 square feet of conditioned space that is attached to one of the garage bays and is part of a complex that also includes the entire Department of Public Works garage. The building itself is home to only offices and related support rooms. There are approximately 2-4 full time employees working in the office 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 Office located at 771 Seashore Road, Erma, NJ. It is a single story building with approximately 1,072 square feet of conditioned space that is attached to one of the garage bays and is part of a complex that also includes the entire Department of Public Works garage. The building itself is home to only offices and related support rooms.

Based on the field visit performed by the SWA staff on November 10th, 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 October 2008 through September 2009, the period of analysis for this audit, the building consumed 14,488 kWh or \$2,400 worth of electricity at an approximate rate of \$0.166/kWh and 2,184 therms or \$3,475 worth of natural gas at an approximate rate of \$1.591/therm. The joint energy consumption for the building, including both electricity and fossil fuel was 268 MMBtus of energy that cost a total of \$5,875.

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 a building floor area of less than 5,000 SF which means that it is still ineligible for Energy Star certification. 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 250.0 kBtu/sq ft yr compared to the national average of an office building consuming 77.0 kBtu/sq ft yr. The Site Energy Use Intensity for the DPW Administrative building appears to be extremely high when compared to the national average. The Portfolio Manager tool is unable to calculate a performance rating for buildings under 5,000 square feet. As a result, the national average that is given by the tool is inaccurate for smaller buildings do to a small sample size of similar buildings within the Portfolio Manager database. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 4.3 kBtu/sqft yr.

Recommendations

The Department of Public Works Administrative Office building consists of a total floor area of 1,072 square feet. The entire HVAC system is new, installed in 2007. Based on the new HVAC system and the small floor area, there are limited opportunities to reduce energy consumption. SWA recommends a package of measures that reduces electrical usage through lighting and also by upgrading the electric DHW heater to a gas-fired unit.

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

- None

Category II Recommendations: Operations and Maintenance

- Repair or replace all damaged sections of exterior siding
- Inspect and maintain exterior walls biannually
- Perform bi-annual roof inspections
- Perform bi-annual inspections of windows and 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 Office as summarized in the following Table 1. The total investment cost for this ECM with incentives is **\$803**. SWA estimates a first year savings of **\$240** with a simple payback of **3.3 years**. SWA also recommends **1** End of Life Cycle ECM with total 1st year savings of \$75 as summarized I Table 2.

The implementation of all the recommended ECMs would reduce the building electric usage by 1,949 kWh annually, or 13% of the building's current electric consumption. Due to the recommendation of replacing the electric hot water heater with a gas-fired unit, natural gas usage will increase slightly however this will be offset by an equivalent reduction in electricity usage from removing the existing unit. SWA estimates that implementing these ECMs will reduce the carbon footprint of The Department of Public Works Office by **2,440 lbs of CO₂**, which is equivalent to avoiding the need of 7 trees to absorb the annual CO₂ 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 \$0.016/kWh, which would have equated to \$232 for the past 12 months. It may also be possible to save up to \$.041/therm in natural gas usage, which would have equated to \$90 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 two tables summarize the proposed Energy Conservation Measures (ECM) and their economic relevance.

Table 1 - Highly Recommended 0-5 Year Payback ECMs																			
ECM #	ECM description	Source	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO ₂ reduced, lbs/yr
1	Install 16 new CFL lamps	RS Means	803	0	803	1,363	0.3	0	4.3	14	240	5	1,094	3.3	36	7	15	291	2,440
TOTALS			803	0	803	1,363	0.3	0	4.3	14	240	-	1,094	3.3	-	-	-	291	2,440

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 3 - Recommended End of Life Cycle ECMs																			
ECM #	ECM description	Source	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO ₂ reduced, lbs/yr
2	Replace electric DHW heater with natural gas unit	RS Means	1,250	50	1,200	586	0.1	-20	0.0	10	75	10	637	15.9	-47	-5	-8	-563	829
TOTALS			1,250	50	1,200	586	0.1	-20	0.0	10	75	-	637	15.9	-	-	-	-563	829

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

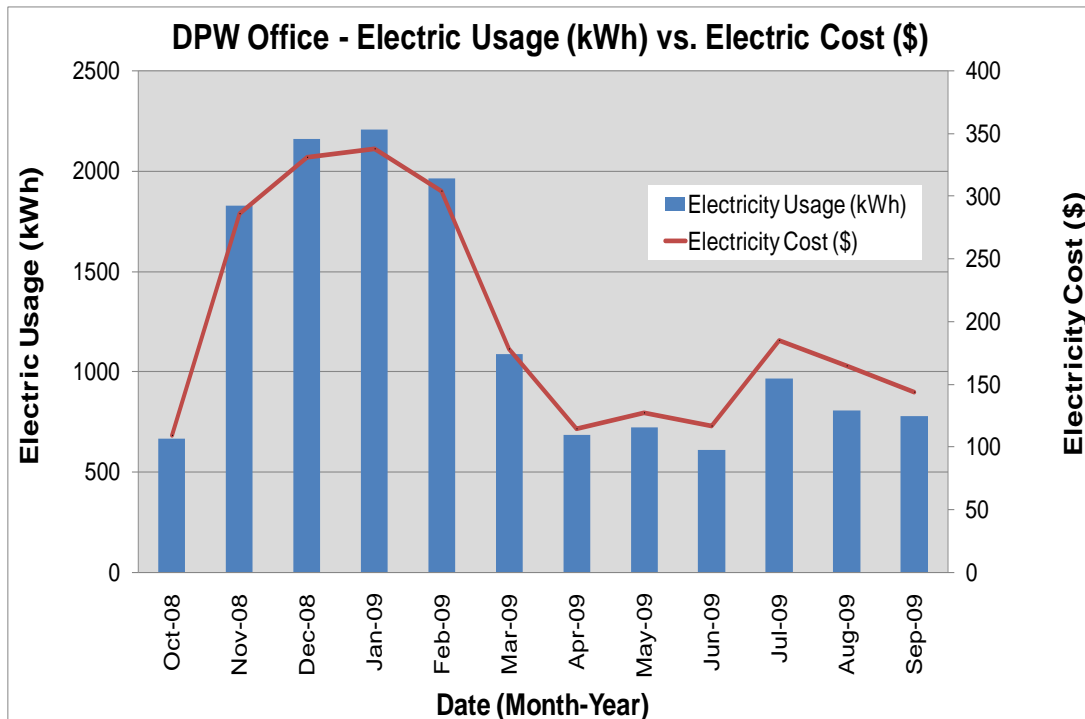
1.1. Energy usage, load profiles and cost analysis

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

Electricity - The Department of Public Works Office buys electricity from Atlantic City Electric at **an average rate of \$0.166/kWh** based on 12 months of utility bills from October 2008 to September 2009. They purchased **approximately 14,488 kWh or \$2,400 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 **5.7 kW** and an annual peak demand of **8.2 kW**.

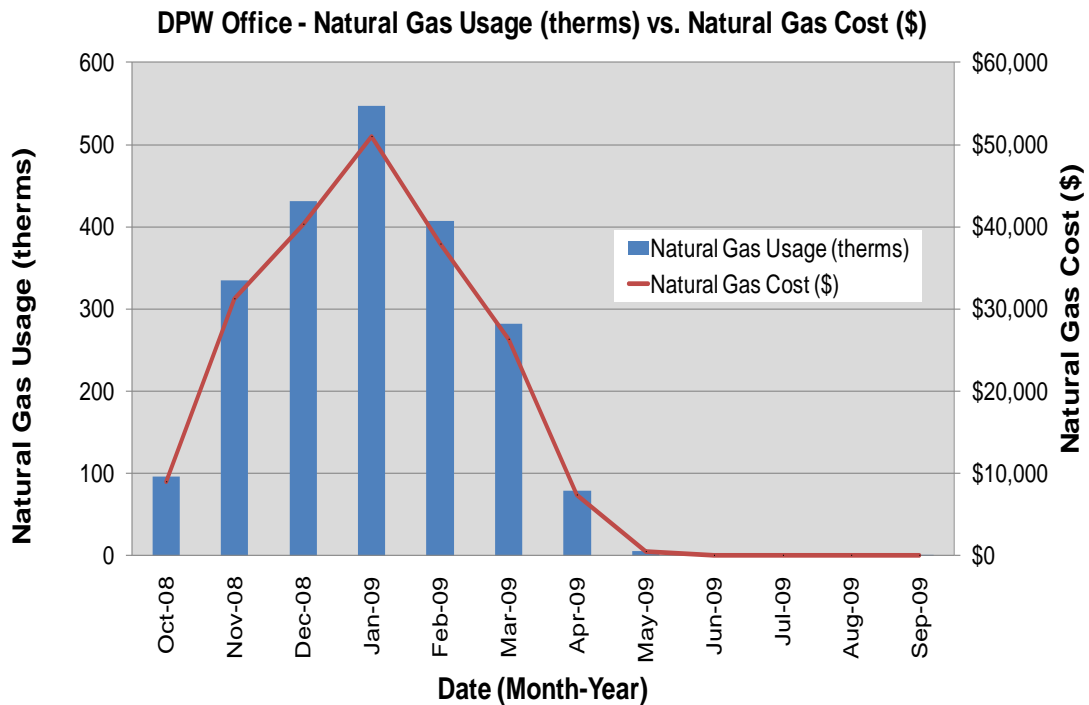
Natural gas – The Department of Public Works Office is currently served by one meter for natural gas. They currently buy natural gas from South Jersey Natural Gas which acts as the transportation company and energy supplier at **an average aggregated rate of \$1.591/therm** and purchased **approximately 2,184 therms or \$3,475 worth of natural gas** in the 12 months from October 2008 to September 2009.

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



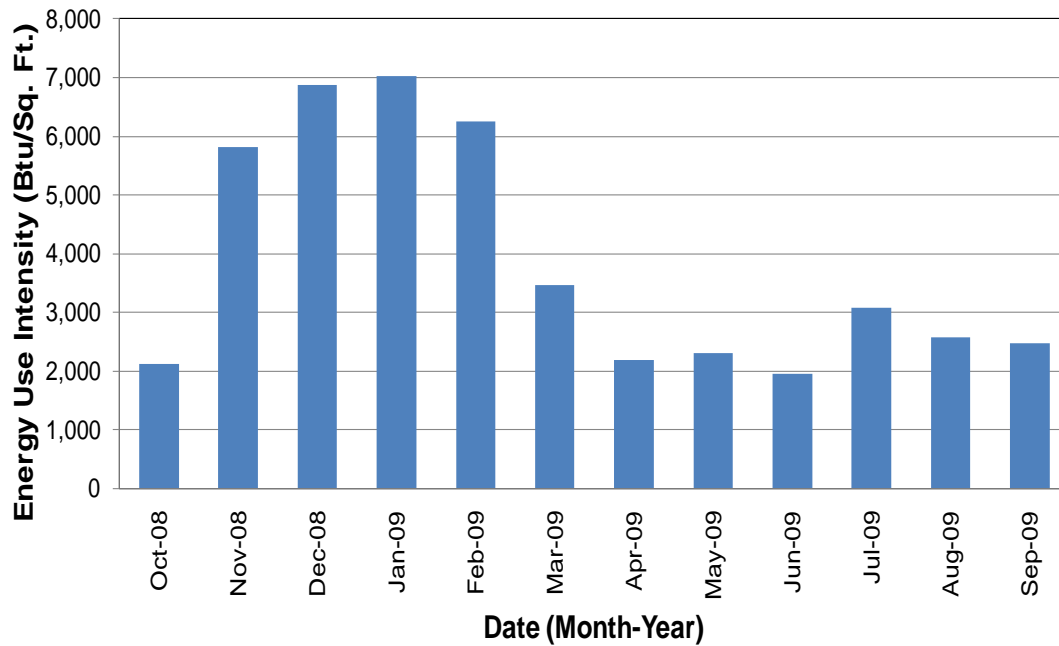
Electricity use follows a trend that is expected for this building because of its heating and cooling systems with usage peaking during the winter and slightly in the summer. The cost of electricity fluctuates as expected with usage peaking in the winter.

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.



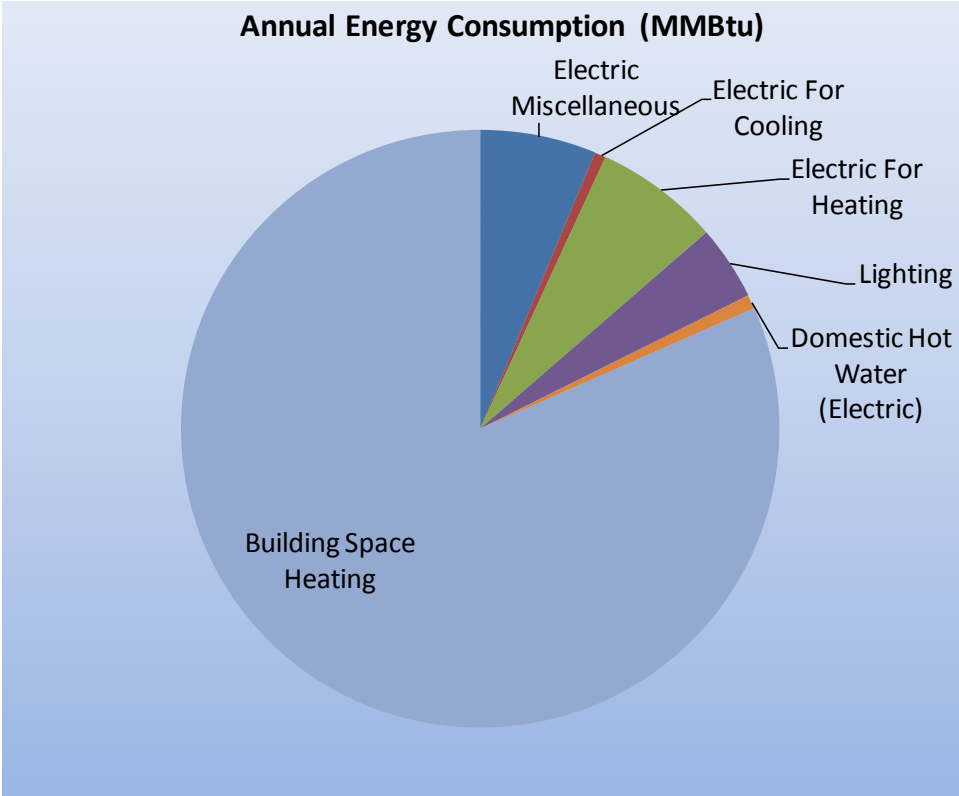
The following chart shows electric consumption in Btu/sq ft for The Department of Public Works Office based on utility bills for the 12 month period of October 2008 to September 2009.

DPW Office - Energy Use Intensity (Btu/Sq. Ft.)

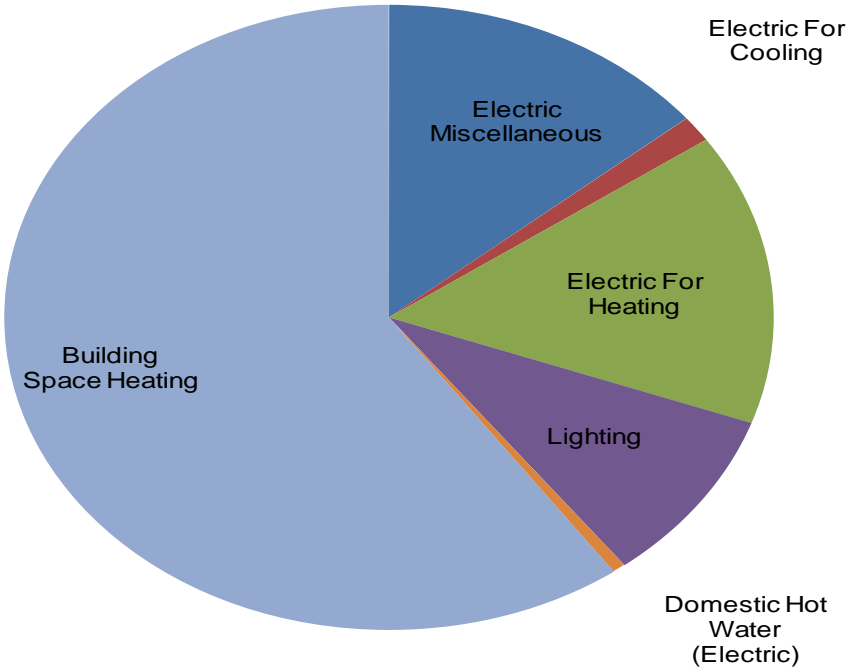


The following table and pie charts show energy use for the Department of Public Works Office based on utility bills for the 12 month period of October 2008 to September 2009. Note: Electrical cost at \$49/MMBtu of energy is almost more than 3 times as expensive to use as typical natural gas at \$16/MMBtu.

Oct. 2008 - Sept. 2009 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	\$	% \$	\$/MMBtu
Electric Miscellaneous	17	6%	\$813	14%	49
Electric For Cooling	2	1%	\$79	1%	49
Electric For Heating	20	8%	\$983	17%	49
Lighting	11	4%	\$524	9%	49
Domestic Hot Water (Electric)	2	1%	\$32	1%	49
Building Space Heating	218	81%	\$3,470	59%	16
Totals	270	100%	\$5,874	100%	
Total Electric Usage	49	18%	\$2,400	41%	49
Total Gas Usage	218	82%	\$3,475	59%	16
Totals	268	100%	\$5,874	100%	

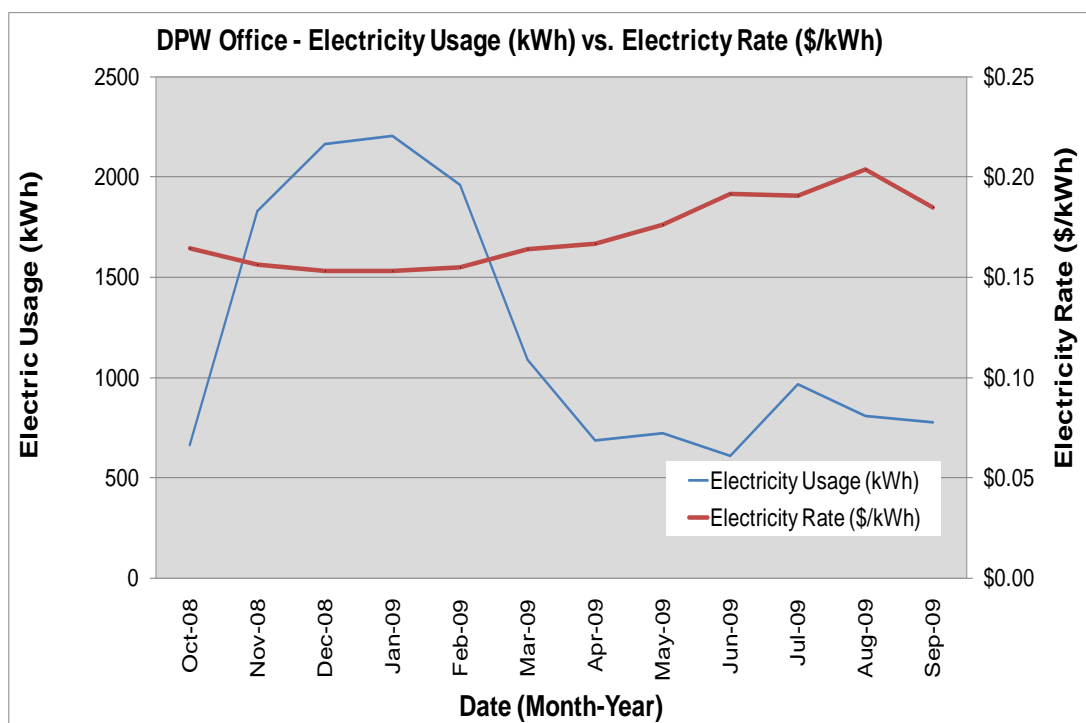


Annual Energy Costs (\$)

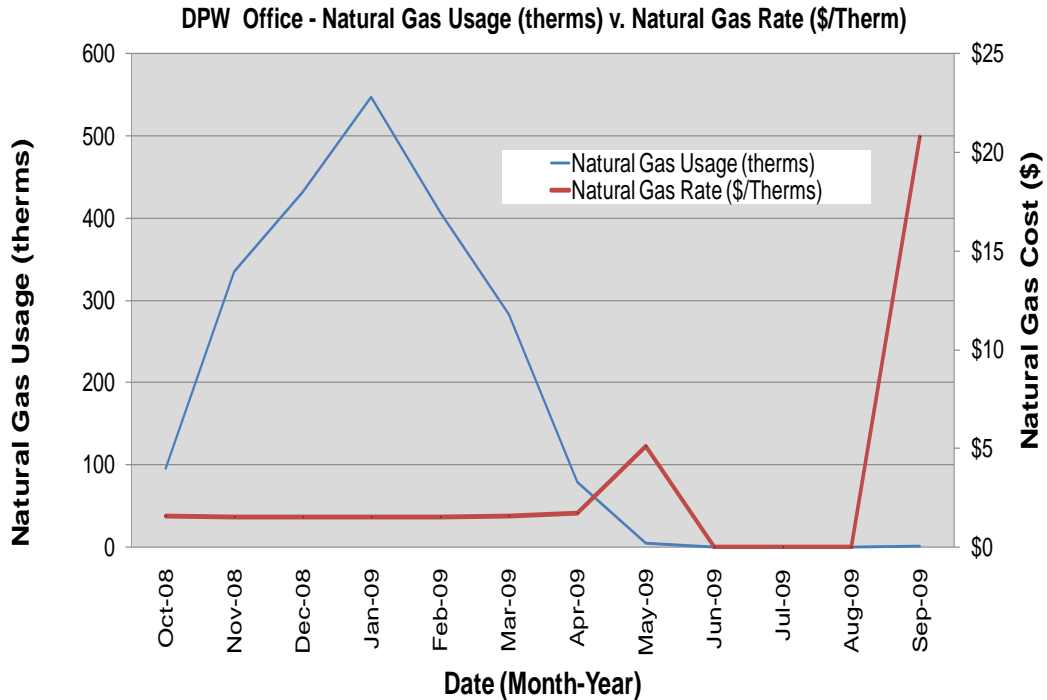


1.2. Utility rate analysis

The Department of Public Works Office 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 Office currently pays an average rate of approximately \$0.166/kWh based on the 12 months of utility bills of October 2008 to September 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 Office 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 Public Safety Building currently. The average aggregated rate (supply and transport) for the meter is approximately \$1.591/therm based on 12 months of utility bills October 2008 to September 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 a building floor area of less than 5,000 SF which means that it is still ineligible for Energy Star certification. 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 141.0 kBtu/sq ft yr compared to the national average of an office building consuming 77 kBtu/sq ft yr. Implementing this report’s highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 4.3 kBtu/sqft yr.

Per the LGEA program requirements, SWA has assisted the Township of Lower 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.

STATEMENT OF ENERGY PERFORMANCE Township of Lower - Public Works Offices

Building ID: 1933191
For 12-month Period Ending: September 30, 2009¹
Date SEP becomes ineligible: N/A

Date SEP Generated: February 01, 2010

Facility
Township of Lower - Public Works Offices
771 Seashore Road
Cape May, NJ 08204

Facility Owner
Township of Lower
2600 Bayshore Road
Villas, NJ 08251

Primary Contact for this Facility
Margaret Vitelli
2600 Bayshore Road
Villas, NJ 08251

Year Built: 1992
Gross Floor Area (ft²): 1,072

Energy Performance Rating² (1-100) N/A**Site Energy Use Summary³**

Electricity - Grid Purchase(kBtu)	49,177
Natural Gas (kBtu) ⁴	218,388
Total Energy (kBtu)	267,545

Energy Intensity⁴

Site (kBtu/ft ² /yr)	250
Source (kBtu/ft ² /yr)	368

Emissions (based on site energy use)
Greenhouse Gas Emissions (M_{CO₂e}/year)

19

Electric Distribution Utility
Pepco - Atlantic City Electric Co

National Average Comparison

National Average Site EUI	77
National Average Source EUI	182
% Difference from National Average Source EUI	101%
Building Type	Office

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 Standards⁶ for Indoor Environmental Conditions:

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

Certifying Professional
N/A

Notes:

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

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, PE facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2622T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The energy audit performed by Steven Winter Associates (SWA) encompasses the Public Works Office located at 771 Seashore Road, Erma, NJ. It is a single story building with approximately 1,072 square feet of conditioned space that is attached to one of the garage bays and is part of a complex that also includes the entire Department of Public Works garage. The building itself is home to only offices and related support rooms.



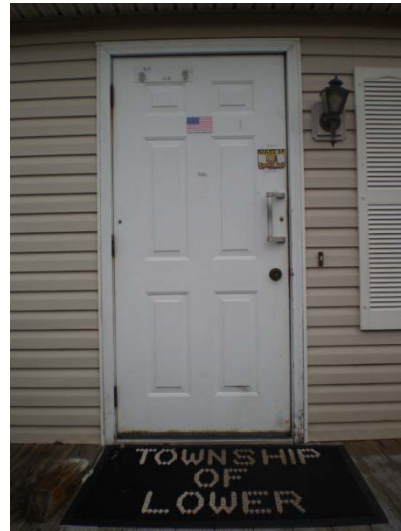
Partial South Façade



Partial North Façade



Partial East Façade



Partial West Façade

1.1. Building Occupancy Profiles

There are approximately 10 full time employees working in the building at any 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.

1.2. Building envelope

2.1.1. Exterior Walls

The exterior wall envelope is mostly constructed of aluminum clapboard siding and a wood stud framing. No visible insulation was present however; code requirements at the time of construction should result in some sort of insulation being installed.

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.

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. There were however, several minor problems with cracked siding or slight signs of water damage.

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



Signs of water damage at perimeter walls and damaged metal siding

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. Repair or replace all damaged sections of exterior siding
2. Inspect and maintain the exterior walls biannually with a focus on displaced or damaged signing, signs of water damage or infiltration.

2.1.2. Roof

The building's roof is predominantly a medium-pitch gable type over a wood structure with a asphalt shingle finish. No visible insulation was present however; code requirements at the time of construction should result in some sort of insulation being installed.

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.

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 typical roof was identified:



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

2.1.3. Base

The building's base is composed of a slab-on-grade floor with concrete block foundation walls 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/ age appropriate condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues neither visible on the interior nor exterior.

2.1.4. 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 throughout the building and were replaced recently. These windows are installed with insect screens and storm doors.
2. A combination unit with two double-hung type windows with an insulated aluminum frame, clear double glazing and interior roller blinds. The windows are located throughout the building and were replaced recently. These windows are installed with insect screens.

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 good condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following typical windows were identified:



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. SWA recommends that all windows be inspected at least twice per year with a focus on the condition of the glazing, frame, airtight seal and proper functioning of the window hardware.

2.1.5. Exterior doors

The building contains only one type of exterior door..

1. Paneled solid metal type exterior doors. 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 good condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific door problem spots and areas were identified:



Partially missing/ worn weather stripping

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. Add insulation and molding/ trim around doors where missing or necessary.
2. If not properly maintained, exterior doors can become major sources of heat loss and infiltration. As a best practice, SWA recommends checking the frames, weather-stripping and airtight seal of each door on a regular basis.

2.1.6. Building air-tightness

Overall the field auditors found the building to be reasonably air-tight, considering the building's use and occupancy, 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.

1.3. HVAC Systems

The DPW Administrative offices consists of only 1,072 square feet and therefore contains a single combination unit to meet the heating, cooling and ventilation needs of the building.

1.3.1. Heating

The building contains one Trane combination unit to meet the heating, cooling and ventilation needs of the building. This unit was installed in 2007 and has a total heating output of 77,500 MBH with a thermal efficiency of 81%. The unit is located on the side of the building and was observed to be in good, age-appropriate condition. The unit is controlled by two non-programmable thermostats. SWA recommends installing 2 programmable thermostats to ensure that the HVAC system is setback during nights and weekends.

1.3.2. Cooling

As mentioned above in Section 1.3.1 Heating, the building contains one Trane combination for heating as well as cooling.

1.3.3. Ventilation

The Trane unit mentioned above mixes fresh outside air with return air from inside the building to provide ventilation to all areas.

In addition to the combination unit, a toilet exhaust fan helps induce fresh air into the building.

1.3.4. Domestic Hot Water

There is one Mor-Flo electric hot water heater with a storage capacity of 30 gallons. This unit was installed in 1980 and is beyond its expected useful lifetime. SWA recommends replacing this unit with an equivalent sized gas-fired unit with a minimum efficiency of 85%.

1.4. Electrical systems

1.4.1. Lighting

Interior Lighting – The Garage contains a mix of efficient and inefficient lighting. There are efficient lighting fixtures such as the existing 4' T8 fixtures with electronic ballasts and screw-in CFL's (compact fluorescent light bulbs). There are also some inefficient 40 watt and 60 watt incandescent fixtures that SWA recommends replacing with CFL's. 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 60 watt incandescent fixtures that SWA recommends replacing with CFL's.

1.4.2. Appliances

SWA performed a basic survey of appliances installed at The Department of Public Works Office 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 (i.e. refrigerators, coffee makers, televisions, etc) be plugged in to power strips and turned off each evening just as the lights are turned off. The Department of Public Works Office computers are generally programmed for the power save mode, to shut down after a period of time that they have not been used.

1.4.3. Elevators

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

1.4.4. Process and others electrical systems

There are currently no other process or electrical systems installed in the building.

2. EQUIPMENT LIST

Inventory

Building System	Description	Physical Location	Make/ Model	Fuel	Space served	Date Installed	Estimated Remaining useful life %
Heating/ Cooling	Trane combination gas-fired forced air furnace with R22 cooling, 96,000 BTUH input, 77,500 BTUH output, 81% thermal efficiency	Exterior, side of building	Trane, Model #2YCC3042A1096AA, Serial #6355WJU9H	Natural Gas/ Electricity	All areas	2007	88%
Domestic Hot Water	Mor-Flo electric hot water heater, Upper element 4500W, Lower element 4500W, Total 4500W, 30 gallons	Office area	Mor-Flow, Model #HEFR90-32DC, Serial #9143127647	Electricity	All areas	1980	0%
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.

3. ENERGY CONSERVATION MEASURES

Based on the assessment of The Department of Public Works Office, 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

- None

Category II Recommendations: Operations and Maintenance

- Repair or replace all damaged sections of exterior siding – The building contains a few areas where siding was slightly damaged or has begun to show signs of water damage. SWA recommends replacing these areas of siding immediately, before any major damage occurs.
- Inspect and maintain exterior walls biannually – SWA recommends that the exterior surfaces are inspected on a bi-annual basis to check for any signs of damage. Damage should be corrected immediately to prevent future problems associated with water damage or air infiltration.
- Perform bi-annual roof inspections – SWA recommends performing bi-annual inspections as part of a preventative maintenance plan. Any displaced or damaged shingles should be replaced immediately to prevent water damage.
- Perform bi-annual inspections of windows and exterior doors – SWA recommends performing inspections on a biannual basis as part of a preventative maintenance program. Any damaged units should be repaired immediately.
- 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 16 new CFL lamps
Description of Recommended End of Life Cycle ECMs	
2	Replace electric DHW heater with natural gas unit

ECM#1: *Install 16 new CFL lamps*

Description:

The DPW Administrative Offices building contains 16 fixtures containing incandescent lights that are inefficient should be replaced. SWA recommends replacing the above mentioned bulbs with Compact Fluorescent Lamps (CFLs) that have an equivalent light output. 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: \$803

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 16 new CFL lamps	RS Means	803	0	803	1,363	0.3	0	4.3	14	240	5	1,094	3.3	36	7	15	291	2,440

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: 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: \$1,200

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	Replace electric DHW heater with natural gas unit	RS Means	1,250	50	1,200	586	0.1	-20	0.0	10	75	10	637	15.9	-47	-5	-8	-563	829

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>

4. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

4.1. Existing systems

There aren't currently any existing renewable energy systems.

4.2. 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.

4.3. Solar Photovoltaic

A Solar Photovoltaic Array has not been recommended due to the limited amount of unobstructed areas with South-South West exposure.

4.4. 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.

4.5. Combined Heat and Power

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

4.6. Geothermal

Geothermal is not applicable for this building because of the current HVAC configuration.

5. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

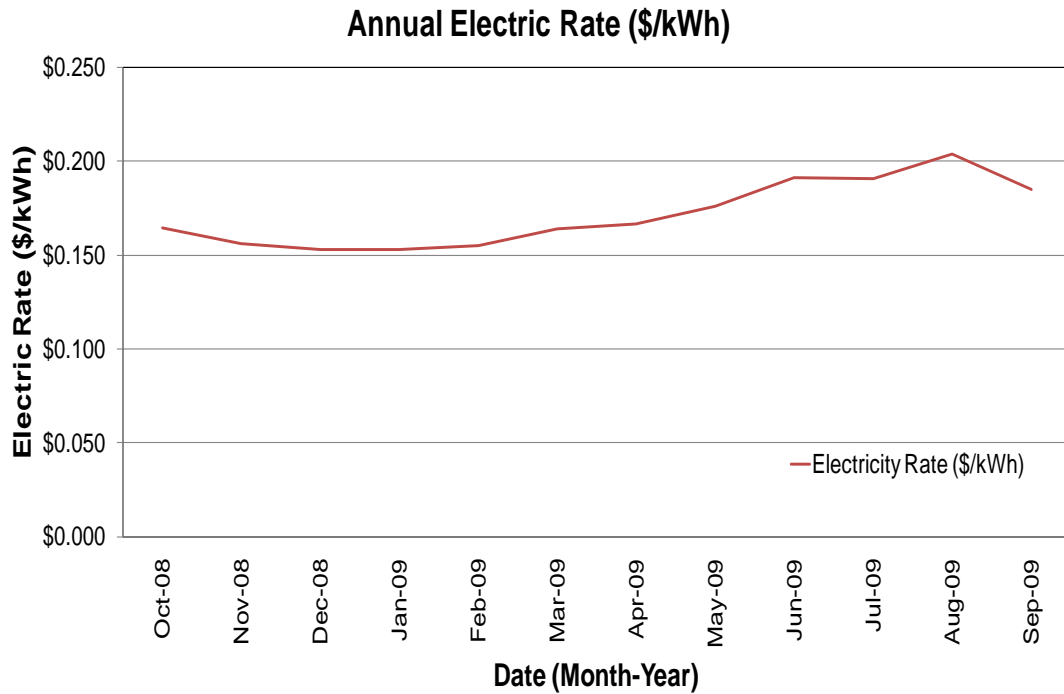
5.1. Energy Purchasing

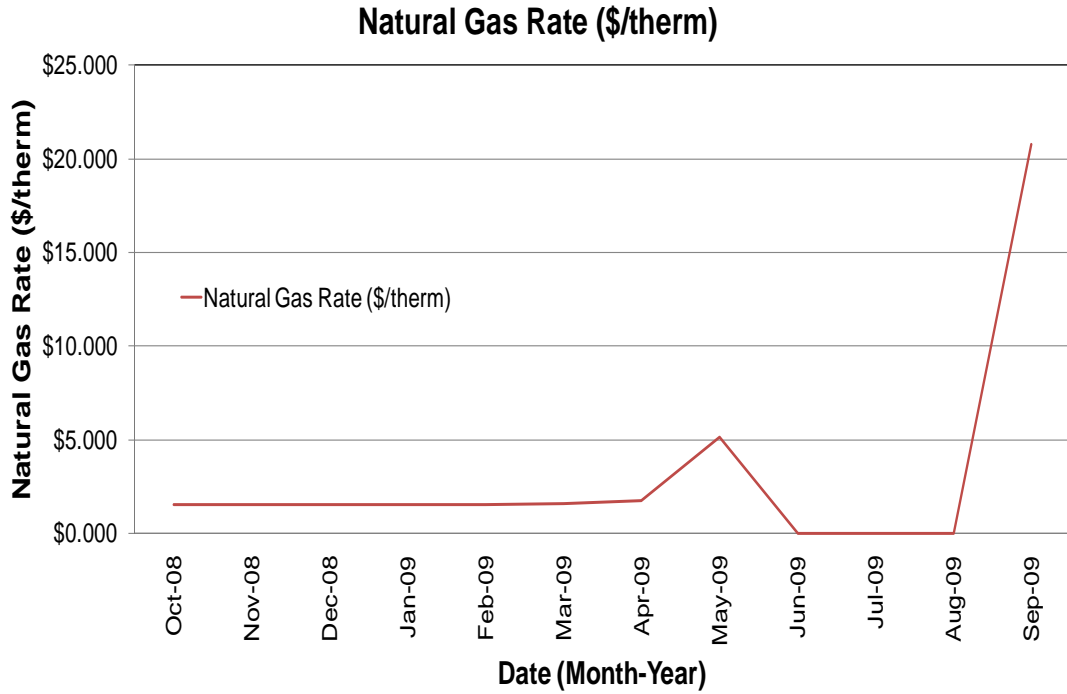
The Department of Public Works Office receives electricity purchased via one incoming meter directly from Atlantic City Electric without an ESCO. An Energy Services Company (ESCO) is a consultancy group that engages in a performance based contract with a client firm to implement measures which reduce 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 25% over the 12 month period between October, 2008 and September, 2008.

The Department of Public Works Office 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 93% over the 12 month period between October, 2008 and September, 2008. 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 \$0.166/kWh, which means there is a potential cost savings of \$232 per year. The current natural gas rate for The Department of Public Works Office is \$1.591/therm which means there is a potential cost savings of \$90 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 Office. 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.





5.2. Energy Procurement strategies

Also, The Department of Public Works Office 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.

6. METHOD OF ANALYSIS

6.1. 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

6.2. 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 Office

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	Vestibule	Parabolic	E	4'T8	1	4	32	S	8	261	13	141	294	N/A	Parabolic	4'T8	E	S	1	4	32	8	261	13	141	294	0	0	0
2	1	Vestibule	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
3	1	Office	Screw-in	N	CFL	1	4	14	S	8	261	0	56	117	N/A	Screw-in	CFL	N	S	1	4	14	8	261	0	56	117	0	0	0
4	1	Office	Parabolic	E	4'T8	1	4	32	S	8	261	13	141	294	N/A	Parabolic	4'T8	E	S	1	4	32	8	261	13	141	294	0	0	0
5	1	Kitchen	Screw-in	N	Inc	1	1	40	S	8	261	0	40	84	CFL	Screw-in	CFL	N	S	1	1	15	8	261	0	15	31	52	0	52
6	1	Hallway	Screw-in	N	Inc	2	1	40	S	8	261	0	80	167	CFL	Screw-in	CFL	N	S	2	1	15	8	261	0	30	63	104	0	104
7	1	Hallway	Exit Sign	N	LED	1	1	5	N	24	365	1	6	53	N/A	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	0	0	0
8	1	Bathroom Men	Screw-in	N	Inc	3	1	60	S	8	261	0	180	376	CFL	Screw-in	CFL	N	S	3	1	20	8	261	0	60	125	251	0	251
9	1	Bathroom Women	Screw-in	N	Inc	3	1	60	S	8	261	0	180	376	CFL	Screw-in	CFL	N	S	3	1	20	8	261	0	60	125	251	0	251
10	1	Janitor's Closet	Screw-in	N	Inc	1	1	60	S	2	261	0	60	31	CFL	Screw-in	CFL	N	S	1	1	20	2	261	0	20	10	21	0	21
11	1	Office	Screw-in	N	Inc	4	1	60	S	8	261	0	240	501	CFL	Screw-in	CFL	N	S	4	1	20	8	261	0	80	167	334	0	334
12	1	Office	Recessed	E	4'T8	1	4	32	S	8	261	13	141	294	N/A	Recessed	4'T8	E	S	1	4	32	8	261	13	141	294	0	0	0
13	Ext	Exterior	Screw-in	N	Inc	2	1	60	S	12	365	0	120	526	CFL	Screw-in	CFL	N	S	2	1	20	12	365	0	40	175	350	0	350
Totals:						22	25	500				41	1,391	3,166						22	25	250			41	796	1,802	1,363	0	1,363

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

Appendix B: Third Party Energy Suppliers (ESCOs)

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

Third Party Electric Suppliers for 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
Integrays Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integraysenergy.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 measures (such as LED lighting versus fluorescent) the operating savings will factor in the cost of replacing the units to match the lifetime of the ECM. In this case or in one where one-time repairs are made, the total replacement / repair sum is averaged over the lifetime of the ECM.

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

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

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

Calculation References

ECM = Energy Conservation Measure
AOCS = Annual Operating Cost Savings
AECS = Annual Energy Cost Savings
LOCS = Lifetime Operating Cost Savings
LECS = Lifetime Energy Cost Savings
NPV = Net Present Value
IRR = Internal Rate of Return
DR = Discount Rate

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

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

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

Excel NPV and IRR Calculation

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

	A	B	C	D	E	F	G	H	I
1									
2									
3					Year	Cash Flow			
4					0	\$(5,000.00)		Investment Cost	
5					1	\$ 850.00		Cash Flow: Annual Energy Cost Savings + Annual Maintenance Savings	
6					2	\$ 850.00			
7					3	\$ 850.00			
8					4	\$ 850.00			
9					5	\$ 850.00			
10					6	\$ 850.00			
11					7	\$ 850.00			
12					8	\$ 850.00			
13					9	\$ 850.00			
14					10	\$ 850.00			
15								Formula: =IRR(F4:F14) =NPV(0.03,F5:F14)+F4	
16					IRR	11.03%			
17					NPV	\$2,250.67			
18									
19									

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