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June 28, 2010

Local Government Energy Program
Energy Audit Report

Township of Livingston

Municipal Court
20 Robert Harp Drive
Livingston, NJ 07039

Project Number: LGEA50

TABLE OF CONTENTS

INTRODUCTION

As an approved energy consulting firm under the Local Government Energy Audit Program (LGEA), Steven Winter Associates, Inc. (SWA) was selected to perform an energy audit and assessment for the Township of Livingston. The audit included a review of the following buildings located in the Township of Livingston for which separate energy audit reports are issued for each of the following referenced buildings:

- Municipal Court
- Main Fire Department
- Northfield Fire Station
- Circle Fire Station
- Township Garage
- Livingston Free Public Library
- Senior & Community Center
- Water Department
- Monmouth Court Community Center
- Well House No. 3, Building 1
- Well House No. 3, Building 2
- Well House No. 4
- Well House No. 9
- Well House No. 11
- Okner Field Concession Building
- Storage Shed
- Northland Pool and Recreation Center
- Sewage Treatment Plant
- Animal Shelter
- Pump House
- Booster Station
- Sewer Station

This report addresses the Municipal Court located at 20 Robert Harp Drive, Livingston 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 Municipal Court located at 20 Robert Harp Drive was opened in 1932. It is a single story with basement free standing building with approximately 3,000 square feet of conditioned space. The building includes basement court house, judges chambers, counsels offices, administrative office, fines payment center and garage. There are approximately 5 full time employees between the court and administrative office working full time at the courthouse on weekdays between 9:00 AM to 4:00 PM.

The goal of this Local Government Energy Audit (LGEA) is to provide sufficient information to the Township of Livingston 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 5 provide a description of our recommendations.
- Appendices include further details and information supporting our recommendations.

EXECUTIVE SUMMARY

The Municipal Court located at 20 Robert Harp Drive was opened in 1932. It is a single story with basement free standing building with approximately 3,000 square feet of conditioned space. The building includes basement court house, judges chambers, counsels offices, administrative office, fines payment center and garage. There are approximately 5 full time employees between the court and administrative office working full time at the courthouse on weekdays between 9:00 AM to 7:00 PM.

Based on the field visit performed by the SWA staff on January 25th, 2010 and the results of a comprehensive energy analysis, this report describes the site's current conditions and recommendations for improvements. Suggestions for measures related to energy conservation and improved comfort are provided in the scope of work. Energy and resource savings are estimated for each measure that results in a reduction of heating, cooling, and electric usage.

Existing conditions

From March 2008 through February 2009, the period of analysis for this audit, the building consumed 16,776 kWh or $3,189 worth of electricity at an approximate rate of $0.19/kWh and 5,618 therms or $5,618 worth of natural gas at an approximate rate of $1.353 per therm. The joint energy consumption for the building, including both electricity and fossil fuel was 472 MMBtus of energy that cost a total of $8,807.

SWA has entered energy information about the Municipal Court in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* Energy benchmarking system. Currently, the building is not eligible to receive a performance rating because its floor area is less than 5,000 square feet which means that it is still ineligible for ENERGY STAR®. SWA encourages the Township of Livingston 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 166 kBtu/sq ft yr compared to the national average of a Municipal Court consuming 118 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 24.4 kBtu/sqft yr, with an additional 2.5 kBtu/sq ft yr from the recommended ECMs.

Implementing this report's recommendations will reduce use by approximately 26.9 kBtu/sq ft yr, which would decrease the building's energy use intensity to 139.1 kBtu/sq ft yr.

Recommendations

The Municipal Court is seventy-eight years old, most of the HVAC equipment has exceeded their recommended useful life cycle and additionally much of the lighting is inefficient. In Appendix C, SWA has included a mechanical inventory list of equipment for the Municipal Court. 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:

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 Improvements

- Replace heating terminal equipment
- Replacement window air conditioners
- Gutter and downspouts repair
- Exterior wall surface transition repair
- Exterior wall penetration air-sealing
- Roof flashing repair
- Install R-30 roof insulation
- Overgrown mold and vegetation removal
- Roof shingle repair
- Building slab sealing
- Site drainage improvement
- Window sill repair
- Damage door frame repairs

Category II Recommendations: - Operations and Maintenance

- Boiler room and attic piping insulation
- Expansion tank inspection
- Use ENERGY STAR® labeled appliances
- Gutter maintenance program
- Exterior wall maintenance program
- Roof maintenance program
- Air conditioner sleeve sealing
- Window maintenance program
- Door maintenance program

Category III Recommendations: Energy Conservation Measures

At this time, SWA highly recommends a total of **2** Energy Conservation Measures (ECMs) for The Municipal Court that is summarized in the following Table 1. The total investment cost for these ECMs with incentives is **$5,473**. SWA estimates a first year savings of **$1, 862** with a simple payback of **2.9 years**. SWA also recommends **2** ECMs with a 5-10 year payback that is summarized in Table 2 and no End of Life Cycle ECMs.

The implementation of all the recommended ECMs would reduce the building electric usage by 3,580 kWh annually, or 21% of the building's current electric consumption and 685 Therms or 12% of the buildings current natural gas consumption. SWA estimates that implementing these ECMs will reduce the carbon footprint of The Municipal Court by **12,920** lbs **of CO_2**, which is equivalent to removing approximately 2 cars from the roads each year or avoiding the need of 40 trees to absorb the annual CO_2 produced. In regards to the purchase of electricity there is a potential cost savings of $671 therefore SWA recommends that Township of Livingston contacts third party energy suppliers in order to negotiate a lower electricity rate.

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

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

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	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
1.2	Install (76) new CFL fixtures	3,433	0	3,433	2,362	0.5	N/A	2.7	384	833	5	4,164	4.1	21	4	7	359	3,236
3.2	incremental cost to replace boilers with packaged high efficiency condensing boiler	2,500	460	2,040	0	0.0	650	21.7	150	1,029	25	21,986	2.0	1162	46	50	15,886	7,605
	TOTALS	5,933	460	5,473	2,362	1	650	24	534	1,862	-	26,150	2.9	-	-	-	16,245	10,841

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	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
1.1	Replace (22) T12 fixtures with T8 fixtures	4,263	660	3,603	1,218	0.3	0	1.4	142	373	15	5,601	9.7	55	4	6	791	1,669
2.2	incremental cost to replace domestic water heater with 95% efficient unit	500	50	450	0	0.0	35	1.2	0	47	15	710	9.6	58	4	6	115	410
	TOTALS	4,763	710	4,053	1,218	0	35	3	142	420	-	6,311	9.7	-	-	-	906	2,079

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

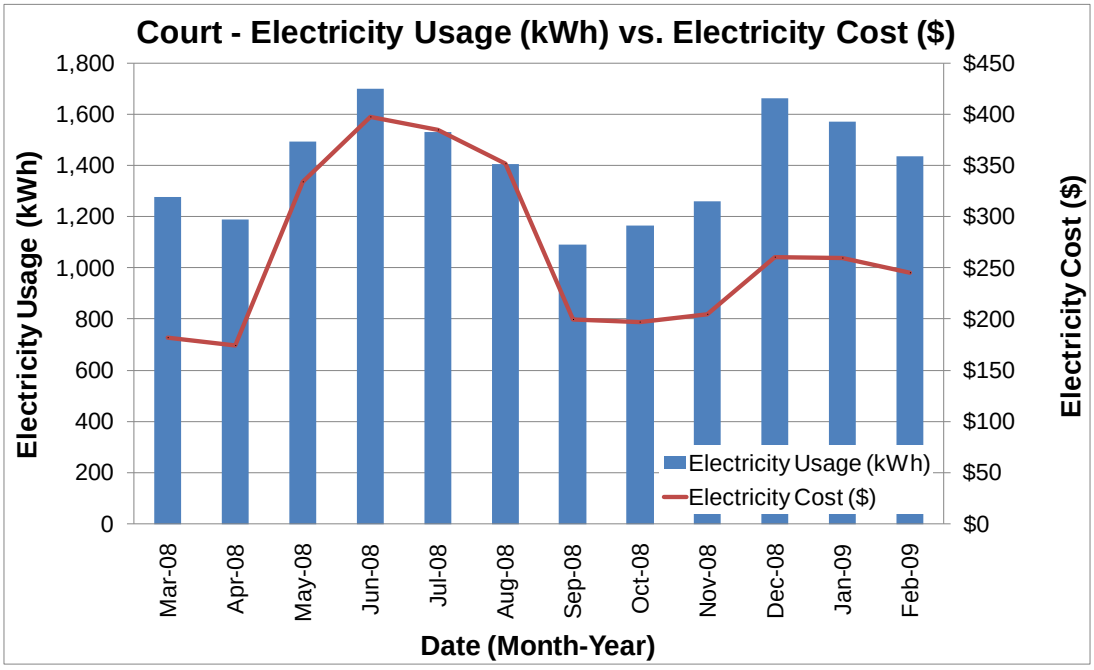
1.1. Energy usage, load profiles and cost analysis

SWA analyzed utility bills for the Municipal Court for the 24 months between March 2007 to February 2009 with a chosen period of analysis between **March 2008 through February 2009**.

Electricity - The Municipal Court buys electricity from PSE&G at **an average rate of $0.19/kWh** based on 12 months of utility bills from **March 2008 through February 2009**. The building purchased **approximately 16,776 kWh or $3,189 worth of electricity** during the analysis period and is currently charged for demand (kW) which has been factored into each monthly bill. The building had an average monthly demand of **8.1 kW** and an annual peak demand of **10.7 kW**.

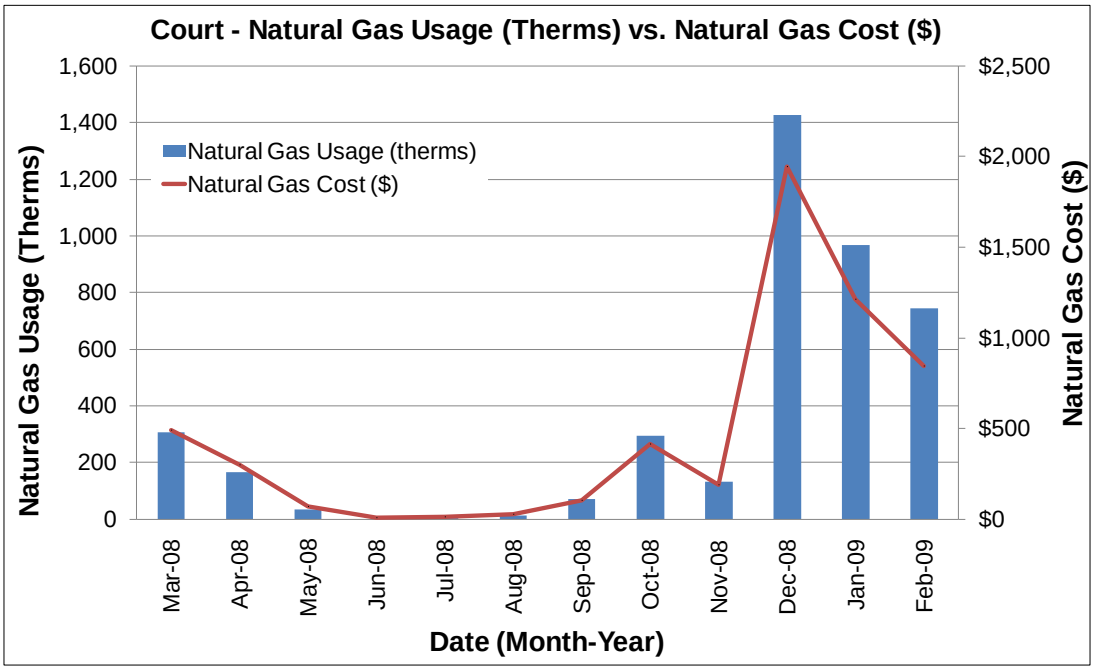
Natural gas – The Municipal Court is currently served by one meter for natural gas. They currently buy natural gas from PSE&G which acts as the transportation company and energy supplier at **an average aggregated rate of $1.353/therm** and purchased **approximately 4,151 therms or $5,618 worth of natural gas** in the 12 months from March 2008 to February 2009.

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

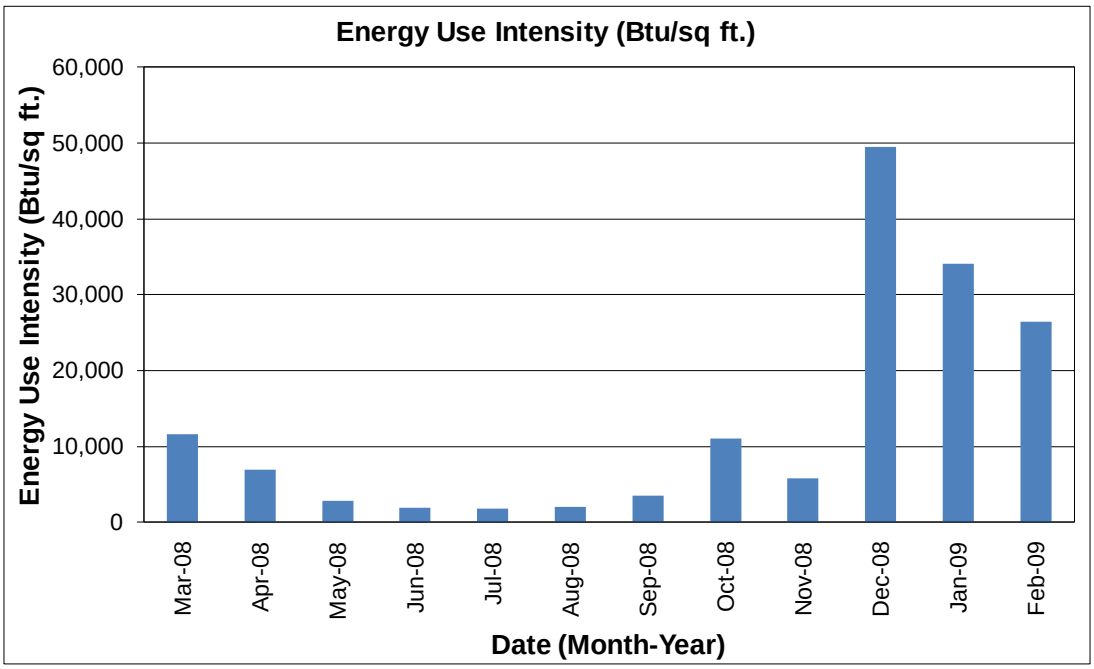


Electricity use follows a trend that is expected for this building with usage peaking during the summer cooling season and winter. SWA believes that the winter time peak is due to heating related pumps, fans and motors, and possibly evidence of the use of personal heating units that were not present at the time of the audit. The cost of electricity fluctuates as expected with usage peaking in the summer during the time of highest usage.

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

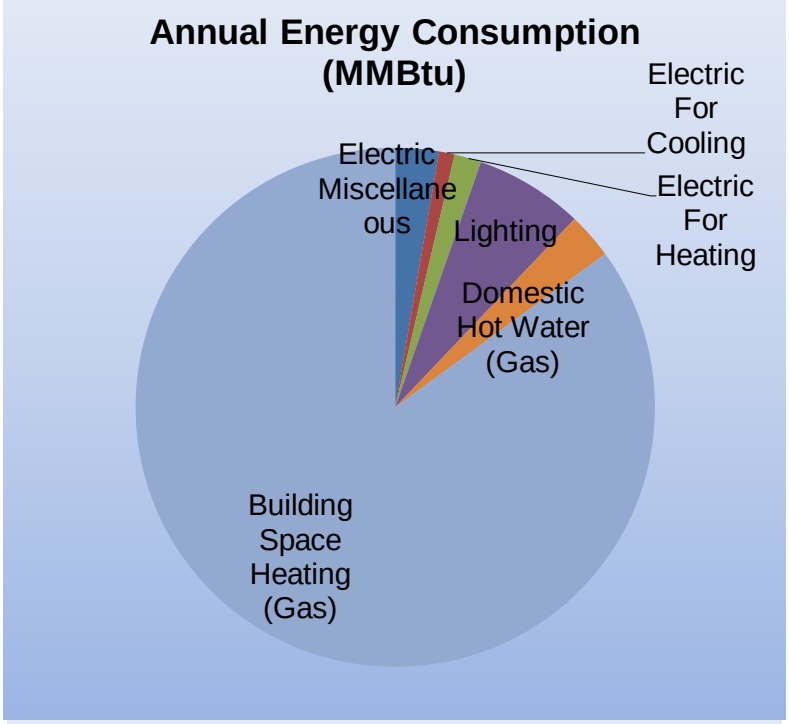


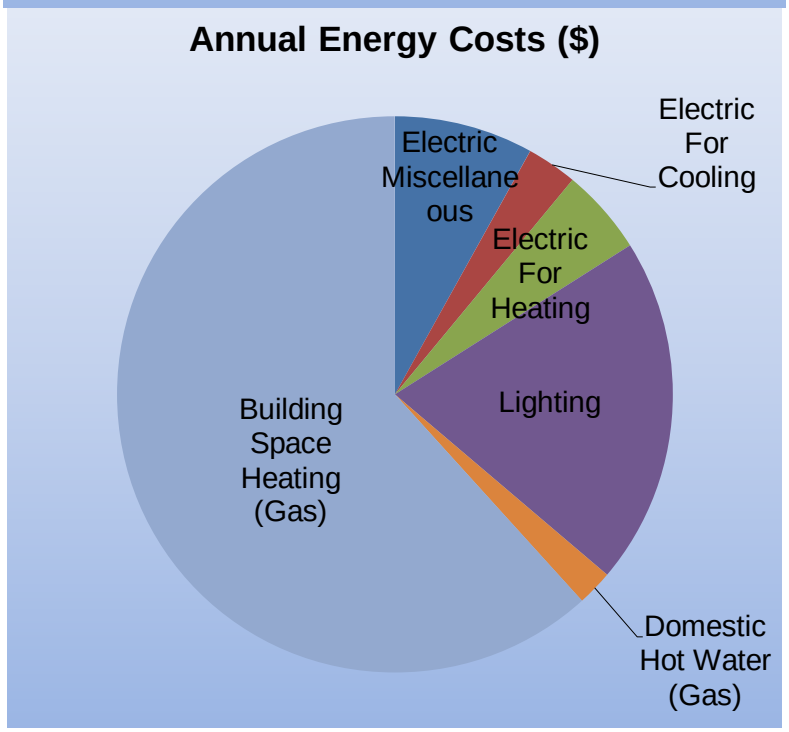
The following chart shows electric consumption in Btu/sq ft for the Municipal Court based on utility bills for the 12 month period of March 2008 to February 2009.



The following table and chart pies show energy use for the Municipal Court based on utility bills for the 12 month period of March 2008 to February 2009. Note: Electrical cost at $78/MMBtu of energy is almost more than 5 times as expensive to use as typical natural gas at $15/MMBtu.

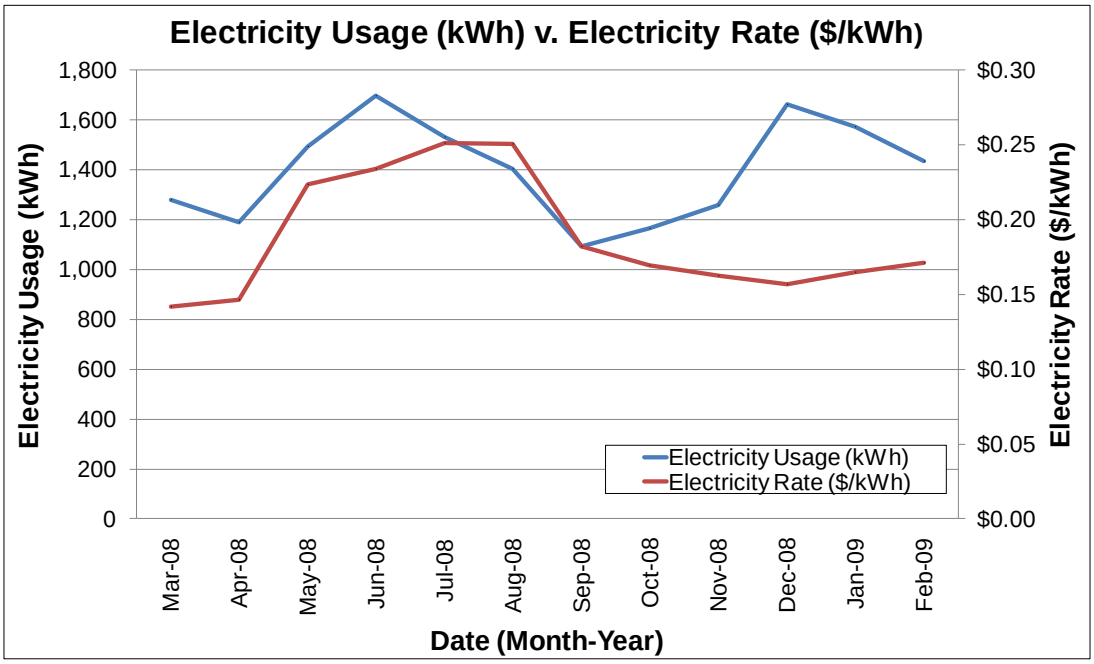
March 2008 - February 2009 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	13	3%	$712	8%	56
Electric For Cooling	5	1%	$258	3%	56
Electric For Heating	8	2%	$440	5%	56
Lighting	32	7%	$1,779	20%	
Domestic Hot Water (Gas)	13	3%	$182	2%	14
Building Space Heating (Gas)	402	85%	$5,436	62%	
Totals	472	100%	$8,807	100%	19
Total Electric Usage	57	12%	$3,189	36%	56
Total Gas Usage	415	88%	$5,618	64%	14
Totals	472	100%	$8,807	100%	19


Annual Energy Consumption (MMBtu)
Electric For Cooling
Electric Miscellaneous
Electric For Heating
Lighting
Domestic Hot Water (Gas)
Building Space Heating (Gas)

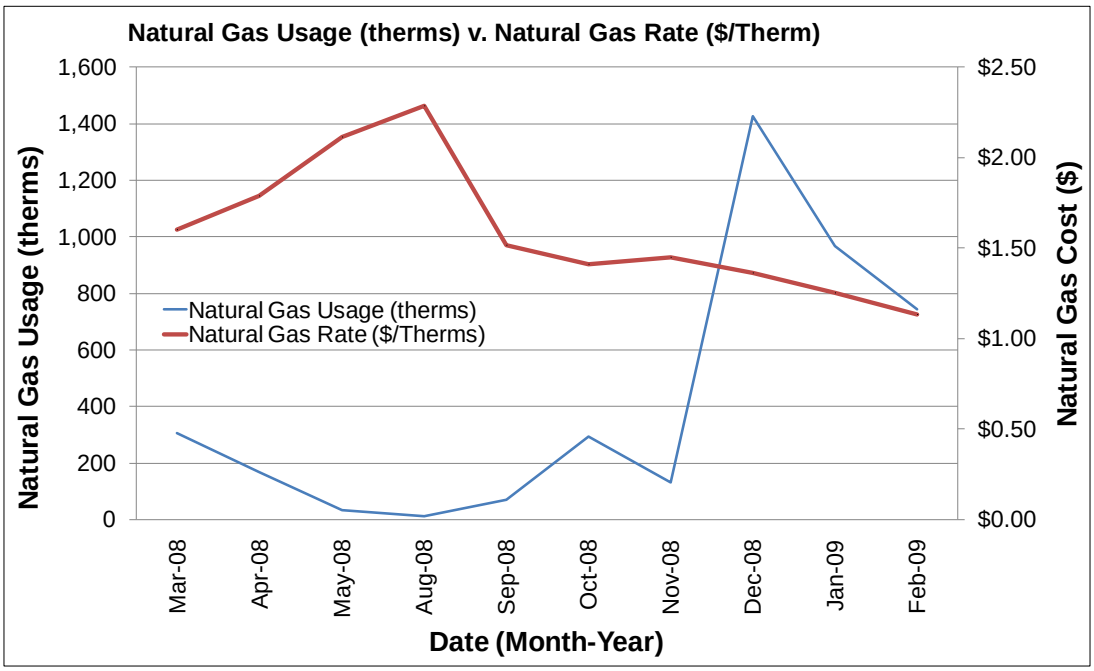

Annual Energy Costs ($)
Electric For Cooling
Electric Miscellaneous
Electric For Heating
Lighting
Building Space Heating (Gas)
Domestic Hot Water (Gas)

1.2. Utility rate analysis

The Municipal Court currently purchases electricity from PSE&G at a general service market rate for electricity use (kWh) including a separate (kW) demand charge that is factored into each monthly bill. The Municipal Court currently pays an average rate of approximately $0.19/kWh based on the 12 months of utility bills of March 2008 to February 2009. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. The electric rate does not show large fluctuations throughout the year except for an anticipated rise in the summer time. Based on these observations this appears to be the appropriate rate for the building.



The Municipal Court currently purchases natural gas from PSE&G 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 Municipal Court currently. The average aggregated rate (supply and transport) for the meter is approximately $1.353/therm based on 12 months of utility bills March 2008 to February 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 Municipal Court in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* Energy benchmarking system. Currently, the building is not eligible to receive a performance rating because its floor area is less than 5,000 square feet which means that it is still ineligible for ENERGY STAR®. SWA encourages the Township of Livingston 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 166 kBtu/sq ft yr compared to the national average of a Municipal Court consuming 118 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 24.4 kBtu/sqft yr, with an additional 2.5 kBtu/sq ft yr from the recommended ECMs.

Implementing this report's recommendations will reduce use by approximately 26.9 kBtu/sq ft yr, which would decrease the building's energy use intensity to 139.1 kBtu/sq ft yr.

Per the LGEA program requirements, SWA has assisted the Township of Livingston 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:

[redacted]

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 Livingston - Municipal Court

Building ID: 2046333
For 12-month Period Ending: February 28, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: March 16, 2010

Facility	Facility Owner	Primary Contact for this Facility
Township of Livingston - Municipal Court 20 Robert Harp Drive Livingston, NJ 07039	Township of Livingston 357 South Livingston Avenue Livingston, NJ 07039	Richard Calbi 357 South Livingston Avenue Livingston, NJ 07039

Year Built: 1932
Gross Floor Area (ft²): 3,000

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	59,367
Natural Gas (kBtu)[4]	439,010
Total Energy (kBtu)	498,377
Energy Intensity[5]	
Site (kBtu/ft²/yr)	166
Source (kBtu/ft²/yr)	219
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	32
Electric Distribution Utility	
Public Service Elec & Gas Co	
National Average Comparison	
National Average Site EUI	118
National Average Source EUI	264
% Difference from National Average Source EUI	-17%
Building Type	Courthouse

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 Municipal Court located at 20 Robert Harp Drive was opened in 1932. It is a single story with basement free standing building with approximately 3,000 square feet of conditioned space. The building includes basement court house, judges chambers, counsels offices, administrative office, fines payment center and garage.


Partial South Façade


Partial East Façade


Partial West Façade


Partial North Façade

2.2. Building Occupancy Profiles

The building's occupancy is approximately 5 full time employees between the court and administrative office working full time at the courthouse on weekdays between 9:00 AM to 4:00 PM. While court is in session occupancy fluctuates based upon the amount of visitors who appear before the court.

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 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 stucco over 3-1/2" framing with 0 inches of detectable/ assumed insulation. There is also a section of the building where the wall is natural stone veneer with 0 inches of detectable/ assumed insulation and small sections of vinyl clapboard siding over 3-1/2" framing with 0 inches of detectable/ assumed insulation.

Note: Wall insulation levels could not be verified in the field and are based on reports from building management/ maintenance personnel.

During the field audit exterior and interior wall surfaces were inspected. They were found/ reported to be in overall acceptable condition with some signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues located mostly at the side(s) of the building.

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

Signs of uncontrolled roof water runoff on walls due to missing/ defective roof flashing and defective/ clogged gutters and downspouts as well as unsealed penetrations and aged / damaged caulk at surface transitions

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 cracked/ ineffective caulk.
2. Apply appropriate air-sealing strategies around all exterior wall penetrations (incl. electrical, plumbing and HVAC).
3. Repair and maintain flashing to minimize uncontrolled wind driven and roof water run-off causing exterior wall damage.
4. Install/ repair and maintain gutters, downspouts and downspout deflectors to minimize uncontrolled roof water run-off causing exterior wall damage.
5. Maintain and inspect all exterior wall surfaces with a focus on the condition of caulking, cracked stucco, signs of water damage, and locations that correspond to areas of known infiltration.

2.3.2. Roof

The building's roof is predominantly a medium-pitch gable type over a wood structure with an asphalt shingle finish. It was recently installed. 0 inches of roof insulation are assumed to be presently installed.

Note: Roof insulation levels could not be verified in the field and are based on reports from building management/ maintenance personnel.

During the field audit roofs, related flashing, gutters and downspouts were inspected. They were found/ reported to be in overall acceptable/ age appropriate condition with some signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues detected on all roof areas.

The following typical roof and problem spots were identified:

Typical asphalt shingle roof with mold, water damage and uncontrolled vegetation growth on the roof, missing and displaced shingles, defective gutters, and missing / ineffective flashing

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 to ineffectively and under-insulated roof/ ceiling sections. SWA suggests applying closed-cell spray-foam (R-30 min.) to the underside of the roof framing.
2. Install/ repair and maintain roof flashing.
3. Overgrown mold should be removed and overgrown vegetation should be trimmed/ removed to not touch or block wall surfaces from necessary access, ventilation and sunlight.
4. Clean gutters and downspouts.
5. Repair or replace all damaged roof shingles and install new shingles in place of missing units.
6. Maintain/ inspect all roof surfaces on a regular basis.

2.3.3. Base

The building's base is composed of a below grade slab floor with a perimeter footing with poured concrete 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. Judging from signs of uncontrolled moisture or water presence and other energy compromising issues, overall the base was found/ reported to be in good condition with some signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues neither visible on the interior nor exterior.

The following specific base problem spots and areas were identified:

Water damage at base of the building and moisture seepage through cracks detected in the slab

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. Apply appropriate air/ water-sealing strategies around all slab penetrations (incl. electrical, plumbing and HVAC).

2. Install footing drains and slope perimeter grade away from building. SWA suggests investigating interior footing drain option.

2.3.4. Windows

The building contains several different types of windows:

1. Double-hung type windows with a wood frame, clear double glazing and interior roller shades the windows are located throughout the building and were installed recently.
2. Fixed type windows with an insulated aluminum frame, clear single glazing and no interior or exterior shading devices. The windows are located throughout the building and were installed recently.
3. Sidelight and trans

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 acceptable/ age appropriate condition with some signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific window problem spots and typical installations were identified:

Damaged/ aged window frames, improperly sealed window A/C units, water pooling at window sill

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. 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.
2. Install/ repair pan or strip flashing and drip edge detail at window sill.

3. Replace all windows with damaged frames during next capital improvement project with ENERGY STAR®® units.
4. Maintain and inspect all exterior windows with a focus on the condition of the frames, glazing, proper hardware operation and signs of water damage/leakage and infiltration

2.3.5. Exterior doors

The building contains several different types of exterior doors.

1. Overhead aluminum type exterior door with glass panels. They are located in the garage only and were recently installed.

2. Aluminum type exterior door. They are located on the west facade.

3. Fiberglass type exterior door with glass panels. They are located in the front of the building and were recently installed.

4. Fiberglass type exterior door with glass panels. They are located in the front of the building and were recently installed.

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 only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

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

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. Repair and maintain damaged door frames and replace units during next major capital improvement.

2. Maintain and inspect all doors with a focus on the condition of the weather-stripping, door frame, air tight seal and signs of water damage and infiltration.

2.3.6. 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, electrical boxes and chimney walls 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

2.4.1. General

The Municipal Court building consists of one main level with offices and a court room and a garage, and a small basement which serves as the boiler and utility room. The large courtroom has adjoining offices in the rear of the courtroom space, and there is a wing of offices and storage/meeting rooms behind the front of the courtroom. The basement is located below the original portion of the building and the garage is attached, but is a later addition.

2.4.2. Heating

The entire building is heated via a Weil-McLain 'PFG' gas fired boiler. This boiler is circa 1998 and provides 215,000 btuh of output. It has an estimated remaining life of 60%. It appears that the building is split into three zones: 'Large Room' (the courtroom), 'offices', and the 'garage'. Heating hot water is supplied to each of these three zones via a dedicated Bell & Gossett pump, one for each zone. The pumps serving the garage and courtroom are in good condition, and the pump serving the offices has recently been replaced. The pumps provide the heating hot water to an assortment of radiators throughout the building. The offices and core areas of the building are heated by free-standing radiators and baseboard radiators located around the perimeter walls of the office wing. The courtroom and adjoining offices in the rear of the space have radiators mounted below the windows, and the garage is served by a very old hydronic unit heater that is

beyond its expected service life. Heating is controlled by wall mounted thermostats, one in each zone of the building.

Gas fired boiler and three heating hot water supply pumps in basement

Radiators throughout the building.

Hydronic Unit Heater in Garage

2.4.3. Cooling

Cooling is provided to the building exclusively by thru-the-wall air conditioning units. The eight (8) plus air conditioners range in age and are anywhere from 2 to 10+ years old.

Thru-the-wall air conditioners

2.4.4. Ventilation

There is no mechanical ventilation for occupancy being provided to the building. Further study should be undertaken to determine if the building meets the code requirements for natural ventilation. However, this analysis is beyond the scope of this energy audit.

2.4.5. Domestic Hot Water

The domestic hot water for the building is provided by a gas-fired, 40 gallon, 28 MBH tank-type water heater, located in the basement. The heater serves two (2) toilet rooms and a break room sink. This water heater is from 1996 and is nearing the end of its expected useful life.

Domestic Hot Water heater

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting – The Municipal Court contains inefficient lighting. There is primarily inefficient lighting such as the existing 4' T12 fixtures with magnetic ballasts and incandescent fixtures. SWA recommends replacing the T12 lights with T8 electronic ballast fixtures and incandescent fixtures with CFL's. SWA also recommends installing 3 occupancy sensors to reduce usage. See attached lighting schedule in Appendix A for a complete lighting inventory throughout the building and estimated power consumption.

Exterior Lighting – The exit lighting surveyed during the building audit was found to be LED exit lights that SWA recommends should remain.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be wall mounted incandescent. SWA recommends installing CFLs in place of them..

2.5.2. Appliances

SWA performed a basic survey of appliances installed at the Municipal Court and has determined that it would not be cost-effective to replace any of the existing appliances. Appliances, such as refrigerators, washers and dryers 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 in the court were observed to be powered on while not in use. 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 Municipal Court 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 Municipal Court does not have any elevators installed on the premises.

2.5.4. Process and others electrical systems

There is currently no significant process and other electrical systems installed at the Municipal Court.

3. EQUIPMENT LIST

Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	Hot Water Boiler	Basement	Weil-McLain: PFG Boiler M# PFG-6-PIN 305MBH in 215MBH out	Natural Gas	Building	1998	60%
Heating	(3) Hot Water Supply Pumps (1 new, 2 old)	Basement	Bell & Gossett Series 100 1/12 HP ea.	Electric	Building	Varies	50-90%
Domestic Hot Water	Hot Water Heater	Basement	Rheem M# 21V40S-2 S# 0696A21068 28MBH in 40 gal.	Natural Gas	Building	1996	0-5%
Plumbing	Sump Pump	Basement	(nameplate inaccessible) Plug-in type, est. fractional horsepower	Electric	Building		
Cooling	(8) Thru wall/ window Air Conditioners	Throughout Main Floor	Various makes & models	Electric	Main Floor rooms & offices	Varies	0-50%
Heating	Finned-tube hot water radiators	Main Floor office areas	(no nameplate information available)	Domestic Hot Water	Main Floor office areas	Circa 1970s	0% beyond useful life
Heating	Free-standing hot water radiators	Main Floor core and toilet room areas	(no nameplate information available)	Domestic Hot Water	Main Floor core and toilet room areas	Est. 1930s-1950s	0% beyond useful life
Heating	(9+) Below window hot water radiators	Court Room & Court Room offices	(no nameplate information available)	Domestic Hot Water	Court Room & Court Room offices	Est. 1930s-1950s	0% beyond useful life
Lighting	See details - Appendix A	building	-	Electric	Building		

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

4. ENERGY CONSERVATION MEASURES

Based on the assessment of the Municipal Court, SWA has separated the investment opportunities into three recommended categories:

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

Category I Recommendations: Capital Improvements

- Replace heating terminal equipment - such as finned tube radiation and free standing radiators in the main building, and the hydronic unit heater in the garage. This equipment is in fair to poor condition, and age and wear have reduced the heat transfer capacity. This equipment should be replaced with more modern equipment suited for the intended use. These changes cannot be justified based on energy savings alone. However, replacement is strongly recommended to improve the overall efficiency of the heating system. This is a replacement in kind recommendation which offers negligible energy savings.
- window air conditioners – A few of the existing window air conditioners still have some useful life remaining (on the average 0-5 years left) but replacement should be considered with more modern, energy efficient systems. The window air conditioners should be replaced with split systems to allow for closing up of the existing window penetrations. These upgrades cannot be justified by energy savings alone but will result in a decrease in energy usage versus the existing equipment. In addition, the existing systems utilize R-22 refrigerant, which is not an ozone-friendly refrigerant. Newer systems should be specified with R-410A refrigerant.
- Install/ repair gutters, downspouts and downspout deflectors to minimize uncontrolled roof water run-off causing exterior wall damage
- Exterior wall surface transition repair - replace cracked/ ineffective caulk.
- Exterior wall penetration air-sealing - Apply appropriate air-sealing strategies around all exterior wall penetrations (incl. electrical, plumbing and HVAC)
- Roof flashing repair – install repair and problem spots and repair flashing to minimize uncontrolled wind driven and roof water run-off causing exterior wall damage
- R-30 roof insulation - add insulation to ineffectively and under-insulated roof/ ceiling sections. SWA suggests applying (R-30 min.) to the underside of the roof framing.
- Overgrown mold and vegetation removal – overgrown mold should be removed and overgrown vegetation should be trimmed/ removed to not touch or block wall surfaces from necessary access, ventilation and sunlight.
- Roof shingle repair - repair or replace all damaged roof shingles and install new shingles in place of missing units.
- Building slab sealing - apply appropriate air/ water-sealing strategies around all slab penetrations (incl. electrical, plumbing and HVAC).
- Site drainage improvement- install footing drains and slope perimeter grade away from building. SWA suggests investigating interior footing drain option.

- Window sill repair - Install/ repair pan or strip flashing and drip edge detail at window sill
- Damaged window replacements - replace all windows with damaged frames during next capital improvement project with ENERGY STAR® units.
- Damage door frame repairs - Repair and maintain damaged door frames and replace units during next major capital improvement.

Category II Recommendations: - Operations and Maintenance

- Boiler room and attic piping insulation - Insulate un-insulated steam and hot water piping in the North Boiler Room and in attic spaces to efficiently deliver heat where required and provide personnel protection.
- Water levels in the expansion tank and the integrity of the tank bladder should be checked to confirm proper operation.
- Use ENERGY STAR® labeled appliances - such as ENERGY STAR® refrigerators that should replace older energy inefficient equipment.
- Gutter maintenance program - maintain and clean gutters, downspouts and downspout deflectors to minimize uncontrolled roof water run-off causing
- Exterior wall maintenance program – biannually maintain and inspect all exterior wall surfaces with a focus on the condition of caulking, cracked stucco, signs of water damage and locations that correspond to areas of known infiltration.
- Roof maintenance program – biannually maintain and inspect the roof surface with a focus on drainage, pooling water, condition of the flashing and shingles.
- Air conditioner sleeve sealing - 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.
- Window maintenance program – biannually maintain and inspect all exterior windows with a focus on the condition of the frames, glazing, proper hardware operation and signs of water damage/leakage and infiltration
- Door maintenance program - maintain and inspect all doors with a focus on the condition of the weather-stripping, door frame, air tight seal and signs of water damage and infiltration.

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1.2	Install (76) new CFL fixtures
3.2	Incremental cost to replace boilers with packaged high efficiency condensing boiler
	Description of Recommended 5-10 Year Payback ECMs
1.1	Replace (22) T12 fixtures with T8 fixtures
2.2	incremental cost to replace domestic water heater with 95% efficient unit

ECM#1: *Building Lighting Upgrades*

Description:

On the days of the site visits, SWA completed a lighting inventory of the Municipal Court (see Appendix A). The Municipal Court currently consists of mostly inefficient lighting with T12 fluorescent fixtures with magnetic ballasts, and incandescent fixtures. Based on measurements of lighting levels for each space, there are not any vastly over-illuminated areas. SWA recommends replacing the following inefficient fixtures with more energy efficient types: T12 lamps should be replaced with T8 electronically ballasted lamps and incandescent with CFL's. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption. The exterior lighting surveyed during the building audit was found to be wall mounted incandescent fixtures. Exterior lighting is controlled by a switch. SWA recommends replacing the incandescent fixtures with CFL's. SWA is not recommending at this time any upgrades to the exterior controls. The labor in all these installations was evaluated using prevailing electrical contractor wages. The Township of Livingston may decide to perform this work with in-house resources on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: $7,696 (this includes $1,772 in labor cost)
Source of cost estimate: RS *Means; Published and established costs*

Economics:

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime cost savings, $	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, $	CO_2 reduced, lbs/yr
1.1	Replace (22) T12 fixtures with T8 fixtures	4,263	660	3,603	1,218	0.3	0	1.4	142	373	15	5,601	9.6	55	4	6	791	1,669
1.2	Install (76) new CFL fixtures	3,433	0	3,433	2,362	0.5	N/A	2.7	384	833	5	4,164	4.1	21	4	7	359	3,236
	Totals	7,696	660	7,036	3,580	1	0	4.1	526	1,206	-	9,765	5.8	-	-	-	1,150	4,905

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 10% failure rate in addition to the standard life cycle.

Rebates / Financial Incentives:
NJ Clean Energy - $30 per T8 fixtures

Options for Funding ECM:
This project may benefit from applying for a grant from the State of New Jersey - American Recovery and Reinvestment Act Energy Efficiency and Conservation Block Grant (EECBG) Program to offset a portion of the cost of implementation.
http://www.state.nj.us/recovery/infrastructure/eecbg_program_criteria.html

ECM#2: Replace Domestic Water Heater

Description:

There is one (1) gas-fired domestic water heater that serves a toilet room lavatory and a commercial washer and that is utilized for the entire year. This unit typically achieves approximately 70% efficiency in natural gas usage considering its current age. This equipment is beyond its expected service life and should be replaced. The Municipal Court can realize energy savings by installing a direct vent high efficiency water heater. This type of heater can achieve up to 95% efficiency. This measure cannot be justified by energy savings alone, but should be considered as an end-of-life energy savings opportunity.

Installation cost:

Estimated installed cost: $2,000 (This includes $980 in labor costs)
Source of cost estimate: Similar projects

Economics (with incentives):

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime 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
2.1	replace domestic water heater with 95% efficient unit	2,000	50	1,950	0	0.0	35	1.2	0	47	15	710	41.2	-64	-4	N/A	-1,385	410
2.2	incremental cost to replace domestic water heater with 95% efficient unit	500	50	450	0	0.0	35	1.2	0	47	15	710	9.5	58	4	6	115	410

Assumptions: SWA calculated the savings for this measure using nameplate data taken the days of the field visits, equipment efficiencies listed above and using the billing analysis.

Rebates/financial incentives:

NJ Clean Energy – Gas-fired water heaters <50 gallons ($50 per heater)
Maximum incentive amount is $50.

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

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

ECM#3: Replace Boiler with Condensing Boiler

Description:

The existing boiler is relatively inefficient as compared to modern condensing boilers and should be replaced to achieve energy savings. The initial efficiency of the existing boiler is approximately 80%, but it can be assumed that in the time since its installation, it has degraded to about 75% efficiency. An upgrade to a condensing boiler of minimum 85% combustion efficiency cannot be justified by energy savings alone. However, replacement should be considered along with upgrades to other portions of the heating system.

The new high efficiency condensing boilers should have a guaranteed minimum thermal efficiency of 85% at the worst case boiler operating conditions, such as mid-fire or high-fire conditions with a return water temperature in the range of 140-160 degrees Fahrenheit, and efficiencies of up to 95% achievable with lower return water temperatures. The boiler should be Low NOx certified with a 5:1 turndown burner, PVC direct venting and direct exhaust, hydronic safety controls and interface systems. The boiler shall have compact design for easy retrofit installation, with sectional aluminum block, ASME relief valve, stainless steel burner as a minimum. The air blower should be variable speed combustion with easily removable access panels. Model shall be similar to Weil-McLain Ultra 230 Series.

Installation cost:

Estimated installed cost: $20,000 (This includes $8,000 in labor costs)
Source of cost estimate: Manufacturer’s data and similar projects

Economics (with incentives):

ECM #	ECM description	est. installed cost, $	est. incentives, $	net est. ECM cost with incentives, $	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, $	total 1st yr savings, $	life of measure, yrs	est. lifetime 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
3.1	Cost to replace boiler with packaged high efficiency condensing boiler	20,000	460	19,540	0	0.0	650	21.7	150	1,029	25	21,986	19.0	32	1	2	-1,614	7,605
3.2	incremental cost to replace boilers with packaged high efficiency condensing boiler	2,500	460	2,040	0	0.0	650	21.7	150	1,029	25	21,986	2.0	1162	46	50	15,886	7,605

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

Rebates/financial incentives:

NJ Clean Energy – Gas-fired boilers <300 MBH ($2.00 per MBH but not less than $300 per unit)
Maximum incentive amount is $460.

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 SYSTEMS

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 system was not considered for this site due to the heavy, tall tree cover to the south of this one-story building.

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 insufficient domestic water use.

5.6 Geothermal

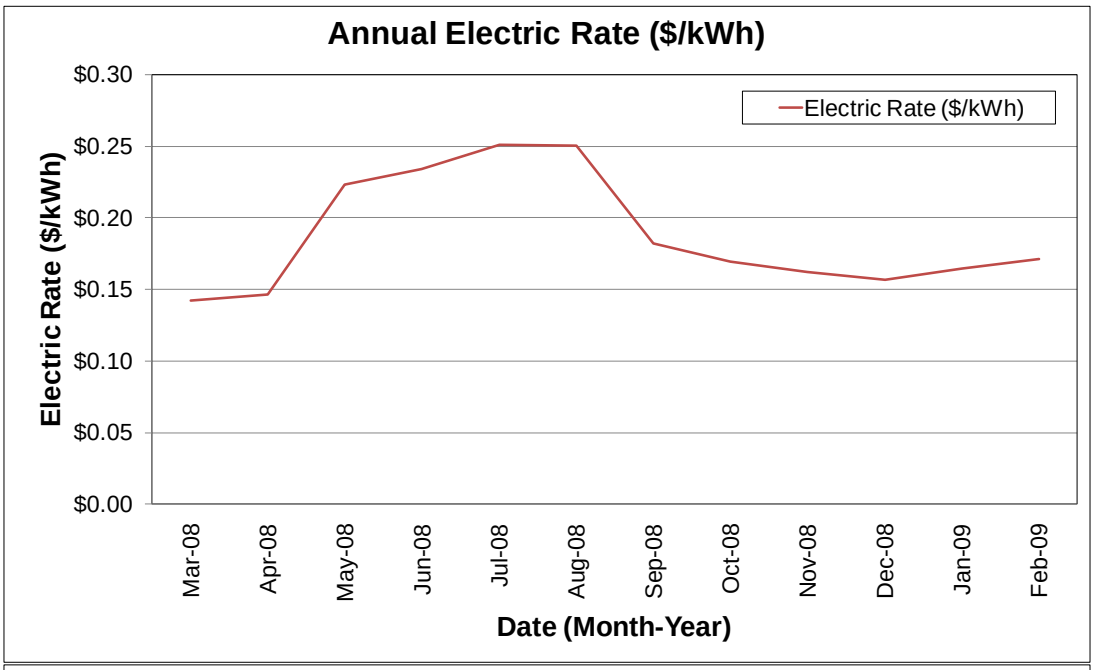
Geothermal is not applicable for this building because it would not be cost effective, and since the building is not currently cooled and this measure would not provide energy savings.

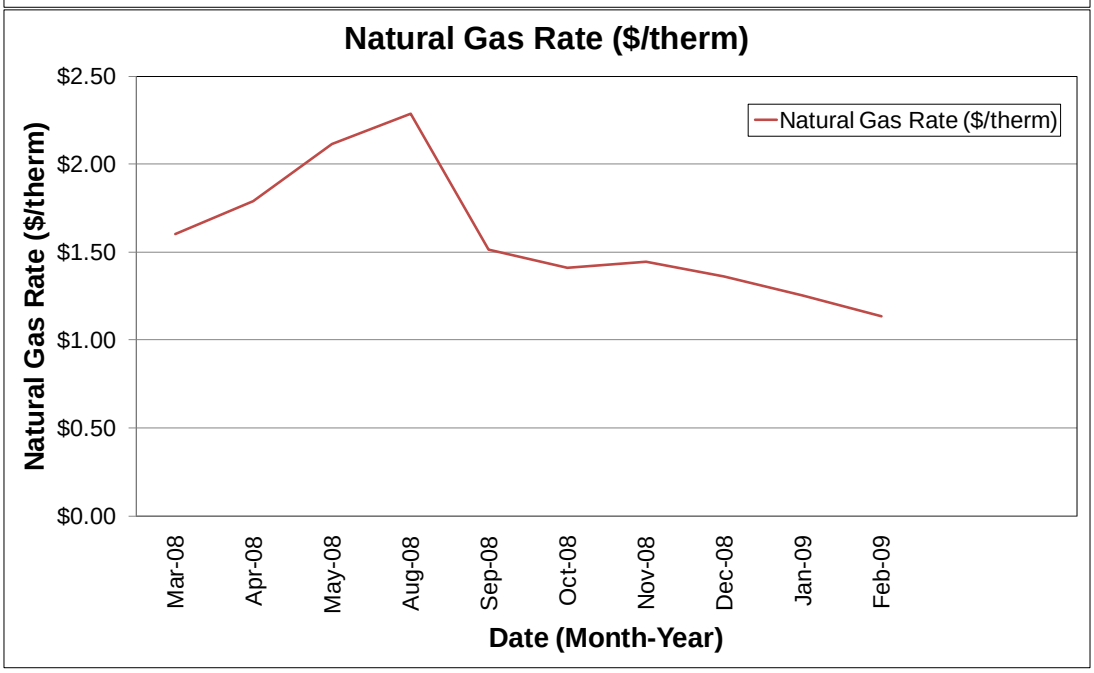
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Energy Purchasing

The Municipal Court receives electricity purchased via one incoming meter directly for the Municipal Court from PSE&G 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 43% over the 12 month period between March 2008 and February 2009. Natural gas is also purchased via one incoming meter directly from PSE&G as well. Natural gas bill analysis shows fluctuations of up to 50% over the 12 month period between March 2008 and February 2009. The high gas price per therm fluctuations in the summer may be due to low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months.

Currently, New Jersey commercial buildings of similar type pay $0.150/kWh for electricity and $1.55/therm for natural gas. The electricity rate for the courthouse is $0.19/kWh, which means there is a potential cost savings of $671. The natural gas rate is $1.353/therm which means that they are already paying below market rate. A large cost savings potential for electricity exists, however this involves contacting third party suppliers and negotiating utility rates. SWA recommends that the Township of Livingston 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 Municipal Court. Appendix B contains a complete list of third party energy suppliers for the Township of Livingston service area. The Township of Livingston may want to consider partnering with other school districts, municipalities, townships and communities to aggregate a substantial electric and natural gas use for better leveraging in negotiations with ESCOs and of improving the pricing structures. This sort of activity is happening in many parts of the country and in New Jersey.





6.2. Energy Procurement strategies

Also, the Municipal Court 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 Municipal Court

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	4'T12	1	2	40	S	7	240	15	95	160	T8	Parabolic	4'T8	E	S	1	2	32	7	240	6	70	118	42	0	42
2	1	Office	Parabolic	M	4'T12	1	2	40	S	7	240	15	95	160	T8	Parabolic	4'T8	E	S	1	2	32	7	240	6	70	118	42	0	42
3	1	Office	Screw-in	N	Inc	1	1	40	S	7	240	0	40	67	CFL	Screw-in	CFL	N	S	1	1	15	7	240	0	15	25	42	0	42
4	1	Court Room - Chandelie	Screw-in	N	Inc	8	8	20	S	8	240	0	1,280	2,458	CFL	Screw-in	CFL	N	S	8	8	5	8	240	0	320	614	1843	0	1843
5	1	Court Room	Exit Sign	N	LED	3	1	5	N	24	365	1	18	158	N/A	Exit Sign	LED	N	N	3	1	5	24	365	1	18	158	0	0	0
6	1	Bathroom	Screw-in	N	Inc	1	1	40	S	7	240	0	40	67	CFL	Screw-in	CFL	N	S	1	1	15	7	240	0	15	25	42	0	42
7	1	Office	Parabolic	M	4'T12	6	2	40	S	7	240	15	570	958	T8	Parabolic	4'T8	E	S	6	2	32	7	240	6	420	706	252	0	252
8	1	Storage Rm	Screw-in	N	Inc	2	1	40	S	2	240	0	80	38	CFL	Screw-in	CFL	N	S	2	1	15	2	240	0	30	14	24	0	24
9	1	Office Area	Parabolic	M	4'T12	2	2	40	S	7	240	15	190	319	T8	Parabolic	4'T8	E	S	2	2	32	7	240	6	140	235	84	0	84
10	1	Office	Parabolic	M	4'T12	2	2	40	S	7	240	15	190	319	T8	Parabolic	4'T8	E	S	2	2	32	7	240	6	140	235	84	0	84
11	1	Office	Parabolic	M	4'T12	2	2	40	S	7	240	15	190	319	T8	Parabolic	4'T8	E	S	2	2	32	7	240	6	140	235	84	0	84
12	1	Office	Parabolic	M	4'T12	2	2	40	S	7	240	15	190	319	T8	Parabolic	4'T8	E	S	2	2	32	7	240	6	140	235	84	0	84
13	1	Vestibule	Screw-in	N	Inc	1	1	40	S	7	240	0	40	67	CFL	Screw-in	CFL	N	S	1	1	15	7	240	0	15	25	42	0	42
14	1	Bathroom	Screw-in	N	Inc	1	1	40	S	7	240	0	40	67	CFL	Screw-in	CFL	N	S	1	1	15	7	240	0	15	25	42	0	42
15	1	Office	Parabolic	M	4'T12	1	2	40	S	7	240	15	95	160	T8	Parabolic	4'T8	E	S	1	2	32	7	240	6	70	118	42	0	42
16	GF	Garage	Parabolic	M	4'T12	5	2	40	S	7	240	15	475	798	T8	Parabolic	4'T8	E	S	5	1	32	7	240	3	175	294	504	0	504
17	GF	Garage	Screw-in	N	Inc	2	1	40	S	7	240	0	80	134	CFL	Screw-in	CFL	N	S	2	1	15	7	240	0	30	50	84	0	84
18	B	Boiler Rm	Screw-in	N	Inc	2	1	40	S	2	240	0	80	38	CFL	Screw-in	CFL	N	S	2	1	15	2	240	0	30	14	24	0	24
19	Ext	Exterior	Exterior	N	Inc	2	1	40	S	12	365	0	80	350	CFL	Exterior	CFL	N	S	2	1	15	12	365	0	30	131	219	0	219
Totals:						45	35	705				136	3,868	6,957						45	34	418			52	1,883	3,377	3,580	0	3,580
Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space																													

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

Appendix B: Third Party Energy Suppliers (ESCOs)

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

Third Party Electric Suppliers for PSEG 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
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450	(212) 538-3124 www.creditsuisse.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
Metro Energy Group, LLC 14 Washington Place Hackensack, NJ 07601	(888) 536-3876 www.metroenergy.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

Third Party Electric Suppliers for PSEG Service Territory	Telephone & Web Site
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
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.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 PSEG Service Territory	Telephone & Web Site
Cooperative Industries	(800) 628-9427
412-420 Washington Avenue	www.cooperativenet.com
Belleville, NJ 07109	
Direct Energy Services, LLC	(866) 547-2722
120 Wood Avenue, Suite 611	www.directenergy.com
Iselin, NJ 08830	
Dominion Retail, Inc.	(866) 275-4240
395 Highway 170, Suite 125	www.retail.dom.com
Lakewood, NJ 08701	
Gateway Energy Services Corp.	(800) 805-8586
44 Whispering Pines Lane	www.gesc.com
Lakewood, NJ 08701	
UGI Energy Services, Inc.	(856) 273-9995
704 East Main Street, Suite 1	www.ugienergyservices.com
Moorestown, NJ 08057	
Great Eastern Energy	(888) 651-4121
116 Village Riva, Suite 200	www.greateastern.com
Princeton, NJ 08540	
Hess Corporation	(800) 437-7872
1 Hess Plaza	www.hess.com
Woodbridge, NJ 07095	

Third Party Gas Suppliers for PSEG Service Territory	Telephone & Web Site
Hudson Energy Services, LLC	(877) 483-7669
545 Route 17 South	www.hudsonenergyservices.com
Ridgewood, NJ 07450	
Intelligent Energy	(800) 724-1880
2050 Center Avenue, Suite 500	www.intelligentenergy.org
Fort Lee, NJ 07024	
Keil & Sons	(877) 797-8786
1 Bergen Blvd.	www.systrumenergy.com
Fairview, NJ 07002	
Metro Energy Group, LLC	(888) 536-3876
14 Washington Place	www.metroenergy.com
Hackensack, NJ 07601	
MxEnergy, Inc.	(800) 375-1277
510 Thornall Street, Suite 270	www.mxenergy.com
Edison, NJ 08837	
NATGASCO (Mitchell Supreme)	(800) 840-4427
532 Freeman Street	www.natgasco.com
Orange, NJ 07050	
Pepco Energy Services, Inc.	(800) 363-7499
112 Main Street	www.pepco-services.com
Lebanon, NJ 08833	
PPL EnergyPlus, LLC	(800) 281-2000
811 Church Road	www.pplenergyplus.com
Cherry Hill, NJ 08002	
Sempra Energy Solutions	(877) 273-6772
581 Main Street, 8th Floor	www.semprasolutions.com
Woodbridge, NJ 07095	
South Jersey Energy Company	(800) 756-3749
One South Jersey Plaza, Route 54	www.southjerseyenergy.com
Folsom, NJ 08037	
Sprague Energy Corp.	(800) 225-1560
12 Ridge Road	www.spragueenergy.com
Chatham Township, NJ 07928	
Stuyvesant Energy LLC	(800) 646-6457
10 West Ivy Lane, Suite 4	www.stuyfuel.com
Englewood, NJ 07631	
Woodruff Energy	(800) 557-1121
73 Water Street	www.woodruffenergy.com
Bridgeton, NJ 08302	

Appendix C: Glossary and Method of Calculations

Glossary of ECM Terms

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

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

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

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

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

Operating Cost Savings (OCS): This calculation is an annual operating savings for the ECM. It is the difference in the operating, maintenance, and / or equipment replacement costs of the existing case versus the ECM. In the case where an ECM lifetime will be longer than the existing 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

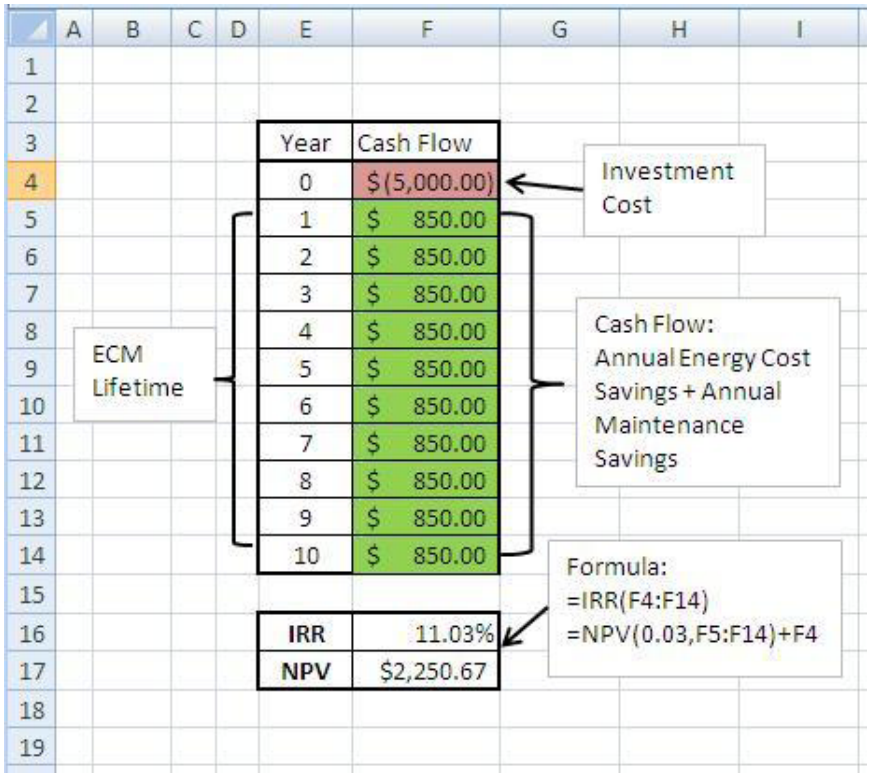
Net ECM Cost = Total ECM Cost – Incentive
LECS = AECS X ECM Lifetime
AOCS = LOCS / ECM Lifetime
LCS = LOCS+LECS

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