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

South River Public Library
South River, NJ 08882

Project Number: LGEA48



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INTRODUCTION

As an approved energy consulting firm under the Local Government Energy Audit Program (LGEA), Steven Winter Associates, Inc. (SWA) was selected to perform an energy audit and assessment for the Borough of South River municipal buildings. The audit, conducted on January 5, 11 and 12, 2010 included a review of the:

- Human Services Building
- Municipal Building
- Public Library
- Criminal Justice Building
- War Memorial Building
- Roads Department Building
- Rescue Squad Building
- George Street Firehouse
- Appleby Avenue Firehouse

The buildings are located in South River, NJ. A separate energy audit report is issued for each of the referenced buildings.

This report addresses the South River Public Library located at 55 Appleby Avenue, South River, NJ 08882. The current conditions and energy-related information were collected in order to analyze and facilitate the implementation of energy conservation measures for the building.

The four-story South River Public Library has had a few minor renovations since it was built in 1977, the last occurring in 2009. The building consists of 8,500 square feet of conditioned space and houses a meeting room, a kitchen, storage areas, an elevator, boiler and mechanical rooms, bathrooms, a children's library, an adult library, administrative offices, a circulation desk and a public floor with book shelves. The Public Library is occupied approximately 56 hours/week and generally staffed by 10 (of a total of 20) employees on average with approximately 30-40 visitors at anyone time. The library is generally open Monday-Thursday 10:00am-9:00pm, Friday 10:00am-5:00pm and Saturday 10:00am-3:00pm, closed every Sunday and closed on Saturdays every August.

The goal of this Local Government Energy Audit (LGEA) is to provide sufficient information to the Borough of South River to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the Criminal Justice 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.

EXECUTIVE SUMMARY

The energy audit performed by Steven Winter Associates (SWA) encompasses the Public Library located at 55 Appleby Avenue, South River, NJ 08882. The Public Library is a four-story building comprising of a total floor area of 8,500 square feet. The original structure was built in 1977 with the latest renovation occurring in 2009.

Based on the field visits performed by the SWA staff on January 5, 11 and 12, 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.

From April 2008 through March 2009 the Public Library consumed 47,840 kWh or \$6,219 worth of electricity at an approximate rate of \$0.130/kWh and 3,669 therms or \$4,827 worth of natural gas at an approximate rate of \$1.315/therm. The joint energy consumption for the building, including both electricity and natural gas, was 530 MMBtus of energy that cost a total of \$11,046.

SWA has entered energy information about the Public Library in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. This Library facility is comprised of non-eligible (Other) space type, since national comparisons are yet unavailable for rating. SWA encourages the Borough of South River to continue entering utility data in *Energy Star Portfolio Manager* in order to track weather normalized source energy use over time. EPA is continually working to expand the available space types.

The Site Energy Use Intensity is 63.0 kBtu/ft²yr compared to the national average of Borough Library building consuming 104.0 kBtu/ft²yr. Implementing this report's recommendations will reduce use by approximately 20.8 kBtu/ft²yr, which when implemented would make the building energy consumption even better than the national average.

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

Category I Recommendations: Capital Improvement Measures

- Replace electric domestic hot water (DHW) heater
- Replace common area heating equipment
- Install/upgrade the Building Management System (BMS)
- Install NEMA Premium motors when replacements are required such as ones on building circulators and fans
- Add insulation into under-insulated exterior wall sections with the next major renovation
- Replace roof finish and add/re-insulate (R-28 min) with the next major renovation
- Replace building bathroom and meeting room exhaust fans
- Overhaul elevator and associated hydraulic piston system

Category II Recommendations: Operations and Maintenance

- Thoroughly and evenly insulate space above/between ceilings and roofs
- Maintain roofs - SWA recommends regular maintenance to verify water is draining correctly

- Maintain downspouts and cap flashing - repair/install missing downspouts, cap flashing and deflectors as needed
- Provide weather stripping/air sealing
- Repair/seal wall cracks and penetrations
- Provide water efficient fixtures and controls
- Use Energy Star labeled appliances
- Use smart power electric strips
- Create an energy educational program

Category III Recommendations: Energy Conservation Measures - Upgrades with associated energy savings

At this time, SWA highly recommends a total of **2** Energy Conservation Measures (ECMs) for the Public Library as summarized in the following Table 1. The total investment cost for these ECMs without incentives is **\$15,725**. SWA estimates a first year savings of **\$5,018** with a simple payback of **3.1 years**. SWA also recommends **4** more ECMs with a total first year savings of **\$319** as summarized in Table 2 and **2** recommended End of Life Cycle ECMs with a total first year savings of **\$1,571** as summarized in Table 3. SWA estimates that implementing these recommended ECMs will reduce the carbon footprint of the Public Library by **54,986 lbs of CO₂**, which is equivalent to removing approximately 5 cars from the roads each year or avoiding the need of 134 trees to absorb the annual CO₂ generated.

There are various incentives available in New Jersey to lower the cost of installing the Energy Conservation Measures (ECMs), like NJ SmartStart program and Direct Install through the New Jersey Office of Clean Energy. These incentive programs can help provide technical assistance for the building in the implementation phase of any energy conservation project. The Borough of South River and 6 other nearby boroughs have a long term contract to purchase electricity as a consortium from the South River Electric Utility and do not pay the Societal Benefit Charges (SBCs) that fund NJCEP programs. Therefore, the Borough of South River is not eligible to receive any equipment incentives for energy conservation under the New Jersey Clean Energy Program (NJCEP) at the present time. SWA recommends the Borough of South River initiate a dialogue with the Board of Public Utilities (BPU) to gain access to these and other incentives in the future.

The following three tables summarize the proposed Energy Conservation Measures (ECMs) and their economic relevance. In order to clearly present the overall energy opportunities for the building and ease the decision and choice of which ECM to implement, SWA calculated each ECM independently and did not incorporate slight/potential overlaps between some of the summarized ECMs (i.e. lighting change influence on heating/cooling).

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
1.1	Replace (19) incandescent, (16) halogen, (26) Mercury Vapor, (6) High Pressure Sodium and (1) Metal Halide lamps with CFLs	RS Means, Lit Search	5,100	0	5,100	14,757	5.2	0	5.9	175	2,093	5	10,467	2.4	105	21	30	4,295	26,422
2	Retro commissioning	Similar projects	10,625	none at this time	10,625	4,784	1.7	367	6.2	1,820	2,924	12	35,093	3.6	230	19	26	17,577	12,610
	Totals		15,725	0	15,725	19,541	6.8	367	12.2	1,995	5,018	-	45,560	3.1	190	-	27	21,873	39,032

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

Table 2 - Recommended 5-10 Year Payback ECMs

ECM #	ECM description	source	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO ₂ reduced, lbs/yr
3	Replace (1) 3HP standard eff pump motor on heating circulating pump with NEMA premium motor	MotorMaster + International, similar projects	450	0	450	680	0.2	0	0.3	0	88	15	1,326	5.1	195	13	18	572	1,217
4	Replace (1) 3HP standard eff pump motor on chilled water circulating pump with NEMA premium motor	MotorMaster + International, similar projects	450	0	450	453	0.2	0	0.2	0	59	15	884	7.6	96	6	10	236	811
5	Replace one (1) old kitchen refrigerator with an 18 cu ft Energy Star model	Energy Star purchasing and procurement site, similar projects	750	0	750	350	0.1	0	0.1	50	96	12	1,146	7.9	53	4	7	183	627
1.2	Replace (4) fluorescent Exit sign fixtures with LED Exit sign type	RS Means, Lit Search	740	0	740	385	0.1	0	0.2	26	76	15	1,145	9.7	55	4	6	153	689
Totals			2,390	0	2,390	1,868	0.7	0	0.7	76	319	-	4,500	7.5	88	-	10	1,144	3,345

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
1.3	Replace (33) T12 fixtures throughout the bldg with new T8 fixtures	RS Means, Lit Search	7,095	0	7,095	1,085	0.4	0	0.4	123	264	15	3,953	26.9	-44	-3	-7	-3,870	1,943
6	Replace (3) old AHUs with condensing furnaces - 93% eff and new evaporator coils, remove duct brittle inside insulation and apply duct insulation on outside	Energy Star purchasing and procurement site, similar projects	96,900	0	96,900	2,569	0.9	550	7.5	250	1,308	15	19,615	74.1	-80	-5	-15	-78,985	10,666
Totals			103,995	0	103,995	3,654	1.3	550	7.9	373	1,571	-	23,568	66.2	-77	-	-15	-82,855	12,609

1. HISTORIC ENERGY CONSUMPTION

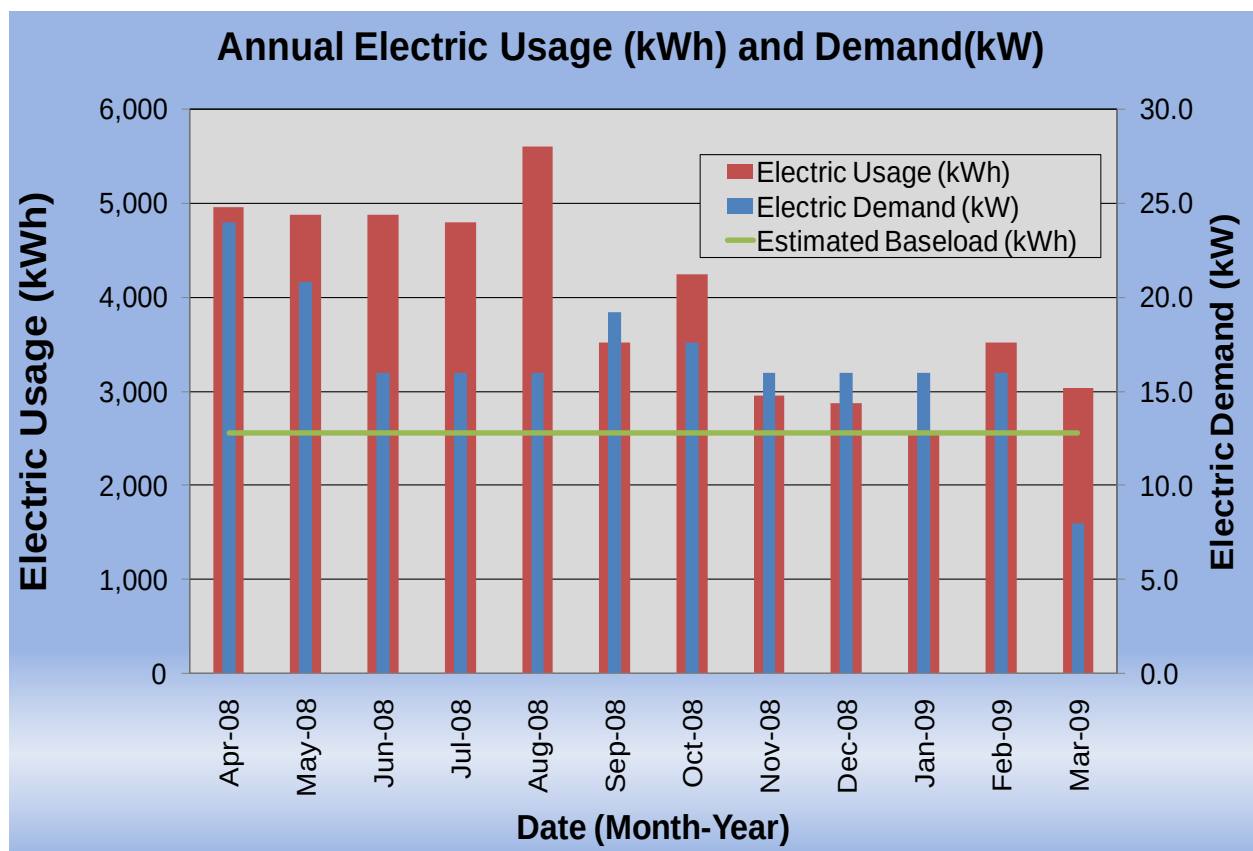
1.1. Energy Usage and Cost Analysis

SWA analyzed utility bills from December 2007 through March 2009 that were received from the utility companies supplying the South River Public Library with electric and natural gas.

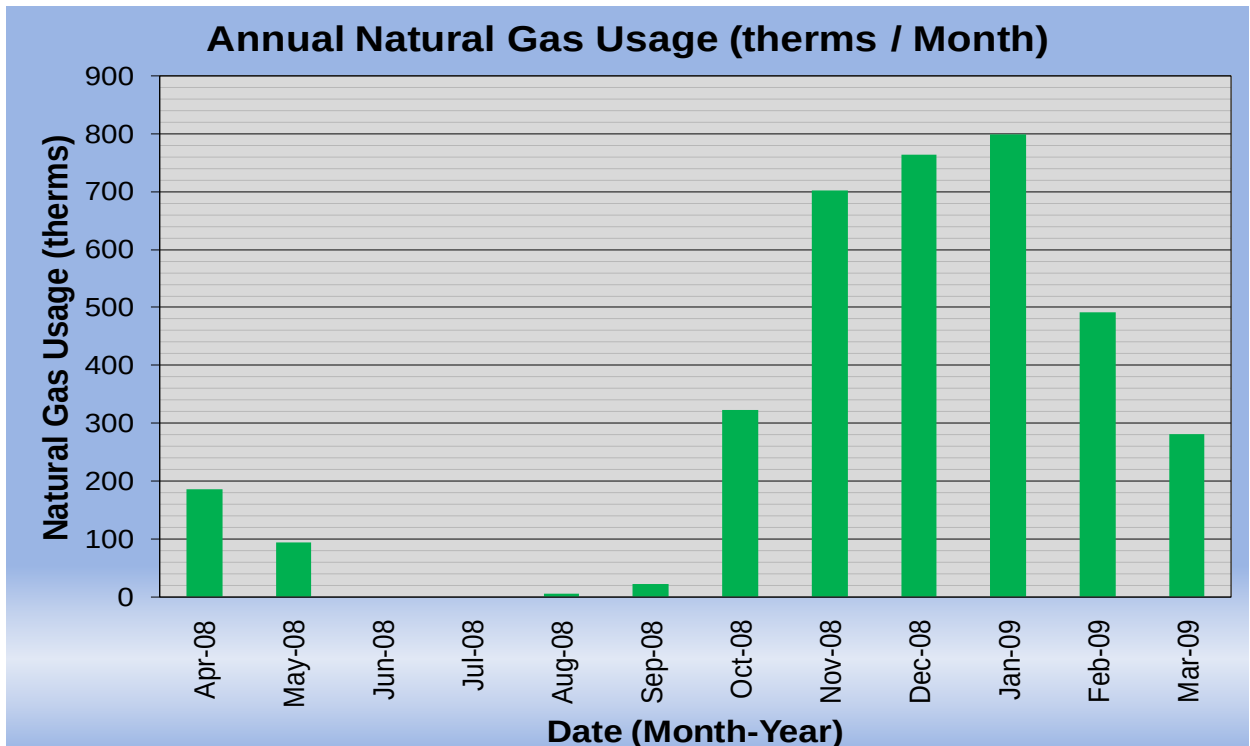
Electricity - The South River Public Library is currently served by one electric meter. The Public Library currently buys electricity from South River Electric Utility at **an average rate of \$0.130/kWh** based on 12 months of utility estimates from April 2008 through March 2009. The Public Library purchased **approximately 47,840 kWh or \$6,219 worth of electricity** in the previous year. The average monthly demand was 17 kW.

Natural gas - The South River Public Library is currently served by one meter for natural gas. The South River Public Library currently buys natural gas from PSE&G at **an average aggregated rate of \$1.315/therm** based on 12 months of utility bills for April 2008 through March 2009. The South River Public Library purchased **approximately 3,669 therms or \$4,827 worth of natural gas** in the previous year at a very competitive rate.

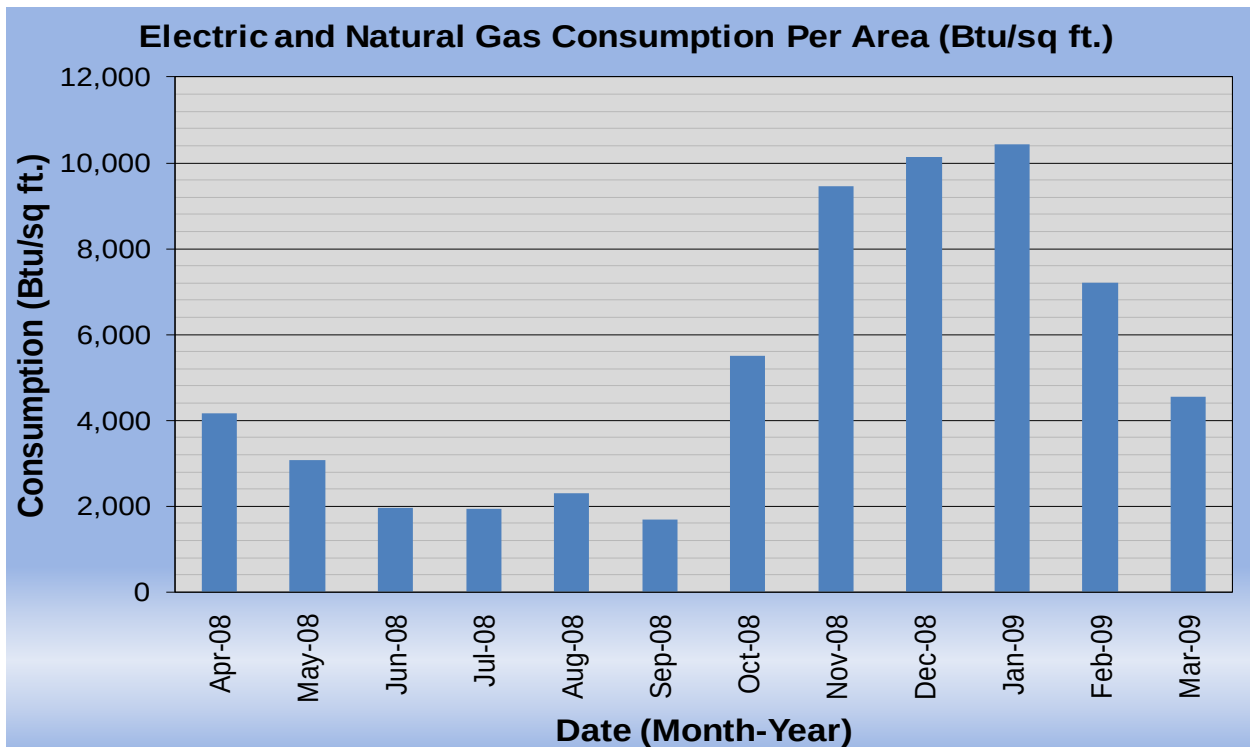
The following chart shows electricity consumption for the Public Library based on electric bills for the 12 month period of April 2008 through March 2009.



The following chart shows the natural gas consumption for the Public Library based on natural gas bills for the 12 month period of April 2008 through March 2009. Summer natural gas usage most likely associated with exercising/operating the natural gas generator.

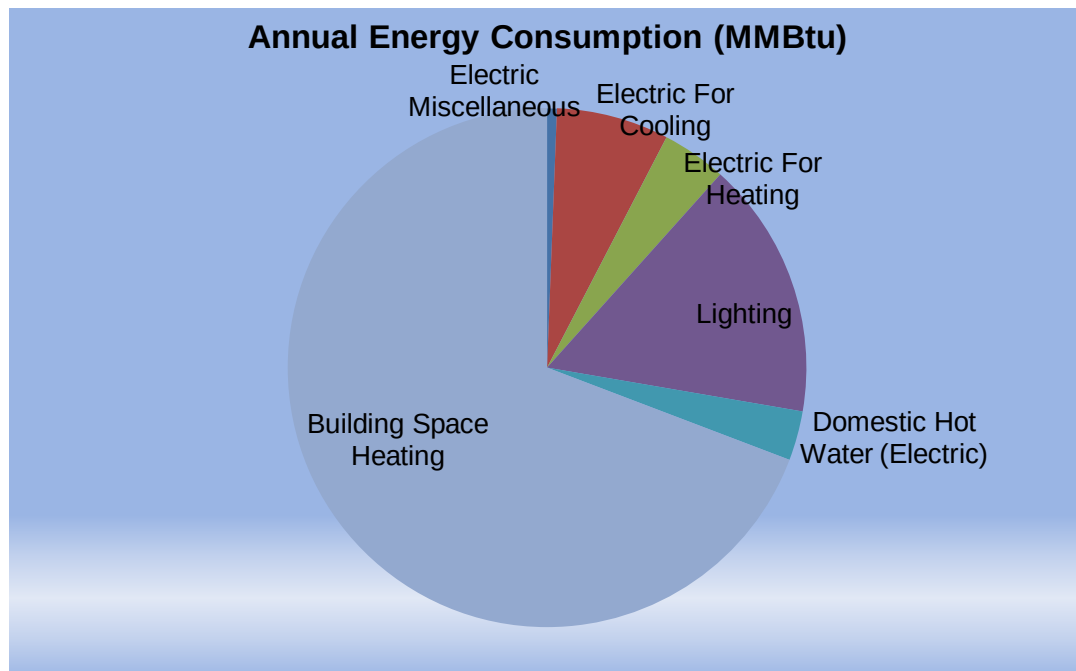


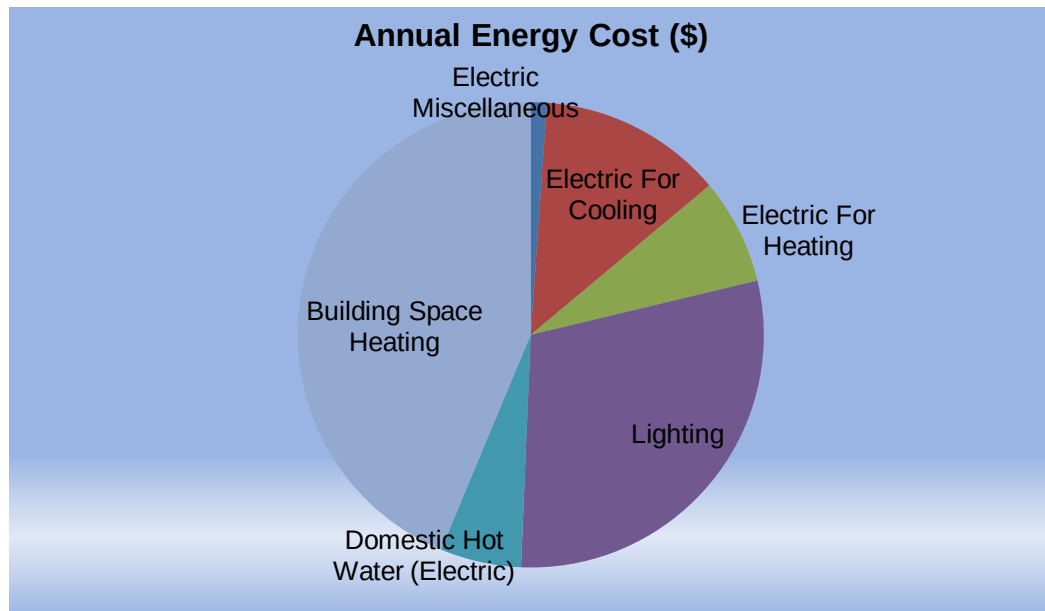
The following chart shows combined natural gas and electric consumption in Btu/sq ft for the Public Library based on estimates and utility bills for the 12 month period of April 2008 through March 2009.



The following table and chart pies show energy use for the Public Library based on utility bills for the 12 month period of April 2008 through March 2009. Note electrical cost at \$38/MMBtu of energy is 3 times as expensive to use as natural gas at \$13/MMBtu.

Annual Energy Consumption/Costs					
	MMBtu	% MMBtu	\$	% \$	\$/MMBtu
Electric Miscellaneous	3	1%	\$123	1%	38
Electric For Cooling	37	7%	\$1,414	13%	38
Electric For Heating	21	4%	\$811	7%	38
Lighting	85	16%	\$3,249	29%	38
Domestic Hot Water (Electric)	16	3%	\$622	6%	38
Building Space Heating	367	69%	\$4,827	44%	13
Totals	530	100%	\$11,046	100%	21
Total Electric Usage	163	31%	\$6,219	56%	38
Total Gas Usage	367	69%	\$4,827	44%	13
Totals	530	100%	\$11,046	100%	21





1.2. Utility Rate

The Public Library currently purchases electricity from South River Electric Utility at a general service market rate for electricity use (kWh) with a separate (kW) demand charge. The Public Library currently pays an average rate of approximately \$0.130/kWh based on the 12 months estimates of April 2008 through March 2009.

The Public Library currently purchases natural gas from PSE&G at a competitive general service market rate for natural gas (therms). PSE&G also acts as the transport company. There is one gas meter that provides natural gas service to the Public Library currently. The average aggregated rate (supply and transport) for the meter is approximately \$1.315/therm based on 12 months of utility bills for April 2008 through March 2009.

Some of the minor unusual utility fluctuations that showed up for a couple of months on the utility bills may be due to adjustments between estimated and actual meter readings.

1.3. Energy Benchmarking

SWA has entered energy information about the Public Library in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. This Library facility is comprised of non-eligible (Other) space type. A Library facility space or "Other" can be used to classify a facility or a portion of a facility where the primary activity does not fall into any of the available space types. Consequently, the Public Library is not eligible to receive a national energy performance rating at this time however *Portfolio Manager* provides a preliminary kBtu/sq ft yr comparison.

The Site Energy Use Intensity is 63.0 kBtu/sq ft yr compared to the national average of a Library building consuming 104.0 kBtu/sq ft yr. Implementing this report's highly recommended Energy Conservations Measures (ECMs) will reduce use by approximately 12.2 kBtu/sq ft yr, with an additional 0.7 kBtu/sq ft yr from the recommended ECMs and 7.9 kBtu/sq ft yr from the recommended End of Life Cycle ECMs. These recommendations could account for at least 20.8

kBtu/sq ft yr reduction, which when implemented would make the building energy consumption even better than the national average.

Per the LGEA program requirements, SWA has assisted the Borough of South River to create an *Energy Star Portfolio Manager* account and share the Public Library facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager site information with the Borough of South River (user name of “sriverboro” with a password of “sriverboro”) and TRC Energy Services (user name of TRC-LGEA).



STATEMENT OF ENERGY PERFORMANCE

Borough of South River - Public Library

Building ID: 2019008
 For 12-month Period Ending: March 31, 2009¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: February 23, 2010

Facility Borough of South River - Public Library 55 Appleby Avenue South River, NJ 08882	Facility Owner N/A	Primary Contact for this Facility N/A
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Year Built: 1977
 Gross Floor Area (ft²): 8,500

Energy Performance Rating² (1-100) N/A

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	161,707
Natural Gas (kBtu) ⁴	377,295
Total Energy (kBtu)	539,002

Energy Intensity⁵

Site (kBtu/ft ² /yr)	63
Source (kBtu/ft ² /yr)	110

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	45
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Electric Distribution Utility

Borough of South River

National Average Comparison

National Average Site EUI	104
National Average Source EUI	246
% Difference from National Average Source EUI	-55%
Building Type	Library

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 (20227), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

EPA Form 5900-16

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The four-story South River Public Library has had a few minor renovations since it was built in 1977, the last occurring in 2009 when the building chiller was replaced. The building consists of 8,500 square feet of conditioned space. The first floor houses a meeting room, a storage area, a custodial closet and an elevator mechanical room. The second floor houses a boiler room, bathrooms, a children's library, administrative offices, an adult library, a director's office, a circulation desk and a public floor with book shelves. The third floor houses a kitchen, a library entry area and two bathrooms. The fourth floor houses an Air Handling Unit (AHU-1) mechanical room, a storage closet and Technical Services cubicles. There are two AHUs in the attic space.



Front Façade



Side Façade (typ.)

2.2. Building Occupancy Profiles

The South River Public Library is occupied approximately 56 hours/week and generally staffed by 10 (of a total of 20) employees on average with approximately 30-40 visitors at any onetime. The library is generally open Monday-Thursday 10:00am-9:00pm, Friday 10:00am-5:00pm and Saturday 10:00am-3:00pm, closed every Sunday and closed on Saturdays every August.

2.3. Building Envelope

Due to favorable weather conditions (min. 20 deg F delta-T in/ outside & no/low wind) some exterior envelope infrared (IR) images were taken during the field audit. Thermal imaging/infrared (IR) technology helps to identify energy compromising problem areas in a non-invasive way.

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

2.3.1. Exterior Walls

The exterior wall envelope is mostly constructed of brick veneer and some vertical wood tong & groove siding accents over 5-1/2" framing with 5 inches of fiberglass batt cavity insulation. The interior is mostly painted gypsum wallboard.

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

During the field audit exterior and interior wall surfaces were inspected. They were found/reported to be in overall good/age appropriate condition with only a few signs of uncontrolled moisture, air-leakage and/or other energy-compromising issues located mostly at the front of the building.

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



Deteriorating exterior wall finishes

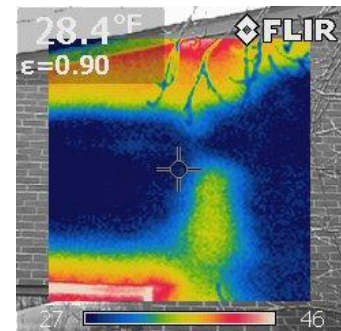
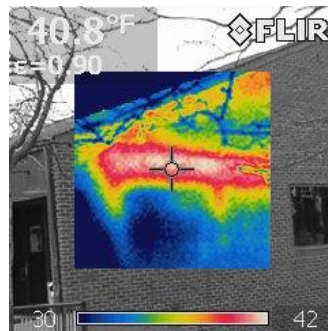
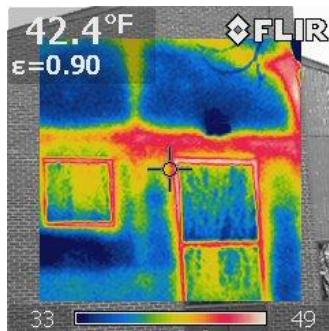


Insect damage/nesting in exterior wall finishes



Uncontrolled roof water run-off due to temporary/open downspout drain connection

The following IR images further visualize some of the exterior wall issues mentioned above:



Uneven wall insulation was detected on most exterior walls but mostly on the right side façade surfaces

In light of the exterior wall conditions mentioned above, SWA has the following recommendations, which are further outlined and categorized in the *Executive Summary*:

1. Install/repair and maintain gutters, downspouts and downspout deflectors to minimize uncontrolled roof water run-off causing exterior wall damage.
2. Repair/replace damaged vertical tong & groove sections and investigate insect issue further.
3. Add insulation into ineffectively or under-insulated exterior wall sections. SWA suggests applying 2" XPS rigid foam boards to the interior and cover with gypsum wallboard or other preferred interior finish with the next major renovation.

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 is not known exactly when the last roof replacement occurred. R-19 fiberglass batt attic/ceiling detectable/assumed roof insulation were recorded.

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

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

The following specific roof problem spots and areas were identified:



The roofing material has reached the end of its expected useful lifespan

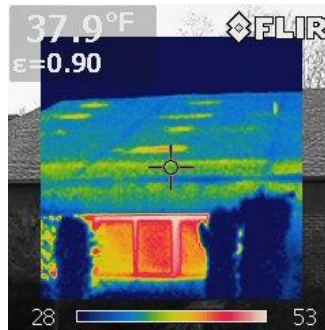


Clogged gutters and downspouts



Signs of mold/water damage on interior finishes throughout the building's ceiling

The following IR image further visualizes the roof issues mentioned above:



Water/moisture issues
within the roof assembly
or uneven roof

In light of the roof conditions mentioned above, SWA has the following recommendations, which are further outlined and categorized in the *Executive Summary*:

1. Replace roof finish due to age and condition and add/re-insulate (R-28 min.)
2. Clean gutters and downspouts.

2.3.3. Base

The building's base is composed of 6-1/2" slab-on-grade floor with a perimeter footing with poured concrete foundation walls and a 2" by 24" rigid Styrofoam 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 at 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 poor condition with no signs of uncontrolled moisture, air-leakage and/or other energy-compromising issues.

In light of the base conditions mentioned above, SWA has no recommendations at this time.

2.3.4. Windows

The building contains basically one type of window.

1. Fixed type windows with a non-insulated aluminum frame, tinted double glazing and no interior or exterior shading devices . The windows are located throughout the building and are original/have never been replaced.

Windows, shading devices, sills, related flashing and caulking were inspected from the exterior and interior as far as accessibility allowed. Based on signs of moisture, air-leakage and other energy compromising issues, overall the windows were found and/or reported to be in acceptable/age appropriate condition with only a few signs of uncontrolled moisture, air-leakage and/or other energy-compromising issues.

The following specific window problem spot and area was identified:

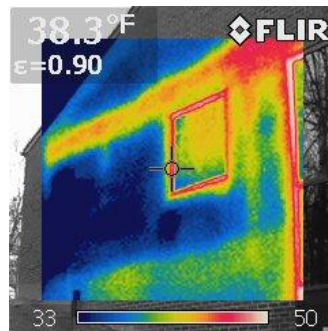


In the lower floor area an ineffective insulation and caulk window to wall connection detail was detected, showing daylight



Main Library area window fogged with moisture trapped between the panes

The following IR image further visualizes some of the window issue mentioned above:



Air-leakage around windows

In light of the window conditions mentioned above, SWA has the following recommendation, which is further outlined and categorized in the *Executive Summary*:

1. Install/replace/maintain insulation/caulk at all window openings for airtight performance.

2.3.5. Exterior Doors

The building contains basically one type of exterior door.

1. Aluminum/glass 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 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 areas were identified:



Missing/worn weather
stripping

In light of the door conditions mentioned above SWA has the following recommendation, which is further outlined and categorized in the *Executive Summary*:

1. Replace/add/maintain caulk around door frames and sills.

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 in the previous sections.

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 that are part of or penetrate the exterior envelope and where air-leakage can occur.

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

2.4. HVAC Systems

The Public Library heating is provided by a hot water boiler via a circulating pump, three air handling units (AHUs) and fin-tube radiators located on exterior walls. Cooling is provided by a fan cooled chiller and pump circulating a glycol-water solution to the AHU evaporating coils.

2.4.1. Heating

The Library heating hot water is provided by a natural gas fired boiler, manufactured by Weil McLain and installed in 1998, when it replaced an original fuel oil fired unit. It is estimated to be 81.5% efficient and in satisfactory operating condition. The boiler burner is a PowerFlame model JR304-10 capable of 700 MBtu/hr input to the boiler. Only one circulating pump (without any inline spare) provides hot water to the heating coils in AHU-

1 (located in the 4th floor Air Handler room), AHU-3 and AHU-4 (located in the attic) and the exterior wall radiator coils (located on exterior walls and under windows). There are 3 small wall mounted electric heaters with manual control knobs in bathrooms (a couple operating and one malfunctioning) beyond their expected lives. SWA recommends that they are replaced with similar Energy Star units of higher efficiency with programmable thermostats.

A typical arrangement for the AHUs is drawing in roughly 20% fresh air from the outside into a mixing chamber where it is combined with return air (brought back via ceiling and fan room plenums) and filtered. An air blower then pushes the filtered, conditioned air to the distribution/ductwork system. The air is then distributed via linear diffusers into the building spaces. AHU-1 services the second floor and the main library room. AHU-3 services the third and fourth floors. AHU-4 services the first floor and first floor administrative offices. All the AHUs are original to the building and operating beyond their estimated useful lives. Their coils are of an older design and may be partly fouled. The blower motors are standard efficiency. The ductwork appears to be acoustically insulated on the inside and there is concern that aged insulation starts to become brittle, breaking apart, dusting and be carried away with the airflow into the conditioned spaces. SWA recommends continuation of AHU routine maintenance, such as belt changes (a couple heard squeaking during the field audit), lubrication, air filter changes and customary inspections until the next major capital HVAC investment.

The boiler has been oversized in design to handle another 4,000 square feet of future, yet to be built library space.

The Public Library original electro-mechanical Barber-Colman (now an Invensys Eurotherm company) temperature control system is dated with parts hard to find and repair. The system seems to be only partially operating and has not been calibrated (especially the sensing elements) for a long time. Many of the temperature controllers are now operated in a manual mode with poor (with one old mechanical timer controlling all spaces as one zone) to no setback control for off-hours. SWA recommends an overhaul of the controls to Direct Digital Controls (DDC) and a Building Management System for monitoring and setting occupancy schedules. This system should be supplied with an aquastat which regulates the temperature of the boiler hot water by keeping the temperature regulated at 160-180 degrees F or perhaps lower. This system should also be supplied with an outdoor reset controller which uses the outside air temperature as the basis for determining an ideal "target" hot water temperature to be supplied to the system's heat emitters. The goal is always the same: to maintain the rate of heat delivery from the heat emitters equal to the rate of heat loss from the building. SWA also recommends relocation of the sensing thermostats to the inside walls and more representative areas of the floor spaces they are servicing.



Weil McLain boiler and PowerFlame burner; AHU-1heating/cooling coils; AHU-3heating/cooling coils; thermostat



Fin-tube wall mounted hot-water radiators; small electric heaters in bathrooms - typical

2.4.2. Cooling

The Public Library cooling is provided by Carrier evaporator coils (located in AHU-1, -3 & -4 discharge ductwork). The cooling coils are supplied with a cold glycol-water solution pumped via one circulating pump (located in the boiler room and without any inline spare). A new fan cooled 45 ton Carrier chiller (located outside the boiler room) was installed in 2009 as a replacement to the original unit. It uses R-22 Freon refrigerant for air cooling. Thermostat control issues are similar to those addressed in the above 2.4.1 Heating section. The chiller has been oversized in design to handle another 4,000 square feet of future, yet

to be built library space. It has an ARI efficiency of 9.6 EER at partial load, 14.1 EER at full load.



New 45 ton Carrier chiller, two views

2.4.3. Ventilation

The various spaces of the building are ventilated by AHU-1, 3 and 4 which serve the respective spaces as described in the “Heating/Cooling” sections above. The bathrooms, some closets/storage areas and the kitchen also have small exhaust fans with fractional horsepower motors that purge air to the outside. In general, the building exhaust fans are operating beyond their estimated useful lives and should be replaced in kind with fans and motors of premium efficiency.

2.4.4. Domestic Hot Water

The domestic hot water (DHW) for the Public Library Building is provided by an original Bradford-White electric heater with 50 gal storage. This heater is operating beyond its estimated useful life. SWA considered its replacement with an Energy Star high efficiency gas fired condensing type unit prior to a catastrophic failure however, because of low DHW use and the competitive utility rates at this time, SWA recommends replacement in kind with a high efficiency electric DHW heater.

2.5. Electrical Systems

2.5.1. Lighting

Interior Lighting - The Public Library contains a mix of T12 fixtures with magnetic ballasts, a couple of T8 fixtures with electronic ballasts, incandescent, halogen lamps and pendant fixtures with Mercury Vapor lamps. SWA recommends replacing the inefficient fixtures as follows: Incandescent, halogen and Mercury Vapor bulbs should be replaced with screw-in CFLs (Compact Fluorescent Light-bulbs). 4ft T12 fixtures should be replaced with 4ft T8 fixtures as an End of Life financial justification. CFL bulbs produce the same lumen output with less wattage than incandescent or halogen bulbs and last up to 5 times longer. All replacements should meet local code requirements, such as shielding for safety hazards. Based on measurements of lighting levels for each space, there are not any vastly over-illuminated areas. SWA also recommends installing occupancy sensors in areas that are

occupied only part of the day and payback on savings is justified. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion is detected within a set time period. Advance micro-phonic lighting sensors include sound detection as a mean to control lighting operation. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption.

Exit Lights - Exit signs were found to be mostly efficient LED type. SWA recommends upgrading the few fluorescent to LED type.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a mix of Metal Halide, High Pressure Sodium and Halogen lamp fixtures. Exterior lighting is controlled by timers. SWA recommends replacing the High Pressure Sodium and Halogen lamp fixtures with CFL lamps. SWA is not recommending at this time any upgrades to the exterior timers.

2.5.2. Appliances and Process

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>. Also, energy vending miser devices are now available for conserving energy usage by Drinks and Snacks vending machines. When equipped with the vending miser devices, vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines.

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 (along with DVDs, stereos, computers, and kitchen appliances which now have internal memories or clocks that always require a trickle of power) use approximately 3-5 watts of electricity when turned off. SWA recommends all computers and all appliances (i.e. fridges, coffee makers, televisions, etc) be plugged in to power strips and turned off each evening just as the lights are turned off. The building's computers are generally NOT 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 Public Library is a four-story building with one 2,500 lbs capacity Dover elevator. The hydraulic system driving the elevator piston is located on the first floor and has a 20 HP, 3510 RPM motor operating beyond its expected useful operating life.

2.5.4. Other Electrical Systems

Besides a few small transformers in satisfactory condition, there are not currently any other significant energy impacting electrical systems installed at the Public Library. The existing service for an estimated 220 kVA capacity appears to be adequately sized.

3. EQUIPMENT LIST

Inventory

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
Heating	Hot water boiler, 1,075 MBH max input - 81.5% est. htg. eff.	Boiler room, 2nd flr	Weil-McLain 6-78 with PowerFlame burner JR304-10 - blower Marathon motor 1/3 HP, 3450 RPM; Serial #: Weil-McLain 119832238-41	(was oil) is now Natural Gas/Electric fan	Library	1998	50%
Heating	Circulating hot water pump, 3 HP, 1725 RPM, and an est. 60% pump operating efficiency	Boiler room, 2nd flr	Taco with GE motor 5K49ZG1343H	Electric	Library	1977	0%
Cooling	Circulating glycol pump, 3 HP, 1725 RPM; and an est. 60% pump operating efficiency	Boiler room, 2nd flr	Taco with GE motor, missing Serial # nametag	Electric	Library	1977	0%
Cooling	Chiller (with 2 compressors, 4 fans) - 45 Ton and circulating pumps (11-13% glycol/water solution) - with an ARI efficiency of 9.6 EER at partial load, 14.1 EER at full load	Outside and back of Library boiler room	Carrier 30RAN050 - - - 511KJ; Serial #: 0409Q57/43	Electric	Library	2009	90%
Heating/ Cooling	AHU-1	4th flr air handler rm	Carrier: chiller coil: 28CW1616FA1056, htg coil: 28CU1116MB1056, 5 HP fan motor; Serial #: 810014064/7851	Electric - blower	2nd flr Main Rm	1977	0%
Heating/ Cooling	AHU-3	Attic	Carrier with Lincoln 2 HP, 1725 RPM fan; missing nametag	Electric - blower	3rd and 4th flr	1977	0%
Heating/ Cooling	AHU-4	Attic	Carrier with Lincoln 1-1/2 HP fan, missing nametag	Electric - blower	1st flr	1977	0%
Heating	Hot water ceiling hung heater	4th flr supply rm closet	Sterling	Electric - fan	4th flr supply rm closet	1977	0%
Heating	Hot water ceiling hung heater	Attic	Sterling	Electric - fan	attic	1977	0%
Heating/ Cooling	Baseboard heating on outer walls	Throughout the Library at outer walls	Missing nametags	N/A	Library	1977	0%
Heating	3 electric wall units	1st and 3rd flr bathrooms	Chromalox TP	Electric	1st and 3rd flr bathrooms	1977	0%
continued on the next page							

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.

Building System	Description	Location	Model #	Fuel	Space Served	Year Installed	Estimated Remaining Useful Life %
continued from the previous page							
Ventilation	EF-1 - 70% est. eff.	Attic	Penn-Rex 12W inline, DVC inline fan, 1/12 HP	Electric	3 toilets	1977	0%
Ventilation	EF-2 - 70% est. eff.	Attic	Penn-Zephyr Z-10	Electric	Mtg rm 1st floor	1977	0%
Domestic Hot Water	50 gal, electrical, original to the bldg, 3 ph, 50 amp, 3 electrical elements, 6 kW each for a total of 18 kW - 98% est. eff.	1st flr custodial space	Bradford-White Co. Spartan BW5018C18; Serial #: TB01-0369	Electric	Library	1977	0%
Elevator	1 hydraulic Dover - 2,500 lbs capacity	1st flr hydraulic pump elevator room	Dover, GE hydraulic pump motor - 20 HP, 3510 RPM	Electric	Library	1977	0%
Lighting	See details - Appendix A	See details - Appendix A	See details - Appendix A	Electric	Library	varies	on the average, 15%

4. ENERGY CONSERVATION MEASURES

Based on the assessment of the South River Public Library, 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 the electric domestic hot water (DHW) heater - SWA considered replacing this heater, which is operating beyond its useful operating life, with a 95% efficiency natural gas fired condensing Energy Star model, prior to catastrophic failure. However, because of low DHW use and the competitive utility rates at this time, SWA recommends replacement in kind with a high efficiency electric DHW heater. This replacement in kind recommendation offers negligible energy savings.
- Replace common area heating equipment - such as finned tube radiation, outer wall baseboard, cabinet unit hot water heaters, small ceiling hung hot water units and small bathroom electric heaters. This equipment is in fair condition, but age and wear have reduced the heat transfer capacity. This equipment should be replaced with more modern Energy Star rated equipment suited for the intended use. These changes cannot be justified based on energy savings alone. However, replacement is strongly recommended along with programmable thermostats and upgrades to other portions of the heating system. This is a replacement in kind recommendation offers negligible energy savings.
- Install/upgrade the Building Management System (BMS) - Currently, the building is controlled by individual stand alone thermostats and an antiquated/unsupported/un-calibrated electro-

mechanical Barber-Colman system. An overall digital BMS will result in energy savings via improved temperature control and coordination for the building. This recommendation will ensure that the retro-commissioning estimated savings (per ECM#2) are maintained and reproducible. SWA recommends this upgrade with the next major building renovation.

- Install premium motors when replacements are required - Select NEMA Premium motors when replacing motors that have reached the end of their useful operating lives such as ones on building circulators and fans.
- Add insulation into ineffectively or under-insulated exterior wall sections. SWA suggests applying 2" XPS rigid foam boards to the interior and cover with gypsum wallboard or other preferred interior finish with the next major renovation.
- Replace roof finish due to age and condition and add/re-insulate (R-28 min.) with the next major renovation.
- Replace building bathroom and meeting room exhaust fans which are operating beyond their estimated useful lives. This replacement with fans in kind and premium efficiency (fractional) motors will generate negligible energy savings.
- Overhaul elevator and associated hydraulic piston system which are operating beyond their estimated useful lives to a state of the art system to insure continuing reliable and safe use.

Category II Recommendations: Operations and Maintenance

- Thoroughly and evenly insulate space above/between ceilings and roof, and plug all ceiling penetration.
- Maintain roofs - SWA recommends regular maintenance to verify water is draining correctly.
- Maintain downspouts and cap flashing - Repair/install missing downspouts and cap flashing as needed to prevent water/moisture infiltration and insulation damage. Maintain gutters, downspouts and downspout deflectors to minimize uncontrolled roof water run-off causing exterior wall damage.
- Provide weather stripping/air sealing - SWA observed that exterior door weather-stripping in places was beginning to deteriorate. Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. The perimeter of all window frames should also be regularly inspected and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frames. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.
- Repair/seal wall cracks and penetrations - SWA recommends as part of the maintenance program to install proper flashing, seal wall cracks and penetrations wherever necessary in order to keep insulation dry and effective. Repair/replace damaged vertical tongue & groove exterior wall sections and investigate insect issue further.
- 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.
- Use smart power electric strips - in conjunction with occupancy sensors to power down computer equipment when left unattended for extended periods of time.
- Create an energy educational program - that teaches how to minimize their energy use. The US Department of Energy offers free information for hosting energy efficiency educational programs and plans, for more information please visit: <http://www1.eere.energy.gov/education/> .

Category III Recommendations: Energy Conservation Measures - Summary Table

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1.1, 1.2 & 1.3	Replace incandescent, halogen, Mercury Vapor, High Pressure Sodium and Metal Halide lamps with CFLs; replace fluorescent Exit sign fixtures with LED type; replace T12 fixtures with magnetic ballasts with T8 fixtures with electronic ballasts
2	Retro-commissioning of heating and cooling equipment
Description of Recommended 5-10 Year Payback ECMs	
3	Install Premium efficiency motor on heating hot water circulator
4	Install Premium efficiency motor on chilled water circulator
5	Replace old refrigerator with Energy Star type model
Description of Recommended End of Life Cycle ECMs	
6	Replace old AHUs with condensing type furnaces, re-insulate ducts
Description of Renewable ECMs	
7	Install a 3 kW solar PV rooftop system

ECM#1: Building Lighting Upgrades

Description:

On the days of the site visits, SWA completed a lighting inventory of the Public Library (see Appendix A). The interior Public Library lighting contains a mix of T12 fixtures with magnetic ballasts, a couple of T8 fixtures with electronic ballasts, incandescent, halogen lamps and pendant fixtures with Mercury Vapor lamps. SWA recommends replacing the inefficient fixtures as follows: Incandescent, halogen and Mercury Vapor bulbs should be replaced with screw-in CFLs (Compact Fluorescent Light-bulbs). 4ft T12 fixtures should be replaced with 4ft T8 fixtures as an End of Life replacement with sound financial justification. CFL bulbs produce the same lumen output with less wattage than incandescent or halogen bulbs and last up to 5 times longer. All replacements should meet local code requirements, such as shielding for safety hazards.

SWA also recommends installing occupancy sensors in areas that are occupied only part of the day and payback on savings is justified. At this time simple payback is in excess of 12 years. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion is detected within a set time period. Advance micro-phonic lighting sensors include sound detection as a mean to control lighting operation. SWA recommends upgrading the few fluorescent Exit signs to LED type.

The exterior lighting surveyed during the building audit was found to be a mix of Metal Halide, High Pressure Sodium and Halogen lamp fixtures. SWA recommends replacing these lamps with CFL lamps. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption. The labor in all these installations was evaluated using prevailing electrical contractor wages. The Borough of South River may decide to perform this work with in-house resources from its Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

Installation cost:

Estimated installed cost: \$12,935 (includes \$9,553 of labor)

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
1.1	Replace (19) incandescent, (16) halogen, (26) Mercury Vapor, (6) High Pressure Sodium and (1) Metal Halide lamps with CFLs	RS Means, Lit Search	5,100	0	5,100	14,757	5.2	0	5.9	175	2,093	5	10,467	2.4	105	21	30	4,295	26,422
1.2	Replace (4) fluorescent Exit sign fixtures with LED Exit sign type	RS Means, Lit Search	740	0	740	385	0.1	0	0.2	26	76	15	1,145	9.7	55	4	6	153	689
1.3a	Replace (33) T12 fixtures throughout the bldg with new T12 fixtures	RS Means, Lit Search	6,600	0	6,600	0	0.0	0	0.0	88	88	15	1,313	75.4	-80	-5	-16	-5,398	0
1.3b	Incremental difference to replace (33) T12 fixtures throughout the bldg with new T8 fixtures	RS Means, Lit Search	495	0	495	1,085	0.4	0	0.4	35	176	15	2,641	2.8	433	29	35	1,528	1,943
1.3 (a+b)	Replace (33) T12 fixtures throughout the bldg with new T8 fixtures	RS Means, Lit Search	7,095	0	7,095	1,085	0.4	0	0.4	123	264	15	3,953	26.9	-44	-3	-7	-3,870	1,943

Assumptions: SWA calculated the savings for this measure using measurements taken on the days of the field visits and using the billing analysis. SWA also assumed an aggregated 9.3 hr/yr to replace aging burnt out lamps vs. newly installed.

Rebates/Financial Incentives:

NJ Clean Energy - There aren't any incentives at this time offered by the state of NJ for this energy conservation measure.

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: Retro-Commissioning

Description:

Retro-commissioning is a process that seeks to improve how building equipment and systems function together. Depending on the age of the building, retro-commissioning can often resolve problems that occurred during design or construction and/or address problems that have developed throughout the building's life. Owners often undertake retro-commissioning to optimize building systems, reduce operating costs, and address comfort complaints from building occupants.

Since the systems at the Public Library have undergone some renovations in recent years, and the building continues to have concerns with thermal comfort control, SWA recommends undertaking retro-commissioning to optimize system operation as a follow-up to completion of the upgrades. The retro-commissioning process should include a review of existing operational parameters for both newer and older installed equipment. During retro-commissioning, the individual instrument control loop temperatures should also be reviewed to identify opportunities for optimizing system performance.

Installation cost:

Estimated installed cost: \$10,625 (includes \$9,031 of labor)

Source of cost estimate: Similar projects

Economics (without incentives):

ECM #	ECM description	source	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO ₂ reduced, lbs/yr
2	Retro commissioning	similar projects	10,625	none at this time	10,625	4,072	1.5	380	6.1	1,820	2,823	12	33,880	3.8	219	18	25	16,614	11,477

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the amount of energy used for heating and cooling the Criminal Justice building. Based on experience with similar buildings, SWA estimated the heating and cooling energy consumption. Typical savings for retro-commissioning range from 5-20%, as a percentage of the total space conditioning consumption. SWA assumed 10% savings. Estimated costs for retro-commissioning range from \$0.50-\$2.00 per square foot. SWA assumed \$1.25 per square foot of a total

square footage of 8,500. SWA also assumed on the average 1 hr/wk operational savings when systems are operating per design vs. the need to make more frequent adjustments.

Rebates/financial incentives:

There are currently no incentives for this measure at this time.

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/eeecbg_program_criteria.html

ECM#3: Install Premium Efficiency Motor on Heating Hot Water Circulator

Description:

The boiler room houses one (1) Taco pipe-mounted circulator pump as part of the hot water heating system to serve the hot water radiators, AHUs and other hot water terminal units listed in this report. The pump looks in satisfactory condition even as it is operating beyond its expected useful life. SWA recommends a standby spare be installed to operate in a lead-lag fashion. The pump is driven by a GE 3 HP motor of standard efficiency. The Public Library will realize energy savings by utilizing a NEMA premium efficiency motor for the pump.

Installation cost:

Estimated installed cost: \$450 (includes \$158 of labor)

Source of cost estimate: Similar projects and DOE MotorMaster+ International selection & savings analysis

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO ₂ reduced, lbs/yr
3	Replace (1) 3HP standard eff pump motor on heating circulating pump with NEMA premium motor	MotorMaster+ International, similar projects	450	0	450	680	0.3	0	0.3	0	88	15	1,326	5.1	195	13	18	572	1,217

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. The DOE MotorMaster+ International selection and calculator was used with the assumption that the heating water pump operates throughout the heating season. According to weather bin data for South River, the pump considered should operate for approximately 4,200 hours per year.

Rebates/financial incentives:

There are currently no incentives for this measure at this time.

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/eeecbg_program_criteria.html

ECM#4: Install Premium Efficiency Motor on Chilled Water Circulator

Description:

The boiler room houses one (1) Taco pipe-mounted circulator pump as part of the chilled glycol-water solution system to serve the chilled water AHUs and other chilled water terminal units listed in this report. The pump looks in satisfactory condition even as it is operating beyond its expected useful life. SWA recommends a standby spare be installed to operate in a lead-lag fashion. The pump is driven by a GE 3 HP motor of standard efficiency. The Public Library will realize energy savings by utilizing a NEMA premium efficiency motor for the pump.

Installation cost:

Estimated installed cost: \$450 (includes \$158 of labor)

Source of cost estimate: Similar projects and DOE MotorMaster+ International selection & savings analysis

Economics (with incentives):

ECM #	ECM description	source	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO ₂ reduced, lbs/yr
4	Replace (1) 3HP standard eff pump motor on chilled water circulating pump with NEMA premium motor	MotorMaster+ International, similar projects	450	0	450	453	0.2	0	0.2	0	59	15	884	7.6	96	6	10	236	811

Assumptions: SWA calculated the savings for this measure using nameplate data taken and using the billing analysis. The DOE MotorMaster+ International selection and calculator was used with the assumption that the chilled water pump operates throughout the summer cooling season. According to weather bin data for South River, the pump considered should operate for approximately 2,800 hours per year.

Rebates/financial incentives:

There are currently no incentives for this measure at this time.

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#5: Replace Old Refrigerator with an Energy Star Model

Description:

On the day of the site visit, SWA observed that there was an old refrigerator in the kitchen area which was not Energy Star rated (using approximately 773 kWh/yr). Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing refrigerator with 18.2 cu. ft. top freezer refrigerator ENERGY STAR®, Mfr. model #6897, 407 kWh/yr, or equivalent. Besides saving energy, the replacement will also keep the surrounding area cooler. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, 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>.

Installation cost:

Estimated installed cost: \$750 (includes \$70 of labor)

Source of cost estimate: *Manufacturer and Store 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
5a	Replace (1) old kitchen refrigerator with an 18 cu ft model in kind	Energy Star purchasing and procurement site, similar projects	700	0	700	50	0.0	0	0.0	50	57	12	678	12.4	-3	0	0	-140	90
5b	Incremental difference to replace (1) old kitchen refrigerator with an 18 cu ft Energy Star model	Energy Star purchasing and procurement site, similar projects	50	0	50	300	0.1	0	0.1	0	39	12	468	1.3	836	70	78	323	537
5 (a+b)	Replace one (1) old kitchen refrigerator with an 18 cu ft Energy Star model	Energy Star purchasing and procurement site, similar projects	750	0	750	350	0.1	0	0.1	50	96	12	1,146	7.9	53	4	7	183	627

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis.

Rebates/financial incentives: *NJ Clean Energy - There aren't any incentives at this time offered by the state of NJ for this energy conservation measure.*

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/eeecbg_program_criteria.html

ECM#6: Replace Old AHUs with Condensing Type Furnaces

Description:

All three (3) AHUs are original to the 1977 building construction and operating beyond their estimated useful lives. Their coils are of an older design and may be partly fouled. The blower motors are standard rather than NEMA premium efficiency. The ductwork appears to be acoustically insulated on the inside and there is concern that aged insulation starts to become brittle and be carried away with the airflow into the conditioned spaces creating a dusty unhealthy atmosphere. SWA recommends continuation of AHU routine maintenance, such as belt changes (a couple heard squeaking during the field audit), lubrication, air filter changes and customary inspections until the next major capital HVAC investment. At that time SWA recommends that the AHUs be replaced/upgraded with Energy Star condensing furnace of 93% Annual Fuel Utilization Efficiency (AFUE) rating. The heat capacity of each furnace should match the capacity of the AHU it is replacing, taking into account whether over-sizing for a library expansion will go ahead in the near future. The 81.5% efficient boiler will still supply hot water to heat the Library's radiators, which are also operating beyond their estimated useful lives and should be replaced with the next major renovation. The brittle insulation inside the ducts should be removed and the ducts thoroughly vacuumed out. Then, new insulation and jacketing should be applied to the outside of all the ducts. This re-insulation work is labor intensive and expensive. New evaporator coils are to be added to the furnace discharge ducts for cooling the re-circulating air with chilled water.

SWA recommends replacement with two-stage furnaces, which is like having two furnaces in one. On the coldest days, the furnace operates in the high-stage mode at 100% capacity. But on most days, the furnace comfortably conserves energy by operating in the low-stage mode at just 70% capacity. The two-stage gas valve runs quietly on the low stage 90% of the time, producing just 25% of the normal high-fire sound, while significantly reducing energy consumption. A central furnace control orchestrates the various functions of the furnace with digital accuracy. Functions like the blower and inducer motor are monitored for proper operation, increasing safety and reliability. SWA also recommends features like the corrosion-resistant, aluminized steel tubular heat exchanger with stainless-steel recuperative coil which will provide many years of trouble-free service. Plus, a furnace heavy-gauge, reinforced and insulated steel cabinet. The high-efficiency combustion process allows venting with 2 - 4 inch PVC without the need for a traditional chimney flue. And because it can be direct-vented to the outside, fresh air can be used for combustion. The fuel stingy auto-ignition system eliminates the old-fashioned standing pilot for greater ignition dependability without the wasted energy.

Installation cost:

Estimated installed cost: \$96,900 (includes \$50,355 of labor)

Source of cost estimate: Manufacturer's data and similar projects

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
6a	Replace (3) old AHUs in kind, remove duct brittle inside insulation and apply duct insulation on outside	Similar projects	88,500	0	88,500	1	0.0	0	0.0	250	250	15	3,752	353.8	-96	-6	-26	-82,904	2
6b	Incremental difference to replace (3) old AHUs with condensing furnaces - 93% eff and new evaporator coils	Similar projects	8,400	0	8,400	2,568	0.9	550	7.5	0	1,058	15	15,863	7.9	89	6	9	3,919	10,665
6 (a+b)	Replace (3) old AHUs with condensing furnaces - 93% eff and new evaporator coils, remove duct brittle inside insulation and apply duct insulation on outside	Energy Star purchasing and procurement site, similar projects	96,900	0	96,900	2,569	0.9	550	7.5	250	1,308	15	19,615	74.1	-80	-5	-15	-78,985	10,666

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

Rebates/financial incentives: *NJ Clean Energy - There aren't any incentives at this time offered by the state of NJ for this energy conservation measure.*

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#7: *Install a 3 kW PV System*

Description:

Currently the South River Public Library does not use any renewable energy systems. Renewable energy systems such as photovoltaic panels, can be mounted on the building roofs, and can offset a portion of the purchased electricity for the building. Power stations generally have two separate electrical charges: usage and demand. Usage is the amount of electricity in kilowatt-hours that a building uses from month to month. Demand is the amount of electrical power that a building uses at any given instance in a month period. During the summer periods, when electric demand at a power station is high due to the amount of air conditioners, lights, equipment, etc... being used within the region, demand charges go up to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems not only offset the amount of electricity use by a building, but also reduce the building's electrical demand, resulting in a higher cost savings as well. The Borough of South River may want to review installing a 3 kW PV system to offset electrical demand and reduce the annual net electric consumption for the Public Library. The Public Library is not eligible for a 30% federal tax credit, available only to residential buildings. The Public Library may want to consider applying for a grant and/or engage a PV generator/leaser who would install the PV system and then sell the power at a reduced rate. Typically, a major utility provides the ability to buy SREC's at \$600/MWh or best market offer. However, this option is not available from the local utility. See below for more information.

Considering the available square footage of the Public Library roof at this time, it would be possible to install a 50 kW PV system. However, considering the facts that:

- the solar PV system should be limited in size to below the minimum electrical demand since the utility will not buy back excess power generated by the system
- the solar PV system installation cost should be limited to allow for available grant money to considerably shorten the payback period

SWA is only recommending a 3 kW PV system. Should the Public Library decide to increase the air conditioned spaces, the minimum demand would increase over the historical data cited in this analysis, and therefore further study into expanding the proposed system would be recommended.

There are many possible locations for a 3 kW PV installation on the building roofs. A commercial crystalline 230 watt panel has 17.5 square feet of surface area (13.1 watts per square foot). A 3 kW system needs approximately 13 panels which would take up 228 square feet. The installation of a renewable Solar Photovoltaic power generating system could serve as a good educational tool and exhibit for the community.

Installation cost:

Estimated installed cost: \$22,500 (includes \$9,000 of labor)

Source of cost estimate: Similar Projects

Economics (without NJ EECBG Grant):

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
7	Install a 3 kW Solar Photovoltaic system	Similar Projects	22,500	0	22,500	3,541	3.0	0	1.4	0	460	25	11,509	48.9	0	0	-5	-14,205	6,341

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

Rebates/financial incentives:

NJ Clean Energy rebates are not available since the South River Utility is part of an energy consortium that does not pay the Societal Benefits Charge that funds these rebates.

NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1,000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. An estimated SREC value of \$1,800 could be realized with a traditional solar PV system setup. However, since net metering is not available from the local utility, savings in the form of SRECs were NOT incorporated into the above analysis.

Options for funding ECM:

This project may benefit from applying for a grant from the State of New Jersey 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

5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

5.1. Existing systems

There aren't currently any existing renewable energy systems.

5.2. Wind

Description:

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

Description:

A Solar PV System would not be recommended because of insufficient financial incentives and a simple payback greater than 40 years. See ECM#7.

5.4. Solar Thermal Collectors

Description:

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

Description:

CHP is not applicable for this building because of insufficient domestic hot water use.

5.6. Geothermal

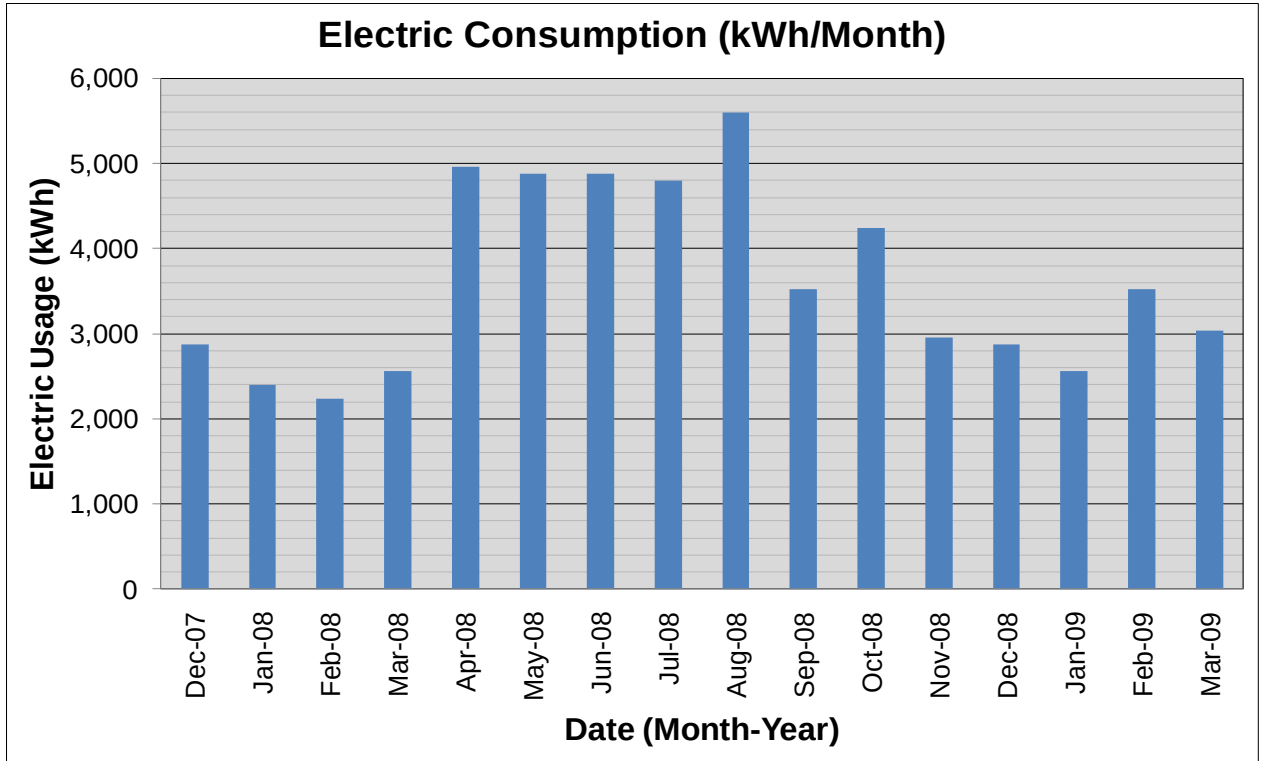
Description:

Geothermal would not be cost effective for this building because it would require replacement of the existing HVAC system, of which major components still have as a whole a number of useful operating years.

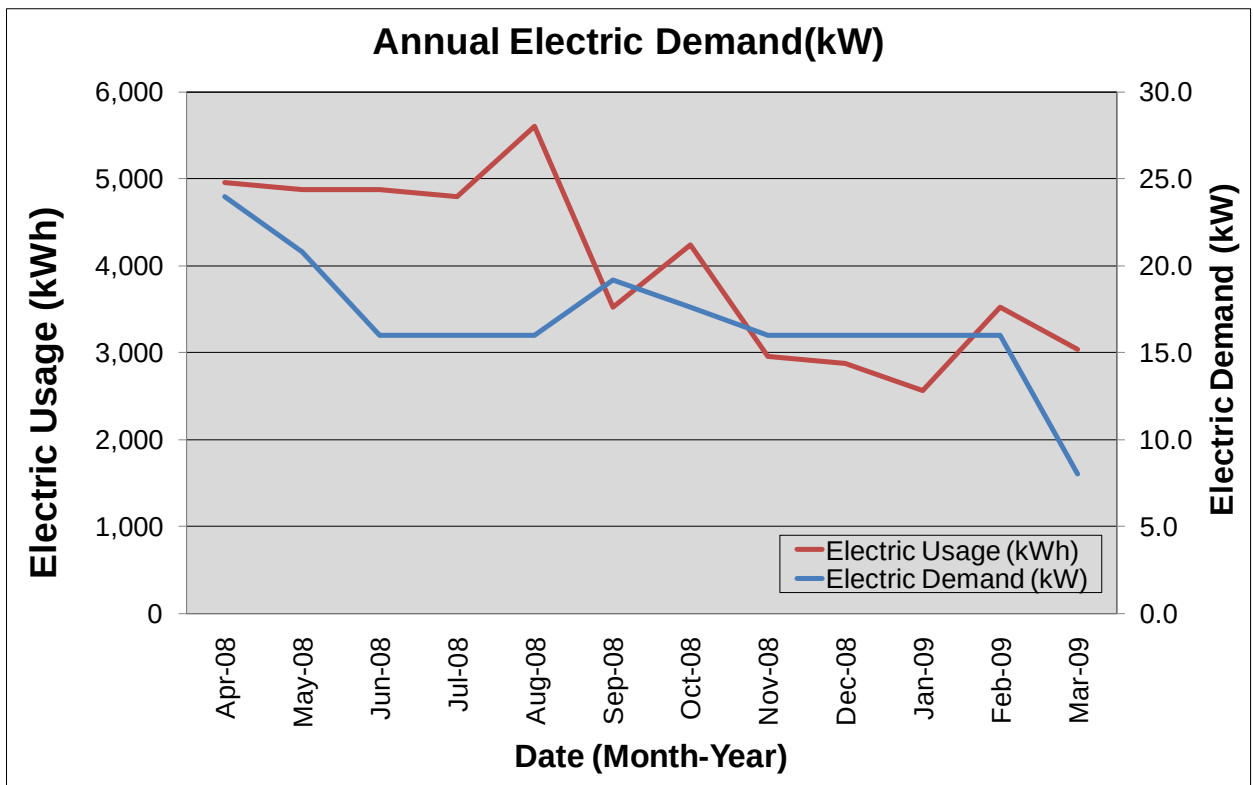
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load Profiles

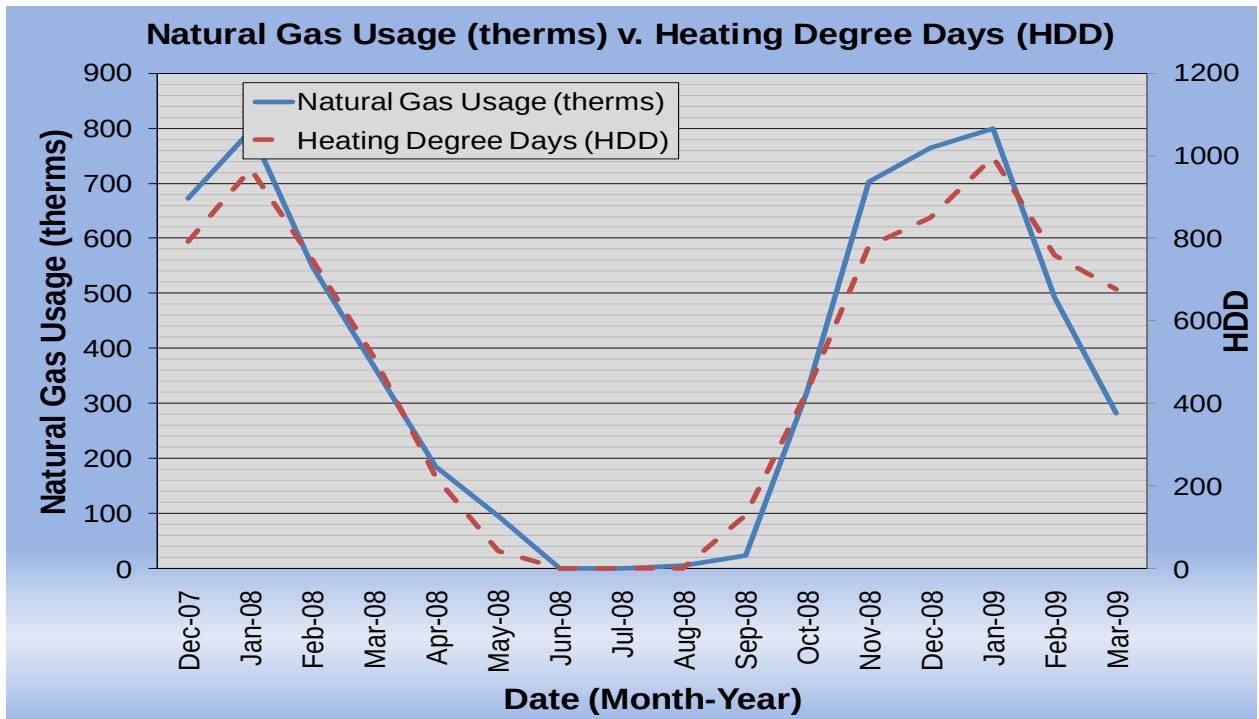
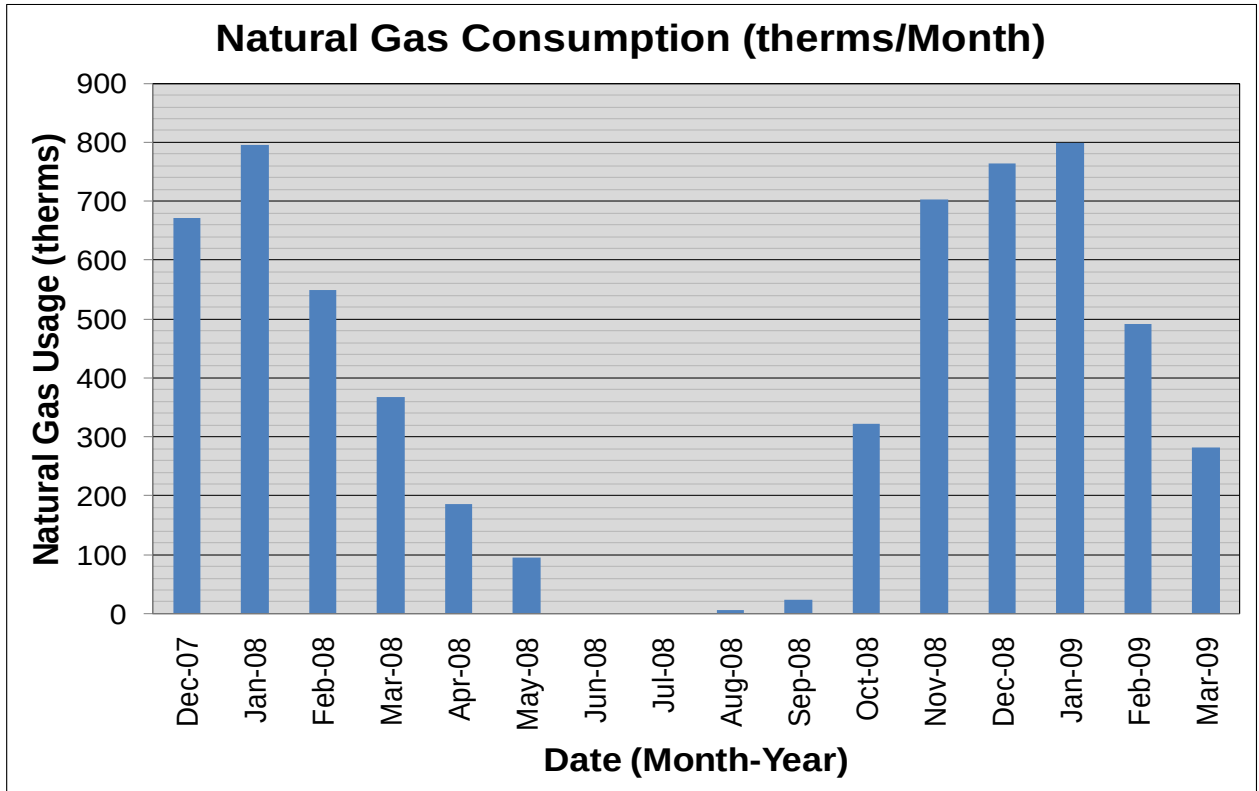
The following are charts that show the annual electric and natural gas load profiles for the South River Public Library. For annual electric and natural gas usage please also see Section 1. Historic Energy Consumption.



Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks.

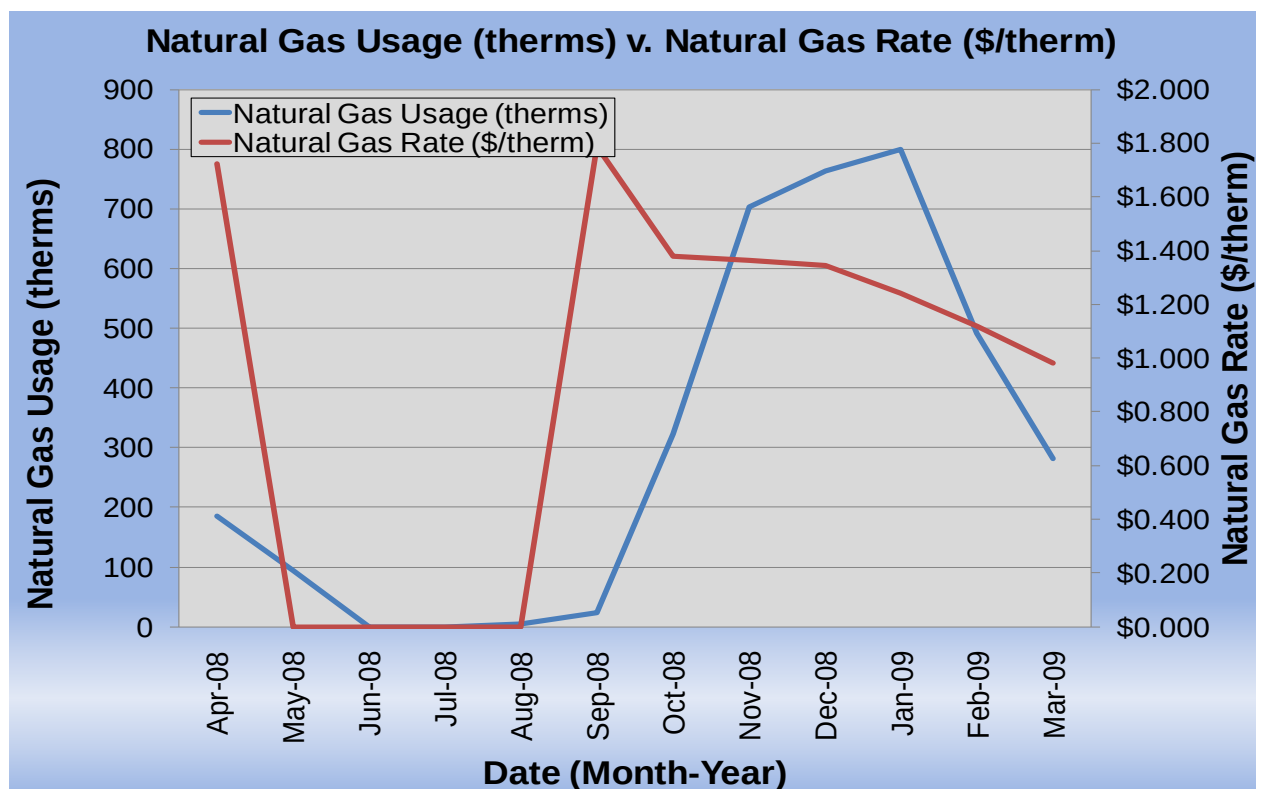


The following is a chart of the natural gas load profile for the building, peaking in the coldest months of the year and a chart showing natural gas consumption following the “heating degree days” curve. Some utility bills have more than one month estimated and combined.



6.2. Tariff Analysis

Currently, natural gas is provided to the Public Library via one gas meter with PSE&G acting as the supply and also the transport company. Gas is provided by PSE&G at a general and very competitive service rate. The suppliers' general service rate for natural gas charges a market-rate price based on use and the Public Library 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 heating months when natural gas is used by the furnace units. Some high gas price per therm fluctuations in the summer may be due to high energy costs that recently occurred and low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months. Some of the cap payments (May - August) are excluded from the following chart.



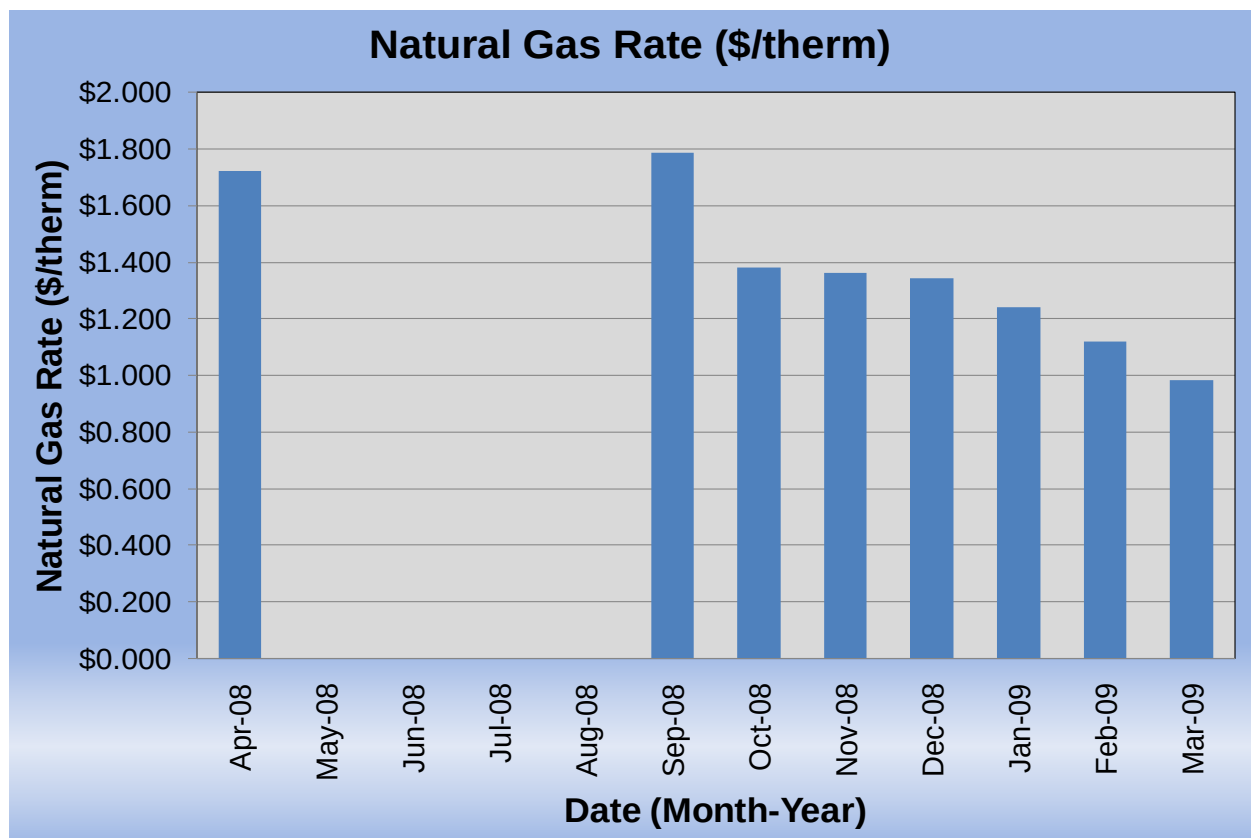
The Public Library is direct-metered and currently purchases electricity from the South River Electric Utility at a general service rate. The general service rate for electric charges is market-rate based on use and the Public Library does not track a breakdown of demand costs. Demand prices are generally reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the electricity prices increase during the cooling months when electricity is used by air conditioning systems.

6.3. Energy Procurement Strategies

The Public Library receives natural gas via one incoming meter. PSE&G supplies the gas and transports it. There is not an ESCO engaged in the process. An Energy Services Company (ESCO) is a consultancy group that engages in a performance based contract with a client firm

to implement measures which reduce energy consumption and costs in a technically and financially viable manner. Electricity is also purchased via one incoming meter directly for the main Public Library from South River Electricity Company without an ESCO. SWA analyzed the utility rate for natural gas and electricity supply over an extended period. Electric rates were estimated by the Borough of South River over the most recent 12 month period. Natural gas bill analysis shows fluctuations up to 33% over the most recent 12 month period. Some of these fluctuations may have been caused by adjustments between estimated and actual meter readings, others may be due to unusual high and recent escalating energy costs.

The average estimated NJ commercial utility rates for electric and gas are \$0.150/kWh and \$1.550/therm respectively. The Public Library annual utility costs are competitive when compared to the average estimated NJ commercial utility rates. SWA recommends that the Borough of South River further explore opportunities of purchasing both natural gas and electricity from ESCOs in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Public Library. Appendix B contains a complete list of third party energy suppliers for the Borough of South River service area. The Borough of South River may want to consider partnering with other school districts, municipalities, boroughs 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. Also, the Public Library 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. The following chart show the Public Library monthly natural gas spending per unit of energy in 2009. Electric rates were estimated by the Borough at a constant rate of \$0.130/kWh.



7. METHOD OF ANALYSIS

7.1. Assumptions and tools

Energy modeling tool: established/standard industry assumptions, 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 & established specialized equipment material & 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

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	GF	Bathroom #1	Parabolic	M	4'T12	3	1	40	S	5	272	12	156	212	T8	Parabolic	4'T8	E	S	3	1	32	5	272	3	105	143	69	0	69
2	GF	Bathroom #2	Parabolic	M	4'T12	3	1	40	S	5	272	12	156	212	T8	Parabolic	4'T8	E	S	3	1	32	5	272	3	105	143	69	0	69
3	B	Elevator Mech. Room	Recessed	M	4'T12	1	4	40	S	1	272	24	184	50	T8	Recessed	4'T8	E	S	1	4	32	1	272	13	141	38	12	0	12
4	B	Meeting Room	Recessed	N	Inc	9	1	65	S	5	272	0	585	796	cfl	Recessed	CFL	N	S	9	1	20	5	272	0	180	245	551	0	551
5	B	Meeting Room	Parabolic	M	4'T12	8	1	40	S	5	272	12	416	566	T8	Parabolic	4'T8	E	S	8	1	32	5	272	3	280	381	185	0	185
6	B	Meeting Room	Exit Sign	N	Fl.	2	1	15	N	24	365	2	34	298	EDex	Exit Sign	LED	N	N	2	1	5	24	365	1	12	105	193	0	193
7	B	AV Room	Parabolic	M	4'T8	2	1	32	S	5	272	3	70	95	N/A	Parabolic	4'T8	M	S	2	1	32	5	272	3	70	95	0	0	0
8	B	Hallway	2'U-shape	M	4'T12	3	2	40	S	11	272	15	285	853	T8	2'U-Shape	4'T8	E	S	3	2	32	11	272	6	210	628	224	0	224
9	B	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
10	B	Storage Room	Parabolic	M	4'T12	3	2	40	S	2	272	15	285	155	T8	Parabolic	4'T8	E	S	3	2	32	2	272	6	210	114	41	0	41
11	B	Elevator	HID	N	Hal	4	1	20	N	12	272	5	100	326	CFL	Screw-in	CFL	N	N	4	1	5	12	272	0	20	65	261	0	261
12	1	Office	Parabolic	M	4'T12	6	1	40	S	11	272	12	312	934	T8	Parabolic	4'T8	E	S	6	1	32	11	272	3	210	628	305	0	305
13	1	Boiler Room	Parabolic	M	4'T12	2	2	40	S	2	272	15	190	103	T8	Parabolic	4'T8	E	S	2	2	32	2	272	6	140	76	27	0	27
14	1	Library	Parabolic	N	MV	18	1	100	S	11	272	25	2,250	6,732	CFL	Screw-in	CFL	N	S	18	1	35	11	272	0	630	1885	4847	0	4847
15	1	Library	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
16	1	Bathroom	Parabolic	M	4'T12	1	1	40	S	5	272	12	52	71	T8	Parabolic	4'T8	E	S	1	1	32	5	272	3	35	48	23	0	23
17	2	Lobby	Recessed	N	Inc	1	1	65	S	11	272	0	65	194	cfl	Recessed	CFL	N	S	1	1	20	11	272	0	20	60	135	0	135
18	2	Lobby	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
19	2	Vestibule	Recessed	N	Inc	2	1	65	S	11	272	0	130	389	cfl	Recessed	CFL	N	S	2	1	20	11	272	0	40	120	269	0	269
20	2	Vestibule	Recessed	N	Inc	2	1	65	S	11	272	0	130	389	cfl	Recessed	CFL	N	S	2	1	20	11	272	0	40	120	269	0	269
21	2	Meeting Room	Parabolic	N	MV	4	1	100	S	5	272	25	500	680	CFL	Screw-in	CFL	N	S	4	1	35	5	272	0	140	190	490	0	490
22	2	Meeting Room	Exit Sign	N	Fl.	1	1	15	N	24	365	2	17	149	EDex	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	96	0	96
23	2	Meeting Room	Recessed	N	Inc	1	1	65	S	5	272	0	65	88	cfl	Recessed	CFL	N	S	1	1	20	5	272	0	20	27	61	0	61
24	3	Office Area	2'U-shape	M	4'T12	1	2	40	S	11	272	15	95	284	T8	2'U-Shape	4'T8	E	S	1	2	32	11	272	6	70	209	75	0	75
25	3	Office Area	Recessed	N	Inc	1	1	65	S	11	272	0	65	194	cfl	Recessed	CFL	N	S	1	1	20	11	272	0	20	60	135	0	135
26	3	Office Area	Exit Sign	N	Fl.	1	1	15	N	24	365	2	17	149	EDex	Exit Sign	LED	N	N	1	1	5	24	365	1	6	53	96	0	96
27	3	Office Area	Parabolic	N	MV	4	1	100	S	11	272	25	500	1,496	CFL	Screw-in	CFL	N	S	4	1	35	11	272	0	140	419	1077	0	1077
28	3	Storage Room	Parabolic	M	4'T12	1	2	40	S	2	272	15	95	52	T8	Parabolic	4'T8	E	S	1	2	32	2	272	6	70	38	14	0	14
29	3	Mechanical Room	Parabolic	M	4'T12	1	2	40	S	2	272	15	95	52	T8	Parabolic	4'T8	E	S	1	2	32	2	272	6	70	38	14	0	14
30	Ext	Exterior	Recessed	N	Inc	3	1	65	T	12	365	0	195	854	cfl	Recessed	CFL	N	T	3	1	20	12	365	0	60	263	591	0	591
31	Ext	Exterior	Exterior	N	Hal	12	1	70	T	12	365	18	1,056	4,625	CFL	Exterior	CFL	N	T	12	1	25	12	365	0	300	1314	3311	0	3311
32	Ext	Exterior	Exterior	N	MH	1	1	100	T	12	365	25	125	548	CFL	Exterior	CFL	N	T	1	1	35	12	365	0	35	153	394	0	394
33	Ext	Exterior	Exterior	N	HPS	6	1	100	T	12	365	25	750	3,285	CFL	Exterior	CFL	N	T	6	1	35	12	365	0	210	920	2365	0	2365
Totals:						110	42	1,617				334	8,993	24,989						110	42	791			73	3,613	8,789	16,200	0	16,200
Rows Highlighted Yellow Indicate an Energy Conservation Measure is recommended for that space																														

Legend:									
<u>Fixture Type</u>		<u>Lamp Type</u>		<u>Control Type</u>		<u>Ballast Type</u>		<u>Retrofit Category</u>	
Exit Sign		LED		N (None)		N/A (None)		N/A (None)	
Screw-in		Inc (Incandescent)		S (Switch)		E (Electronic)		T8 (Install new T8)	
Pin		1'T5		OS (Occupancy Sensor)		M (Magnetic)		T5 (Install new T5)	
Parabolic		2'T5		T (Timer)				CFL (Install new CFL)	
Recessed		3'T5		PC (Photocell)				LEDex (Install new LED Exit)	
2'U-shape		4'T5		D (Dimming)				LED (Install new LED)	
Circiline		2'T8		DL (Daylight Sensor)				D (Delamping)	
Exterior		3'T8		M (Microphonic Sensor)				C (Controls Only)	
HID (High Intensity Discharge)		4'T8							
		6'T8							
		8'T8							
		2'T12							
		3'T12							
		4'T12							
		6'T12							
		8'T12							
		CFL (Compact Fluorescent Lightbulb)							
		MR16							
		Halogen							
		MV (Mercury Vapor)							
		MH (Metal Halide)							
		HPS (High Pressure Sodium)							
		LPS (Low Pressure Sodium)							

Appendix B: Third Party Energy Suppliers (ESCOs)
<http://www.state.nj.us/bpu/commercial/shopping.html>

PSE&G NATURAL GAS SERVICE TERRITORY Last Updated: 06/15/09		
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109 800-6BUYGAS (6-289427) www.cooperativenet.com	Direct Energy Services, LLP 120 Wood Avenue, Suite 611 Iselin, NJ 08830 866-547-2722 www.directenergy.com	Dominion Retail, Inc. 395 Highway 170 - Suite 125 Lakewood, NJ 08701 866-275-4240 http://retail.dom.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701 800-805-8586 www.gesc.com	UGI Energy Services, Inc. d/b/a GASMAR 704 East Main Street, Suite 1 Moorestown, NJ 08011 856-273-9995 www.ugienergyservices.com	Great Eastern Energy 116 Village Riva, Suite 200 Princeton, NJ 08540 888-651-4121 www.greateastern.com
Hess Energy, Inc. One Hess Plaza Woodbridge, NJ 07095 800-437-7872 www.hess.com	Hudson Energy Services, LLC 920 Route 17 South Ridgewood, NJ 07450 877- Hudson 9 www.hudsonenergyservices.com	Intelligent Energy 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024 800-724-1880 www.intelligentenergy.org
Keil & Sons 1 Bergen Blvd. Fairview, NJ 07002 1-877-Systrum www.systrumenergy@aol.com	Metromedia Energy, Inc. 6 Industrial Way Eatontown, NJ 07724 877-750-7046 www.metromediaenergy.com	Metro Energy Group, LLC 14 Washington Place Hackensack, NJ 07601 888-111-Metro www.metroenergy.com
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 088327 800-375-1277 www.mxenergy.com	NATGASCO (Mitchell Supreme) 1112 Freeman Street Orange, NJ 07050 800-840-4GAS 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 - Office 105 Cherry Hill, NJ 08002 800-281-2000 www.pplenergyplus.com	Sempra Energy Solutions The Mac-Cali Building 581 Main Street, 8th fl. Woodbridge, NJ 07095 877-273-6772 800-2 SEMPRA www.semprasolutions.com	South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037 800-756-3749 www.sjindustries.com/sje.htm
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 011128 800-225-1560 www.spragueenergy.com	Stuyvesant Energy LLC 10 West Ivy Lane, Suite 4 Englewood, NJ 07631 800-646-64111 www.stuyfuel.com	Woodruff Energy 73 Water Street Bridgeton, NJ 08302 800-5111-1121 www.woodruffenergy.com

Appendix C

Glossary and Method of Calculations

Glossary of ECM Terms

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

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

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

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

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

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

Return on Investment (ROI): The ROI is 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
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:

	A	B	C	D	E	F	G	H	I
1									
2									
3									
4					Year	Cash Flow			
5					0	\$ (5,000.00)			Investment Cost
6					1	\$ 850.00			
7					2	\$ 850.00			
8					3	\$ 850.00			
9					4	\$ 850.00			
10					5	\$ 850.00			
11					6	\$ 850.00			
12					7	\$ 850.00			
13					8	\$ 850.00			
14					9	\$ 850.00			
15					10	\$ 850.00			
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