TOWNSHIP OF MARLBORO

LIBRARY

40 WYNCREST ROAD
MARLBORO, NJ 07746

FACILITY ENERGY REPORT

TABLE OF CONTENTS

I. HISTORIC ENERGY CONSUMPTION/COST

The energy usage for the facility has been tabulated and plotted in graph form as depicted within this section. Each energy source has been identified and monthly consumption and cost noted per the information provided by the Owner.

Electric Utility Provider:	Jersey Central Power & Light
Electric Utility Rate Structure:	General Service Secondary Space Heating 3 Phase
Third Party Supplier:	Hudson Energy Services

Natural Gas Utility Provider:	New Jersey Natural Gas
Utility Rate Structure:	General Service Large (GSL)
Third Party Supplier:	Woodruff Energy

The electric usage profile represents the actual electrical usage for the facility. The electric utility measures consumption in kilowatt-hours (KWH) and maximum demand in kilowatts (KW). One KWH usage is equivalent to 1000 watts running for one hour. One KW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the historical data received for the facility.

The gas usage profile within each facility report shows the actual natural gas energy usage for the facility. The gas utility measures consumption in cubic feet x 100 (CCF), and converts the quantity into Therms of energy. One Therm is equivalent to 100,000 BTUs of energy.

Table 1
Electricity Billing Data

ELECTRIC USAGE SUMMARY

Utility Provider: Jersey Central Power & Light
Rate: General Service Secondary Space Heating Service 3 Phase
Meter No: G35518172
Account No: 100 011 239 355
Third Party Utility Provider: Hudson Energy Services
TPS Meter / Acct No: -

MONTH OF USE	CONSUMPTION KWH	DEMAND KW	TOTAL BILL
Jan-13	19,760	93.4	$2,698
Feb-13	16,320	93.4	$2,822
Mar-13	14,080	93.4	$1,829
Apr-13	17,280	64.6	$2,261
May-13	13,440	64.6	$1,851
Jun-13	20,800	85.5	$4,408
Jul-13	22,480	90.6	$3,026
Aug-13	20,080	83.5	$2,595
Sep-13	19,680	83.5	$2,555
Oct-13	18,160	65.0	$2,245
Nov-13	11,120	65.0	$1,538
Dec-13	14,560	49.8	$1,785
Totals	**207,760**	**93.4 Max**	**$29,611**

AVERAGE DEMAND **77.7 KW average**
AVERAGE RATE **$0.143** **$/kWh**

Figure 1
Electricity Usage Profile

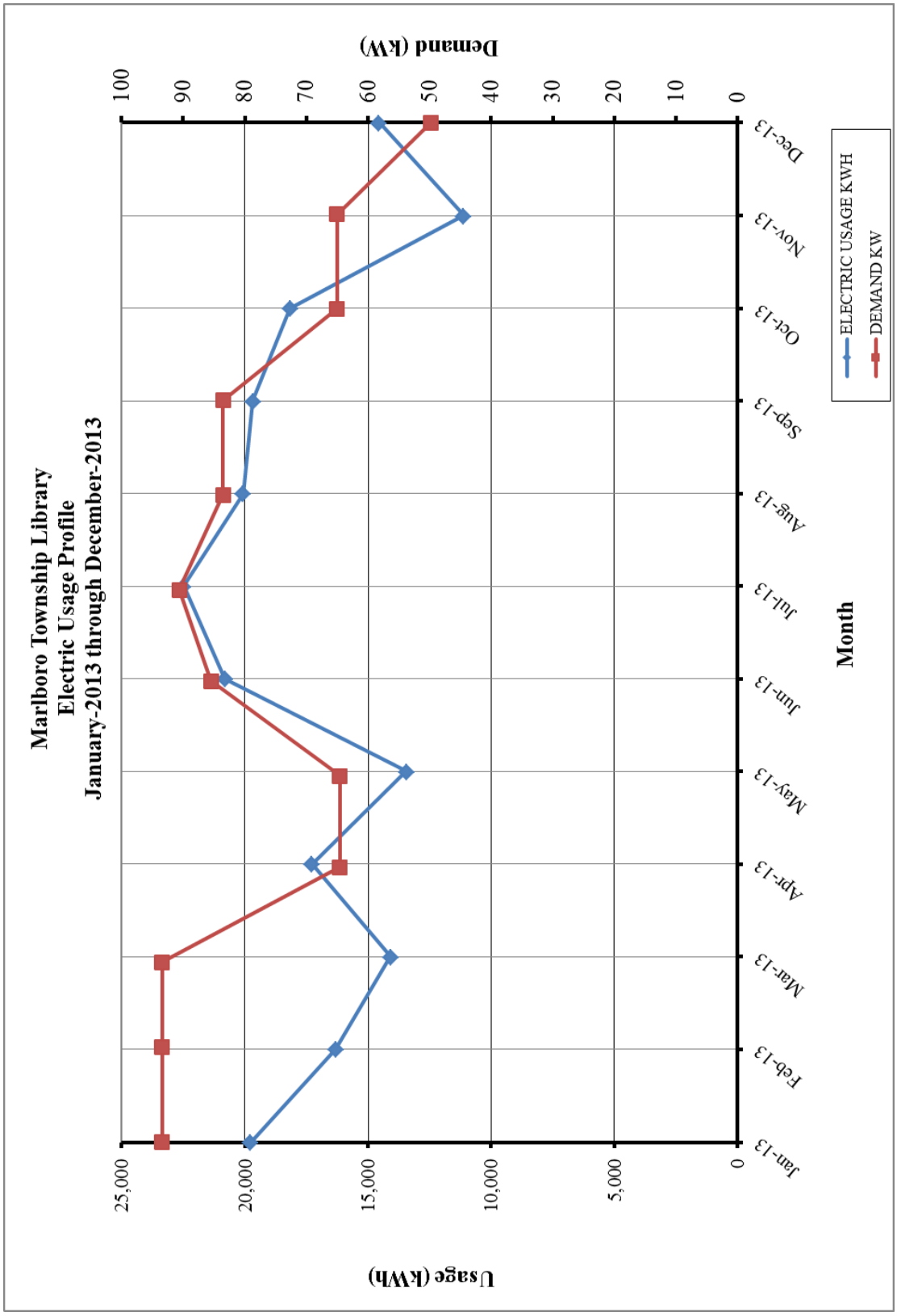
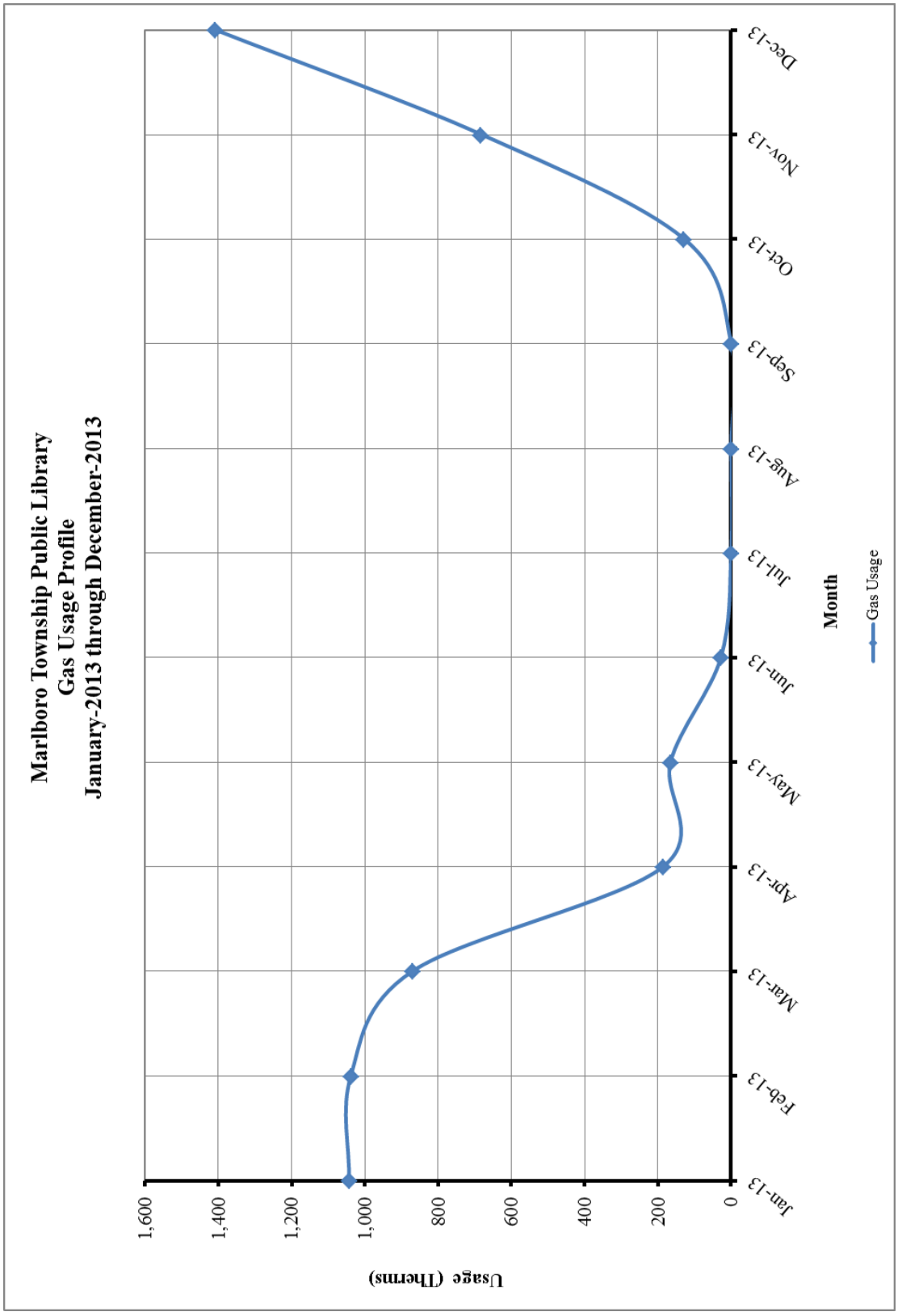


Table 2
Natural Gas Billing Data

NATURAL GAS USAGE SUMMARY		
Utility Provider: New Jersey Natural Gas (NJNG)		
Rate: GSL		
Meter No: 00726420		
Account No: 13-3462-0795-11		
Third Party Utility Provider: Woodruff Energy		
TPS Meter No: -		
MONTH OF USE	**CONSUMPTION (THERMS)**	**TOTAL BILL**
Jan-13	1,043.25	$1,134.27
Feb-13	1,038.38	$1,129.56
Mar-13	870.10	$966.81
Apr-13	185.48	$304.33
May-13	165.62	$285.51
Jun-13	27.88	$152.66
Jul-13	0.00	$125.34
Aug-13	0.00	$125.34
Sep-13	0.00	$125.34
Oct-13	128.25	$245.34
Nov-13	682.61	$751.77
Dec-13	1,409.07	$1,527.93
TOTALS	**5,550.64**	**$6,874.20**
AVERAGE RATE:	**$1.24**	**$/THERM**

Figure 2
Natural Gas Usage Profile



II. FACILITY DESCRIPTION

The Library is located at 40 Wyncrest Road in Marlboro, New Jersey. This 16,300 SF facility was built in 1974 with no additions. The building is a single-story facility comprised of offices, meeting rooms, main library area, lunch room, storage room, custodian closet, and mechanical room.

Occupancy Profile

The typical hours of operation for the facility are Monday through Thursday between 9:00 AM and 9:00 PM, Friday between 1 AM and 5 PM, and Saturday between 9 AM and 5 PM. There are 2 employees that normally occupy the facility.

Building Envelope

Exterior walls for the building are masonry brick faced with a concrete block construction. The windows throughout the facility are in very good condition. Typical windows are double pane, 1/4" with aluminum frames. The roof consists of a rubber membrane over a metal deck supported by steel joists. The amount of insulation below the roofing could not be determined.

HVAC Systems

The Library is conditioned by seven (7) rooftop units with DX cooling and gas-fired heating as follows:

Unit ID	Mfg.	Cooling Capacity	Heating Capacity	Efficiency
RTU-1	Carrier	5-Tons	115 MBH	10 SEER
RTU-2	Carrier	7.5-Tons	180 MBH	8.9 EER
RTU-3	York	20-Tons	300 MBH	10 EER
RTU-4	Carrier	2-Tons	60 MBH	10 SEER
RTU-5	Carrier	7.5-Tons	125 MBH	8.9 EER
RTU-6	Carrier	6-Tons	115 MBH	9 EER
RTU-7	Carrier	5-Tons	74 MBH	10 SEER

In addition, there is a Trane Model RAUE-B256 rooftop, split, air-cooled condensers rated at 2.5-Tons with an efficiency of 10 SEER.

The meeting room has two (2) horizontal, ceiling-mounted, self-contained, unit ventilators with unknown capacity.

Exhaust System

Toilet exhaust air is relieved through roof-mounted exhaust fans while the various rooftop units deliver fresh, outdoor air and remove stale, exhaust air.

HVAC System Controls

The heating and cooling is controlled by various 7-day programmable thermostats throughout the facility. The electric baseboards are controlled by various wall thermostats. The packaged rooftop units contain standalone thermostat controls within each space they condition.

Domestic Hot Water

The domestic hot water is provided by an electric Bradford White Model M16U6SS2 tank water heater with a capacity of 6 gallons located in the custodian closet.

Lighting

Refer to the Investment Grade lighting Audit Appendix for a detailed list of the lighting throughout the facility and estimated operating hours per space.

III. MAJOR EQUIPMENT LIST

The equipment list contains major energy consuming equipment that through implementation of energy conservation measures could yield substantial energy savings. The list shows the major equipment in the facility and all pertinent information utilized in energy savings calculations. An approximate age was assigned to the equipment in some cases if a manufactures date was not shown on the equipment's nameplate. The ASHRAE service life for the equipment along with the remaining useful life is also shown in the Appendix.

Refer to the **Major Equipment List Appendix** for this facility.

IV. ENERGY CONSERVATION MEASURES

Energy Conservation Measures are developed specifically for this facility. The energy savings and calculations are highly dependent on the information received from the site survey and interviews with operations personnel. The assumptions and calculations should be reviewed by the owner to ensure accurate representation of this facility. The following ECMs were analyzed:

Table 1
ECM Financial Summary

ENERGY CONSERVATION MEASURES (ECM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST[A]**	**ANNUAL SAVINGS[B]**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
ECM #1	Lighting Upgrade - General	$75,170	$9,742	7.7	94.4%
ECM #2	Lighting Upgrade - Exterior	$4,990	$1,960	2.5	489.1%
ECM #3	Lighting Controls Upgrade	$650	$85	7.6	97.2%
ECM #4	Rooftop Unit Replacement	$76,067	$2,048	37.1	-59.6%
ECM #5	Water Conservation	$150	$584	0.3	3793.3%
ECM #6	Domestic Hot Water Heater Upgrade	$21,532	$503	42.8	-76.6%
ECM #7	Energy Star Refrigerator	$800	$141	5.7	76.3%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST**	**ANNUAL SAVINGS**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
REM #1	131.52 kW PV System	$644,917	$51,343	12.6	19.4%

Notes: A. Cost takes into consideration applicable NJ Smart StartTM incentives.
B. Savings takes into consideration applicable maintenance savings.

Table 2
ECM Energy Summary

ENERGY CONSERVATION MEASURES (ECM's)					
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION			
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)	WATER (GALLONS)
ECM #1	Lighting Upgrade - General	26.3	68,126	0	0
ECM #2	Lighting Upgrade - Exterior	3.4	13,704	0	0
ECM #3	Lighting Controls Upgrade	0.0	597	0	0
ECM #4	Rooftop Unit Replacement	12.7	14,322	0	0
ECM #5	Water Conservation	0.0	1,852	0	21,250
ECM #6	Domestic Hot Water Heater Upgrade	0.0	5,106	-183	0
ECM #7	Energy Star Refrigerator	0.0	987	0	0
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION			
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)	WATER (GALLONS)
REM #1	131.52 kW PV System	131.5	153,682	0	0

Table 3
ECM Emissions Summary

ENERGY CONSERVATION MEASURES (ECM's)				
ECM NO.	DESCRIPTION	GREENHOUSE GAS EMISSIONS REDUCTION		
		CO_2 EMISSIONS (LBS)	NO_X EMISSIONS (LBS)	SO_2 EMISSIONS (LBS)
ECM #1	Lighting Upgrade - General	103,552	191	443
ECM #2	Lighting Upgrade - Exterior	20,830	38	89
ECM #3	Lighting Controls Upgrade	908	2	4
ECM #4	Rooftop Unit Replacement	21,769	40	93
ECM #5	Water Conservation	251,440	201	12
ECM #6	Domestic Hot Water Heater Upgrade	7,761	14	33
ECM #7	Energy Star Refrigerator	1,500	3	6

Notes: A. Emissions Reduction based on NJCEP published factors for electric & gas.

Table 4
Facility Project Summary

FACILITY PROJECT SUMMARY TABLE					
ENERGY CONSERVATION MEASURES	**ANNUAL ENERGY SAVINGS ($)**	**PROJECT COST ($)**	**SMART START INCENTIVES**	**CUSTOMER COST**	**SIMPLE PAYBACK**
Lighting Upgrade - General	$9,742	$75,670	$500	$75,170	7.7
Lighting Upgrade - Exterior	$1,960	$6,130	$1,140	$4,990	2.5
Lighting Controls Upgrade	$85	$800	$150	$650	7.6
Rooftop Unit Replacement	$2,048	$78,750	$2,683	$76,067	37.1
Water Conservation	$584	$150	$0	$150	0.3
Domestic Hot Water Heater Upgrade	$503	$21,772	$240	$21,532	42.8
Energy Star Refrigerator	$141	$800	$0	$800	5.7
Total Project	**$15,063**	**$184,072**	**$4,713**	**$179,359**	**11.9**

Note the measure totals in this table do not take into account interactive effects of measures; see Method of Analysis Section III in Executive Report for further explanation.

This project does not qualify for additional incentives through the Pay for Performance Program, please see the Installation Funding Options section for additional program options.

ECM #1: Lighting Upgrade – General

Description:

The majority of the interior lighting throughout the Library is provided with fluorescent fixtures with older generation, T12 lamps and magnetic ballasts. These fixtures can be replaced and retrofit with new LED type fixtures and lamps.

This ECM includes replacing and retrofitting the interior lighting with new LED type lamps and fixtures. It is recommended the Township consult with a professional engineer prior to retrofitting or replacing fixtures to ensure code required minimum light levels will be met.

Energy Savings Calculations:

The **Investment Grade Lighting Audit Appendix** outlines the hours of operation, proposed retrofits, costs, savings, and payback periods for each set of fixtures in the each building.

LIGHTING UPGRADE SAVINGS SUMMARY	
DESCRIPTION	**SAVINGS**
Electric Demand Savings (kW)	26.3
Electric Usage Savings (kWh)	68,126
Electric Cost Savings ($)	$9,742

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$75,670
NJ Smart Start Equipment Incentive ($):	$500
Net Installation Cost ($):	$75,170
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$9,742
Total Yearly Savings ($/Yr):	$9,742
Estimated ECM Lifetime (Yr):	15
Simple Payback	7.7
Simple Lifetime ROI	94.4%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$146,131
Internal Rate of Return (IRR)	10%
Net Present Value (NPV)	$41,130.26

ECM #2: Lighting Upgrade – Exterior Lighting

Description:

The exterior lighting at the Library is currently lit by metal halide and high pressure sodium fixtures. The exterior would be better served with more efficient LED lighting system. Concord Engineering recommends upgrading the lighting to an energy-efficient LED lighting system that includes LED lamps and fixtures for the existing exterior lighting.

This ECM would replace the existing exterior lamps and fixtures with equivalent LED lamps and fixtures.

Energy Savings Calculations:

A detailed Investment Grade Lighting Audit can be found in **Investment Grade Lighting Audit Appendix** that outlines the proposed retrofits, costs, savings, and payback periods.

LIGHTING UPGRADE SAVINGS SUMMARY	
DESCRIPTION	**SAVINGS**
Electric Demand Savings (kW)	3.4
Electric Usage Savings (kWh)	13,704
Electric Cost Savings ($)	$1,960

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$6,130
NJ Smart Start Equipment Incentive ($):	$1,140
Net Installation Cost ($):	$4,990
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,960
Total Yearly Savings ($/Yr):	$1,960
Estimated ECM Lifetime (Yr):	15
Simple Payback	2.5
Simple Lifetime ROI	489.1%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$29,395
Internal Rate of Return (IRR)	39%
Net Present Value (NPV)	$18,404.44

ECM #3: Lighting Controls Upgrade – Occupancy Sensors

Description:

Some of the lights in the Library are left on unnecessarily. In many cases the lights are left on because of the inconvenience to manually switch lights off when a room is left or on when a room is first occupied. This is common in rooms that are occupied for only short periods and only a few times per day. In some instances lights are left on due to the misconception that it is better to keep the lights on rather than to continuously switch lights on and off. Although increased switching reduces lamp life, the energy savings outweigh the lamp replacement costs. The payback timeframe for when to turn the lights off is approximately two minutes. If the lights are expected to be off for at least a two minute interval, then it pays to shut them off.

Lighting controls come in many forms. Sometimes an additional switch is adequate to provide reduced lighting levels when full light output is not needed. Occupancy sensors detect motion and will switch the lights on when the room is occupied. Occupancy sensors can either be mounted in place of a current wall switch, or on the ceiling to cover large areas.

The U.S. Department of Energy sponsored a study to analyze energy savings achieved through various types of building system controls. The referenced savings is based on the "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways," document posted for public use April 2005. The study has found that commercial buildings have the potential to achieve significant energy savings through the use of building controls. The average energy savings are as follows based on the report:

- Occupancy Sensors for Lighting Control 20% - 28% energy savings.

Savings resulting from the implementation of this ECM for energy management controls are estimated to be 20% of the total light energy controlled by occupancy sensors.

This ECM includes installation of ceiling or switch mount sensors for mostly offices. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent. The **Investment Grade Lighting Audit Appendix** of this report includes the summary of lighting controls implemented in this ECM and outlines the proposed controls, costs, savings, and payback periods. The calculations adjust the lighting power usage by the applicable percent savings for each area that includes lighting controls.

Energy Savings Calculations:

$$\text{Energy Savings} = \left(\%\ \text{Savings} \times \text{Controlled Light Energy}\ \left(\text{kWh/Yr}\right)\right)$$

$$\text{Savings.} = \text{Energy Savings}\left(\text{kWh}\right) \times \text{Ave Elec Cost}\left(\frac{\$}{\text{kWh}}\right)$$

LIGHTING CONTROLS SAVINGS SUMMARY	
DESCRIPTION	**SAVINGS**
Electric Usage Savings (kWh)	597
Electric Cost Savings ($)	$85

Rebates and Incentives:

From the **NJ Smart Start® Program Incentives Appendix**, the installation of a lighting control device warrants the following incentive:

Smart Start Incentive
$= (\#\ \text{Wall mount sensors} \times \$20\ \text{per sensor})$
$+ (\#\ \text{Ceiling mount sensors} \times \$35\ \text{per sensor})$

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$800
NJ Smart Start Equipment Incentive ($):	$150
Net Installation Cost ($):	$650
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$85
Total Yearly Savings ($/Yr):	$85
Estimated ECM Lifetime (Yr):	15
Simple Payback	7.6
Simple Lifetime ROI	97.2%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$1,282
Internal Rate of Return (IRR)	10%
Net Present Value (NPV)	$369.97

ECM #4: Packaged Rooftop Unit Replacements

Description:

The Library has a total of (5) five packaged rooftop units and one split system condensing unit which serve several areas within the library and are 20 years old. These rooftop units have surpassed their ASHRAE service life expectancy of 15 years. Replacing these units with newer more efficient units would result in significant energy savings.

The units currently installed have lower efficiencies compared to modern high-efficiency units. New units provide higher full load and part load efficiencies due to advances in inverter motor technologies, higher efficiency refrigerants such as R410A which would be used in place of R12 that is currently used in the unit.

This ECM includes replacement of the older rooftop units and split systems with new higher efficiency rooftops, condensing units and indoor coils. It is recommended to fully evaluate the capacity needed for the new rooftop units and split systems prior to moving forward with this ECM. A summary of the unit replacement for this ECM can be found in the table below:

IMPLEMENTATION SUMMARY					
ECM INPUTS	**SERVICE FOR**	**NUMBER OF UNITS**	**COOLING CAPACITY, BTU/HR**	**TOTAL CAPACITY, TONS**	**REPLACE UNIT WITH**
RTU-1	Packaged Rooftop	1	60,000	5.0	Carrier Weathermaster or Equivalent
RTU-2	Packaged Rooftop	1	90,000	7.5	Carrier Weathermaster or Equivalent
RTU-5	Packaged Rooftop	1	90,000	7.5	Carrier Weathermaster or Equivalent
RTU-6	Packaged Rooftop	1	72,000	6.0	Carrier Weathermaster or Equivalent
RTU-7	Packaged Rooftop	1	60,000	5.0	Carrier Weathermaster or Equivalent
CU-1	Split System	1	30,000	2.5	York CZH CU & Indoor Coil or Equivalent
Total		**6**	**402,000**	**33.5**	

The high-efficiency rooftops and split systems used as the basis for the calculation are Carrier and York. The unit pricing and install cost were estimated based on current rates quotes and labor rates. The payback may change based on actual unit pricing and installed costs if the ECM is implemented.

Energy Savings Calculations:

<u>Cooling Energy Savings:</u>

Seasonal energy consumption of the air conditioners at the cooling mode is calculated with the equation below:

$$\text{Energy Savings, kWh} = \text{Cooling Capacity,} \frac{\text{BTU}}{\text{Hr}} \times \left(\frac{1}{\text{SEER}_{\text{Old}}} - \frac{1}{\text{SEER}_{\text{New}}} \right) \times \frac{\text{Operation Hours}}{1000 \frac{\text{W}}{\text{kWh}}}$$

$$\text{Demand Savings, kW} = \frac{\text{Energy Savings (kWh)}}{\text{Hours of Cooling}}$$

$$\text{Cooling Cost Savings} = \text{Energy Savings, kWh} \times \text{Cost of Electricity}\left(\frac{\$}{\text{kWh}}\right)$$

ENERGY SAVINGS CALCULATIONS							
ECM INPUTS	**EXISTING COOLING CAPACITY, BTU/Hr**	**ANNUAL COOLING HOURS**	**EXISTING UNIT EFFICIENCY**	**NEW UNIT EFFICIENCY**	**# OF UNITS**	**ENERGY SAVINGS kWh**	**DEMAND SAVINGS kW**
RTU-1	60,000	1,131	10 SEER	15.2 SEER	1	2,322	2.1
RTU-2	90,000	1,131	8.9 EER	12 EER	1	2,955	2.6
RTU-5	90,000	1,131	8.9 EER	12 EER	1	2,955	2.6
RTU-6	72,000	1,131	9 EER	12 EER	1	2,262	2.0
RTU-7	60,000	1,131	10 EER	15.2 SEER	1	2,322	2.1
CU-1	30,000	1,131	10 EER	18 SEER	1	1,508	1.3
Total					6	14,322	12.7

Project Cost, Incentives and Maintenance Savings

From the NJ Smart Start® Program appendix, the replacement of split system AC units and unitary systems with high efficiency AC systems falls under the category "Unitary HVAC Split System" and warrants an incentive based on efficiency (EER/SEER). The program incentives are calculated as follows:

$$\text{Smart Start® Incentive} = (\text{Cooling Tons} \times \ \$/\text{Ton Incentive})$$

AC UNITS REBATE SUMMARY				
UNIT DESCRIPTION	**UNIT EFFICIENCY**	**REBATE $/TON**	**PROPOSED CAPACITY TONS**	**TOTAL REBATE $**
≥ 5.4 to < 11.25 tons	11.5 EER	73	21.0	$1,533
5.4 tons or less Unitary AC and Split System	≥14 SEER	$92	12.5	$1,150
TOTAL			**33.5**	**$2,683.0**

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$78,750
NJ Smart Start Equipment Incentive ($):	$2,683
Net Installation Cost ($):	$76,067
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$2,048
Total Yearly Savings ($/Yr):	$2,048
Estimated ECM Lifetime (Yr):	15
Simple Payback	37.1
Simple Lifetime ROI	-59.6%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$30,721
Internal Rate of Return (IRR)	-10%
Net Present Value (NPV)	($51,617.20)

ECM #5: Water Conservation

Description:

The Library utilizes standard plumbing fixtures. The typical water faucet consumption only meets the minimum federal required standard for water efficiency. New fixtures are available that use less water than today's requirements and can add up to significant water reduction over a long period.

This ECM includes the retrofitting of the existing faucets within the facility with new low flow aerators. The estimated usage of the plumbing fixtures is based on the total population of the facility. The number of plumbing fixtures to be replaced is based on observations of the facility. (Please note that the estimate of occupants for the library is an estimate based on daily employees at the facility)

The proposed retrofit includes installation of low flow aerators. For the basis of this calculation the LEED rating system was used to estimate the occupancy usage for people in the library. When water consumption information was not available, the GPF values were estimated for the existing fixtures.

Energy Savings Calculations:

Faucets:

$$\text{Water Usage} = \text{Occupancy}\left(\frac{\text{Days}}{\text{yr}}\right) \times \frac{\text{Uses}}{\text{Day}} \times \text{Duration}\left(\frac{\text{min}}{\text{Use}}\right) \times \text{Fixture}\left(\frac{\text{Gal}}{\text{Min}}\right)$$

$$\text{Electric Cost (kWh)} = \text{Faucet Water Consumption (Gallons)} \times \frac{8.33\,\text{lbs}}{\text{Gal}} \times \Delta T(70F) \times \frac{\text{kWh}}{3{,}412\,\text{BTU}}$$

$$\text{Electric Usage } (kWh) = \text{Faucet Water Usage (Gal)} \times 8.33\frac{\text{lbs}}{\text{Gal}} \times \text{Specific Heat (1)} \times \Delta\text{T(70°F)} \times \frac{kWh}{3{,}412\ \text{Btu}} \times \frac{1}{\text{HWH Efficiency}}$$

LOW FLOW WATER SAVING DEVICES			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Quantity of Sinks	5	5	
Flow Rate (GPM)	2.2	0.5	1.7
Device Usage (min per day)	10	10	
Facility Operation (days / year)	250	250	
Heat Content of Water (Btu/gal/°F)	8.33	8.33	
Temperature Rise (°F)	70.0	70.0	
Efficiency of Heating System (%)	98%	98%	
Conversion Factor for Electric	3413	3413	
Electric Rate ($/kWh)	$0.143	$0.143	
Water Rate ($/1000gal)	$15.000	$15.000	
ENERGY SAVINGS CALCULATIONS			
Electric Usage (kWh)	2,397	545	1,852
Water Usage (gallons)	27,500	6,250	21,250
Energy Cost ($)	$755	$172	$584
COMMENTS:	Heating Savings based on 50% Hot Cold Mix		

The cost for installation and materials is based on 5 faucet aerators. There are no Smart Start rebates for installation of low flow plumbing fixtures.

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$150
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$150
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$584
Total Yearly Savings ($/Yr):	$584
Estimated ECM Lifetime (Yr):	10
Simple Payback	0.3
Simple Lifetime ROI	3793.3%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$5,840
Internal Rate of Return (IRR)	389%
Net Present Value (NPV)	$4,831.64

ECM #6: High Efficiency Gas Hot Water Heater

Description:

The Library has a single electric hot water heater located in the janitor closet. The current unit is a single element with a storage capacity of 6 gallons and total electric input of 1.5 kilowatts. The unit is only 8 years, but could be replaced with a much more efficient and cost effective natural gas fired domestic boiler.

This ECM will replace the domestic water heater with a Natural Gas fired 95% thermal efficient Bradford White EFR series 60 gallon 120 MBH heater, or equivalent. The natural gas line will need to be extended to the heater, and venting can be extended from the heater out the side wall. (Before proceeding with installation of aforementioned system, Concord Engineering suggests consulting an engineer to evaluate the system fully.)

Energy Savings Calculations:

Energy Density for "Other" type building = 1.7 kBtu / SF / year

$$\text{DHW Heat Usage (kBtu)} = \text{Energy Density} \left(\frac{\frac{\text{kBtu}}{\text{yr}}}{\text{SF}} \right) \times \text{Building Area (SF)}$$

$$\text{DHW Total Usage} = \frac{\text{DHW Heat Usage (Btu)}}{\text{Heating Eff (\%)} \times \text{Fuel Heat Value} \left(\frac{\text{Btu}}{\text{Fuel Unit}} \right)}$$

$$\text{Energy Cost} = \text{Heating Fuel Usage (Fuel Units)} \times \text{Avg. Fuel Cost} \left(\frac{\$}{\text{Fuel Unit}} \right)$$

DOM. HOT WATER HEATER CALCULATIONS			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
ECM INPUTS	Existing Electric Water Heater	High Efficiency Heater	
Building Type	Library		
Building Square-foot	16,303	16,303	
Domestic Water Usage, kBtu	17,426.78	17,426.78	
DHW Heating Fuel Type	Electric	Gas	
Heating Efficiency	98%	95%	-3%
Total Usage (kBTU)	17,782	18,344	-562
Electric Cost ($/kWh)	$ 0.143	$ -	
Nat Gas Cost ($/Therm)	$ -	$ 1.240	
ENERGY SAVINGS CALCULATIONS			
ECM RESULTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Electric Usage (kWh)	5,106	0	5,106
Natural Gas Usage (Therms)	0	183	-183
Energy Cost ($)	$730	$227	$503
COMMENTS:	Savings are based on Energy Information Administration Commercial Building Energy Consumption Survey 2003 Information		

Energy Savings Summary:

ECM #6 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$21,772
NJ Smart Start Equipment Incentive ($):	$240
Net Installation Cost ($):	$21,532
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$503
Total Yearly Savings ($/Yr):	$503
Estimated ECM Lifetime (Yr):	10
Simple Payback	42.8
Simple Lifetime ROI	-76.6%
Simple Lifetime Maintenance Savings	0
Simple Lifetime Savings	$5,030
Internal Rate of Return (IRR)	-20%
Net Present Value (NPV)	($17,241.18)

ECM #7: Refrigerator Replacement

Description:

There is a residential style refrigerator located in the Library. This unit is an older model that is not nearly as energy efficient as one manufactured today.

The proposed replacement is a one-for-one with a unit of similar size and dimensions that has the most up-to-date Energy Star Rating. The Frigidaire model FFHT1513LQ or equivalent should be considered as the replacement for this measure.

Energy Savings Calculations:

ENERGY STAR REFRIGERATOR CALCULATION			
ECM INPUTS	**EXISTING**	**PROPOSED**	**SAVINGS**
Quantity	1	1	
Manufacturer	Whirlpool	Frigidaire	
Type	Top Freezer	Top Freezer	
Model	ET14AKXRNR1	FFHT1513LQ	
Size (Cu-Ft)	14.1	14.8	
Per Unit Electric Usage (kWh)	1,338	351	987
Electric Rate ($/kWh)	$0.143	$0.143	
ENERGY SAVINGS CALCULATIONS			
Electric Usage (kWh)	1,338	351	987
Energy Cost ($)	$191	$50	$141
COMMENTS:	Calculations based Energy Star Website http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator		

Energy Savings Summary:

ECM #7 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$800
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$800
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$141
Total Yearly Savings ($/Yr):	$141
Estimated ECM Lifetime (Yr):	10
Simple Payback	5.7
Simple Lifetime ROI	76.3%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$1,410
Internal Rate of Return (IRR)	12%
Net Present Value (NPV)	$402.76

REM #1: 131.52 kW Solar System

Description:

The Library has available roof and parking lot space that could accommodate solar arrays. Based on the available area a 131.52 kilowatt solar array could be installed. The array will produce approximately 153,682 kilowatt-hours annually that will reduce the overall electric usage of the facility by 73.97%. The owner should consult a structural engineer prior to installing any solar array to insure the roof can accommodate the additional weight.

Energy Savings Calculations:

See **Renewable / Distributed Energy Measures Calculations Appendix** for detailed financial summary and proposed solar layout areas. Financial results in table below are based on 100% financing of the system over a fifteen year period.

Energy Savings Summary:

REM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$644,917
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$644,917
Maintenance Savings ($/Yr):	$29,366
Energy Savings ($/Yr):	$21,977
Total Yearly Savings ($/Yr):	$51,343
Estimated ECM Lifetime (Yr):	15
Simple Payback	12.6
Simple Lifetime ROI	19.4%
Simple Lifetime Maintenance Savings	$440,494
Simple Lifetime Savings	$770,142
Internal Rate of Return (IRR)	2.3%
Net Present Value (NPV)	($31,990.33)

V. ADDITIONAL RECOMMENDATIONS

The following recommendations include no cost/low cost measures, Operation & Maintenance (O&M) items, and water conservation measures with attractive paybacks. These measures are not eligible for the Smart Start Buildings incentives from the office of Clean Energy but save energy none the less.

A. Chemically clean the condenser and evaporator coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.

B. Maintain all weather stripping on windows and doors.

C. Clean all light fixtures to maximize light output.

D. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

E. Turn off computers when not in use. Ensure computers are not running in screen saver mode.

F. Replace any old CRT Monitors with LED/LCD Type Monitors, which can draw as much as a quarter the power of an equivalent CRT monitor.

G. Ensure outside air dampers are functioning properly and only open during occupied mode.

APPENDIX A

ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING GROUP

Marlboro Township - Library

ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY														
ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME	LIFETIME ENERGY SAVINGS	LIFETIME MAINTENANCE SAVINGS	LIFETIME ROI	SIMPLE PAYBACK	INTERNAL RATE OF RETURN (IRR)	NET PRESENT VALUE (NPV)
		MATERIAL	LABOR	REBATES, INCENTIVES	NET INSTALLATION COST	ENERGY	MAINT. / SREC	TOTAL		(Yearly Saving * ECM Lifetime)	(Yearly Maint Svaing * ECM Lifetime)	(Lifetime Savings - Net Cost) / (Net Cost)	(Net cost / Yearly Savings)	$\sum_{n=0}^{N} \frac{C_n}{(1+IRR)^n}$	$\sum_{n=0}^{N} \frac{C_n}{(1+DR)^n}$
		($)	($)	($)	($)	($/Yr)	($/Yr)	($/Yr)	(Yr)	($)	($)	(%)	(Yr)	($)	($)
ECM #1	Lighting Upgrade - General	$56,435	$19,235	$500	$75,170	$9,742	$0	$9,742	15	$146,131	$0	94.4%	7.7	9.75%	$41,130.26
ECM #2	Lighting Upgrade - Exterior	$3,700	$2,430	$1,140	$4,990	$1,960	$0	$1,960	15	$29,395	$0	489.1%	2.5	38.99%	$18,404.44
ECM #3	Lighting Controls Upgrade	$550	$250	$150	$650	$85	$0	$85	15	$1,282	$0	97.2%	7.6	10.00%	$369.97
ECM #4	Rooftop Unit Replacement	$50,250	$28,500	$2,683	$76,067	$2,048	$0	$2,048	15	$30,721	$0	-59.6%	37.1	-9.65%	($51,617.20)
ECM #5	Water Conservation	$100	$50	$0	$150	$584	$0	$584	10	$5,840	$0	3793.3%	0.3	389.33%	$4,831.64
ECM #6	Domestic Hot Water Heater Upgrade	$8,256	$13,516	$240	$21,532	$503	$0	$503	10	$5,030	$0	-76.6%	42.8	-20.33%	($17,241.18)
ECM #7	Energy Star Refrigerator	$700	$100	$0	$800	$141	$0	$141	10	$1,410	$0	76.3%	5.7	11.90%	$402.76
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	131.52 kW PV System	$644,917	$0	$0	$644,917	$21,977	$29,366	$51,343	15	$770,142	$440,494	19.4%	12.6	2.30%	($31,990.33)

Notes:
1) The variable Cn in the formulas for Internal Rate of Return and Net Present Value stands for the cash flow during each period.
2) The variable DR in the NPV equation stands for Discount Rate
3) For NPV and IRR calculations: From n=0 to N periods where N is the *lifetime of ECM* and Cn is the *cash flow during each period* .

APPENDIX B

Concord Engineering Group, Inc.

520 BURNT MILL ROAD
VOORHEES, NEW JERSEY 08043
PHONE: (856) 427-0200
FAX: (856) 427-6508

SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives from July 1, 2013 to June 30, 2014:

Electric Chillers

Water-Cooled Chillers	$16 - $170 per ton
Air-Cooled Chillers	$8 - $52 per ton

Energy Efficiency must comply with ASHRAE 90.1-2007

Gas Cooling

Gas Absorption Chillers	$185 - $450 per ton
Gas Engine-Driven Chillers	Calculated through custom measure path)

Desiccant Systems

$1.00 per cfm – gas or electric

Electric Unitary HVAC

Unitary AC and Split Systems	$73 - $92 per ton
Air-to-Air Heat Pumps	$73 - $92 per ton
Water-Source Heat Pumps	$81 per ton
Packaged Terminal AC & HP	$65 per ton
Central DX AC Systems	$40- $72 per ton
Dual Enthalpy Economizer Controls	$250
Occupancy Controlled Thermostat (Hospitality & Institutional Facility)	$75 per thermostat
A/C Economizing Controls	≤ 5 tons $85/unit; >5 tons $170/unit

Energy Efficiency must comply with ASHRAE 90.1-2007

Gas Heating

Gas Fired Boilers < 300 MBH	$2.00 per MBH, but not less than $300 per unit
Gas Fired Boilers ≥ 300 - 1500 MBH	$1.75 per MBH
Gas Fired Boilers ≥1500 - ≤ 4000 MBH	$1.00 per MBH
Gas Fired Boilers > 4000 MBH	(Calculated through Custom Measure Path)
Gas Furnaces	$400 per unit, AFUE ≥ 95%
Boiler Economizing Controls	$1,200 - $2,700
Low Intensity Infrared Heating	$300 - $500 per unit

Ground Source Heat Pumps

Closed Loop	$450 per ton, EER ≥ 16 $600 per ton, EER ≥ 18 $750 per ton, EER ≥ 20

Energy Efficiency must comply with ASHRAE 90.1-2007

Variable Frequency Drives

Variable Air Volume	$65 - $155 per hp
Chilled-Water Pumps ≥ 20 hp	$60 per VFD rated hp
Rotary Screw Air Compressors ≥ 25 hp	$5,250 to $12,500 per drive
Cooling Towers ≥ 10 hp	$60 per VFD rated hp
Boiler Fans ≥ 5 HP	$65 to $155 per hp
Boiler Feed Water Pumps ≥ 5 HP	$60 to $155 per hp
Commercial Kitchen Hood up to 50 HP	Retrofit $55 – $300 per hp New Hood $55 - $250 per hp

Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons, 0.67 energy factor or better	$50 per unit
Gas-Fired Water Heaters > 50 gallons	$1.00 - $2.00 per MBH
Gas-Fired Booster Water Heaters	$17 - $35 per MBH
Gas Fired Tankless Water Heaters	$300 per unit

Prescriptive Lighting

T-8 reduced Wattage (28w/25w 4', 1-4 lamps) Lamp & ballast replacement	$10 per fixture
For retrofit of T-8 fixtures by permanent de-lamping & new reflectors (Electronic ballast replacement required)	$15 per fixture
T-5 and T-8 High Bay Fixtures	$16 - $200 per fixture
Metal Halide w/Pulse Start Including Parking Lot (For fixtures ≥ 150w)	$25 per fixture
HID ≥ 100w Replace with new induction fixture. (must be 30% less watts/fixture than HID system)	$70 per fixture
HID ≥ 100w Retrofit with induction lamp, power coupler and generator (must be 30% less watts/fixture than HID system)	$50 per fixture

Prescriptive Lighting - LED

LED Display Case Lighting	$30 per display case
LED Shelf-Mtd. Display & Task Lights	$15 per linear foot
LED Portable Desk Lamp	$20 per fixture
LED Wall-wash Lights	$30 per fixture
LED Recessed Down Lights	$35 per fixture
LED Outdoor Pole/Arm-Mounted Area and Roadway Luminaries	$175 per fixture
LED Outdoor Pole/Arm-Mounted Decorative Luminaries	$175 per fixture
LED Outdoor Wall-Mounted Area Luminaries	$100 per fixture
LED Parking Garage Luminaries	$100 per fixture
LED Track or Mono-Point Directional Lighting Fixtures	$50 per fixture
LED High-Bay and Low-Bay Fixtures for Commercial & Industrial Bldgs.	$150 per fixture
LED High-Bay-Aisle Lighting	$150 per fixture
LED Stairwell and Passageway Luminaires	$40 per fixture
LED Bollard Fixtures	$50 per fixture
Luminaires for Ambient Lighting of Interior Commercial Spaces (1x4, 2x2, 2x4)	$50 per fixture
LED Fuel Pump Canopy	$100 per fixture
LED Screw-based & Pin-based (PAR, MR, BR, R) Standards (A-Style) and Decorative Lamps	$10 per lamp for R/PAR20,MR/PAR16,Globe,Candelabra or Misc $20 per lamp for R/BR/PAR 30, R/BR/PAR 38-40, A-Lamp
LED Refrigerator/Freezer case lighting replacement of fluorescent in medium and low temperature display case	$30 per 4 foot $42 per 5 foot $65 per 6 foot
LED Retrofit Kits	To be evaluated through the customer measure path

Lighting Controls – Occupancy Sensors

Wall Mounted (Existing Facilities Only)	$20 per control
Remote Mounted (Existing Facilities Only)	$35 per control
Daylight Dimming Controls	$45 per fixture controlled
Occupancy Based hi-low Dimming Control	$35 per fixture controlled
Occupancy Sensor Remote Mounted	$35 per control

Refrigeration Doors/Covers

Energy-Efficient Doors/Covers for Installation on Open Refrigerated Cases	$100 per door
Aluminum Night Curtains for Installation on Open Refrigerated Cases	$3.50 per linear foot

Refrigeration Controls

Door Heater Controls	$50 per control
Electric Defrost Controls	$50 per control
Evaporator Fan Controls	$75 per control
Novelty Cooler Shutoff	$50 per control

Other Equipment Incentives

Performance Lighting	$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2007 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive
Custom Measures	$0.16 KWh and $1.60/Therm of 1st year savings, or a buy down to a 1 year payback on estimated savings. Minimum required savings of 75,000 KWh or 1,500 Therms and an IRR of at least 10%.

APPENDIX C

ENERGY STAR® Statement of Energy Performance

N/A

ENERGY STAR® Score[1]

Library

Primary Property Function: Library
Gross Floor Area (ft²): 16,303
Built: 1974

For Year Ending: December 31, 2013
Date Generated: July 11, 2014

1. The ENERGY STAR score is a 1-100 assessment of a building's energy efficiency as compared with similar buildings nationwide, adjusting for climate and business activity.

Property & Contact Information

Property Address	Property Owner	Primary Contact
Library 40 Wyncrest Road Marlboro, New Jersey 07746	Marlboro Township 1979 Township Drive Marlboro, NJ 07446 (____)____-_____	Jonathan Capp 1979 Township Drive Marlboro, NJ 07446 732-536-0200 jcapp@marlboro-nj.gov

Property ID: 4091276

Energy Consumption and Energy Use Intensity (EUI)

Site EUI
77.5 kBtu/ft²

Source EUI
172.3 kBtu/ft²

Annual Energy by Fuel	
Natural Gas (kBtu)	555,064 (44%)
Electric - Grid (kBtu)	708,877 (56%)

National Median Comparison	
National Median Site EUI (kBtu/ft²)	106
National Median Source EUI (kBtu/ft²)	235.6
% Diff from National Median Source EUI	-27%
Annual Emissions	
Greenhouse Gas Emissions (Metric Tons CO2e/year)	119

Signature & Stamp of Verifying Professional

I _____ (Name) verify that the above information is true and correct to the best of my knowledge.

Signature: _____Date: _____

Licensed Professional

____ _____
,
(____)____-_____
_____

Professional Engineer Stamp (if applicable)

APPENDIX D

MAJOR EQUIPMENT LIST

Concord Engineering Group

Library

AC Units

Tag	RTU-1	RTU-2	RTU-3
Unit Type	Packaged Rooftop	Packaged Rooftop	Packaged Rooftop
Qty	1	1	1
Location	Roof	Roof	Roof
Area Served	Library	Library	Library
Manufacturer	Carrier	Carrier	York
Model #	48TJE006---501--	48TJE008---501--	ZF240S24J2FZZ10001B
Serial #	4893G00685	5193G02497	N1H1274024
Cooling Type	DX, R-22	DX, R-22	DX, R-410A
Cooling Capacity (Tons)	5 Tons	7.5 Tons	20 Tons
Cooling Efficiency (SEER/EER)	10 SEER	8.9 EER	10 EER
Heating Type	Gas Heat	Gas Heat	Gas Heat
Heating Input (MBH)	115	180	300
Efficiency	80%	80%	80%
Fuel	Natural Gas	Natural Gas	Natural Gas
Approx Age	21	21	3
ASHRAE Service Life	15	15	15
Remaining Life	(6)	(6)	12
Comments			

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

AC Units

Tag	RTU-4	RTU-5	RTU-6
Unit Type	Packaged Rooftop	Packaged Rooftop	Packaged Rooftop
Qty	1	1	1
Location	Roof	Roof	Roof
Area Served	Library	Library	Library
Manufacturer	Carrier	Carrier	Carrier
Model #	48SS-024060301--	48TJD008---501--	48TJE007---501--
Serial #	4693G00546	5093G02330	4893G00606
Cooling Type	DX, R-410A	DX, R-22	DX, R-22
Cooling Capacity (Tons)	2 Tons	7.5 Tons	6 Tons
Cooling Efficiency (SEER/EER)	10 SEER	8.9 EER	9 EER
Heating Type	Gas Heat	Gas Heat	Gas Heat
Heating Input (MBH)	60	125	115
Efficiency	81%	80%	80%
Fuel	Natural Gas	Natural Gas	Natural Gas
Approx Age	3	21	21
ASHRAE Service Life	15	15	15
Remaining Life	12	(6)	(6)
Comments			

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

AC Units

Tag	RTU-7	CU-1	
Unit Type	Packaged Rooftop	Split System Condensing Unit	
Qty	1	1	
Location	Roof	Roof	
Area Served	Library	Library	
Manufacturer	Carrier	Trane	
Model #	48TJD006---501--	RAUE-B256-1-A	
Serial #	4693G01085	C82L-08629	
Cooling Type	DX, R-22	DX, R-22	
Cooling Capacity (Tons)	5 Tons	2.5 Tons	
Cooling Efficiency (SEER/EER)	10 SEER	10 SEER	
Heating Type	Gas Heat	N/A	
Heating Input (MBH)	74	N/A	
Efficiency	80%	N/A	
Fuel	Natural Gas	N/A	
Approx Age	21	32	
ASHRAE Service Life	15	15	
Remaining Life	(6)	(17)	
Comments			

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

MAJOR EQUIPMENT LIST

Concord Engineering Group

Library

Domestic Water Heaters

Tag	DHW-1		
Unit Type	Tank Water Heater		
Qty	1		
Location	Janitor Closet		
Area Served	Domestic Hot Water Loop		
Manufacturer	Bradford White		
Model #	M16U6SS2		
Serial #	CE7720101		
Size (Gallons)	6		
Input Capacity (MBH/KW)	1.5 kW		
Recovery (Gal/Hr)	-		
Efficiency %	98%		
Fuel	Electric		
Approx Age	8		
ASHRAE Service Life	12		
Remaining Life	4		
Comments			

Note:
"N/A" = Not Applicable.
"-" = Info Not Available

APPENDIX E

CEG Project #: 1C13521
Facility Name: Library
Address: 40 Wyncrest Road
City, State, Zip Marlboro, NJ 07746

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT							RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS					
Fixture Reference #	Location	Average Burn Hours	Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Work Description	Equipment Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Energy Savings, kW	Energy Savings, kWh	Energy Savings, $	Control Ref #	Controls Description	Qty of Controls	Hour Reduction %	Energy Savings, kWh	Energy Savings, $
121.34	Elec Room	2000	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., No Lens	2	78	6	0.47	936	Bypass Ballast, Relamp	4' Alledra 18w LED; LLT-X-T8-Y-SW-120-Z-S-N	2	36	6	0.22	432	0.25	504	$72	0	No New Controls	0	0.0%	0	$0
121.34	Custodial Closet	2000	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., No Lens	2	78	1	0.08	156	Bypass Ballast, Relamp	4' Alledra 18w LED; LLT-X-T8-Y-SW-120-Z-S-N	2	36	1	0.04	72	0.04	84	$12	0	No New Controls	0	0.0%	0	$0
121.34	Fire Alarm Room	2000	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., No Lens	2	78	1	0.08	156	Bypass Ballast, Relamp	4' Alledra 18w LED; LLT-X-T8-Y-SW-120-Z-S-N	2	36	1	0.04	72	0.04	84	$12	0	No New Controls	0	0.0%	0	$0
142.21	Periodicals/Shelves	2600	2x4, 4 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	4	156	5	0.78	2,028	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	5	0.20	507	0.59	1,521	$218	0	No New Controls	0	0.0%	0	$0
127.21	Periodicals/Shelves	2600	2x2, 2 Lamp, 34w T12 U-Tube, Mag. Ballast, Recessed Mnt., Prismatic Lens	2	72	1	0.07	187	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	1	0.03	81	0.04	107	$15	0	No New Controls	0	0.0%	0	$0
128.14	Hall to Elec Room	2600	8' Channel, 2 Lamp, 60w T12, Mag. Ballast, Surface Mnt., No Lens	2	124	1	0.12	322	Replace Fixture	1x4 Surface LED 48w	1	48	1	0.05	125	0.08	198	$28	0	No New Controls	0	0.0%	0	$0
132.21	Circulation Work Room	2600	2x4, 3 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	3	110	7	0.77	2,002	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	7	0.27	710	0.50	1,292	$185	0	No New Controls	0	0.0%	0	$0
127.21	Circulation Work Room	2600	2x2, 2 Lamp, 34w T12 U-Tube, Mag. Ballast, Recessed Mnt., Prismatic Lens	2	72	1	0.07	187	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	1	0.03	81	0.04	107	$15	0	No New Controls	0	0.0%	0	$0
121.31	Fiction Area	2600	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	2	78	34	2.65	6,895	Replace Fixture	1x4 Pendant LED 48w	1	48	34	1.63	4,243	1.02	2,652	$379	0	No New Controls	0	0.0%	0	$0
142.21		2600	2x4, 4 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	4	156	10	1.56	4,056	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	10	0.39	1,014	1.17	3,042	$435	0	No New Controls	0	0.0%	0	$0
2		2600	Recessed Down Light, 2 Lamp, 26w PL	2	52	9	0.47	1,217	Existing to Remain	No Change	2	52	0	0.47	1,217	0.00	0	$0	0	No New Controls	0	0.0%	0	$0
142.21	Voorhees Room	2600	2x4, 4 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	4	156	9	1.40	3,650	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	9	0.35	913	1.05	2,738	$392	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	183	$26
142.21	Voorhees Room Closet	2600	2x4, 4 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	4	156	2	0.31	811	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	2	0.08	203	0.23	608	$87	0	No New Controls	0	0.0%	0	$0
132.21	Staff Lounge	2600	2x4, 3 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	3	110	8	0.88	2,288	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	8	0.31	811	0.57	1,477	$211	6	Dual Technology Occupancy Sensor - Switch Mnt.	1	20.0%	162	$23
142.21	Biography Area	2600	2x4, 4 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	4	156	8	1.25	3,245	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	8	0.31	811	0.94	2,434	$348	0	No New Controls	0	0.0%	0	$0
1002		2600	100w MV Recessed Down Light	1	120	4	0.48	1,248	Re-lamp & Bypass ballast	18w LED PAR38	2	36	4	0.14	374	0.34	874	$125	0	No New Controls	0	0.0%	0	$0
1003		2600	2x2 400w MV Recessed	1	465	5	2.33	6,045	Re-lamp & Bypass ballast	80w LED 360 Degree Lamp;360-HID-RS-80w	1	83	5	0.42	1,079	1.91	4,966	$710	0	No New Controls	0	0.0%	0	$0
127.21		2600	2x2, 2 Lamp, 34w T12 U-Tube, Mag. Ballast, Recessed Mnt., Prismatic Lens	2	72	1	0.07	187	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	1	0.03	81	0.04	107	$15	0	No New Controls	0	0.0%	0	$0
93		2600	65w R30	1	65	8	0.52	1,352	Relamp	9w LED R30 - Dimmable	1	9	8	0.07	187	0.45	1,165	$167	0	No New Controls	0	0.0%	0	$0
184.21	Check Out Counter	2600	4x4, 8 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	8	312	4	1.25	3,245	Bypass Ballast, Relamp	4' Alledra 18w LED; LLT-X-T8-Y-SW-120-Z-S-N	8	144	4	0.58	1,498	0.67	1,747	$250	0	No New Controls	0	0.0%	0	$0

			EXISTING FIXTURES						PROPOSED FIXTURE RETROFIT						RETROFIT ENERGY SAVINGS			PROPOSED LIGHTING CONTROLS					
Fixture Reference #	Location	Average Burn Hours	Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Work Description	Equipment Description	Lamps per Fixture	Watts per Fixture	Qty of Fixtures	Total kW	Usage kWh/Yr	Energy Savings, kW	Energy Savings, kWh	Energy Savings, $	Control Ref #	Controls Description	Qty of Controls	Hour Reduction %	Energy Savings, kWh	Energy Savings, $
127.21	Lobby/Vestibule	2600	2x2, 2 Lamp, 34w T12 U-Tube, Mag. Ballast, Recessed Mnt., Prismatic Lens	2	72	6	0.43	1,123	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	6	0.19	484	0.25	640	$91	0	No New Controls	0	0.0%	0	$0
93	Men's Restroom	2600	65w R30	1	65	1	0.07	169	Relamp	9w LED R30 - Dimmable	1	9	1	0.01	23	0.06	146	$21	6	Dual Technology Occupancy Sensor - Switch Mnt.	0.5	20.0%	5	$1
127.21	Men's Restroom	2600	2x2, 2 Lamp, 34w T12 U-Tube, Mag. Ballast, Recessed Mnt., Prismatic Lens	2	72	3	0.22	562	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	3	0.09	242	0.12	320	$46	6	Dual Technology Occupancy Sensor - Switch Mnt.	0.5	20.0%	48	$7
93	Women's Restroom	2600	65w R30	1	65	2	0.13	338	Relamp	9w LED R30 - Dimmable	1	9	2	0.02	47	0.11	291	$42	6	Dual Technology Occupancy Sensor - Switch Mnt.	0.5	20.0%	9	$1
127.21	Women's Restroom	2600	2x2, 2 Lamp, 34w T12 U-Tube, Mag. Ballast, Recessed Mnt., Prismatic Lens	2	72	3	0.22	562	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x2 P 32L 31W840 2 0-10 7 G2	1	31	3	0.09	242	0.12	320	$46	6	Dual Technology Occupancy Sensor - Switch Mnt.	0.5	20.0%	48	$7
1003	Main Floor/Shelves	2600	2x2 400w MV Recessed	1	465	4	1.86	4,836	Re-lamp & Bypass ballast	80w LED 360 Degree Lamp;360-HID-RS-80w	1	83	4	0.33	863	1.53	3,973	$568	0	No New Controls	0	0.0%	0	$0
142.21		2600	2x4, 4 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	4	156	46	7.18	18,658	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	46	1.79	4,664	5.38	13,993	$2,001	0	No New Controls	0	0.0%	0	$0
93		2600	65w R30	1	65	14	0.91	2,366	Relamp	9w LED R30 - Dimmable	1	9	14	0.13	328	0.78	2,038	$291	0	No New Controls	0	0.0%	0	$0
1002		2600	100w MV Recessed Down Light	1	120	10	1.20	3,120	Re-lamp & Bypass ballast	18w LED PAR38	2	36	10	0.36	936	0.84	2,184	$312	0	No New Controls	0	0.0%	0	$0
121.31		2600	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	2	78	142	11.08	28,798	Replace Fixture	1x4 Pendant LED 48w	1	48	142	6.82	17,722	4.26	11,076	$1,584	0	No New Controls	0	0.0%	0	$0
142.21	Reading Room	2600	2x4, 4 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	4	156	7	1.09	2,839	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	7	0.27	710	0.82	2,129	$305	5	Dual Technology Occupancy Sensor - Remote Mnt.	1	20.0%	142	$20
92	Reading Room	2600	26w CFL	1	26	7	0.18	473	Relamp	9w LED R30 - Dimmable	1	9	7	0.06	164	0.12	309	$44	0	No New Controls	0	0.0%	0	$0
132.21	Meeting Rooms	2600	2x4, 3 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	3	110	20	2.20	5,720	Retrofit Kit - Remove Lense Bypass Ballast	Phillips LED Evokit 2x4 P 42L 39W840 2 0-10 5 G2	1	39	20	0.78	2,028	1.42	3,692	$528	0	No New Controls	0	0.0%	0	$0
1002	Meeting Rooms	2600	100w MV Recessed Down Light	1	120	6	0.72	1,872	Re-lamp & Bypass ballast	18w LED PAR38	2	36	6	0.22	562	0.50	1,310	$187	0	No New Controls	0	0.0%	0	$0
709	Exterior	4000	175w MH Wallpack	1	210	7	1.47	5,880	Replace Fixture	RAB 42w LED Wallpack	1	39	7	0.27	1,092	1.20	4,788	$685	0	No New Controls	0	0.0%	0	$0
1002	Exterior	4000	100w MV Recessed Down Light	1	120	1	0.12	480	Re-lamp & Bypass ballast	18w LED PAR38	2	36	1	0.04	144	0.08	336	$48	0	No New Controls	0	0.0%	0	$0
612	Exterior	4000	100w A Lamp	1	100	2	0.20	800	Relamp	PHILIPS 120V EnduraLED 12.5W A19 2700K	1	12.5	2	0.03	100	0.18	700	$100	0	No New Controls	0	0.0%	0	$0
700	Exterior	4000	100w HPS Bollard	1	120	3	0.36	1,440	Bypass Ballast, Relamp	25w LED Self Ballasted, Multi-volt; retrofit	1	25	3	0.08	300	0.29	1,140	$163	0	No New Controls	0	0.0%	0	$0
714	Exterior	4000	400w MH Shoebox	1	456	4	1.82	7,296	Replace Fixture	RAB 110w LED Area Light	1	110	4	0.44	1,760	1.38	5,536	$792	0	No New Controls	0	0.0%	0	$0
716	Exterior	4000	150w 360 degree pole mount	1	185	2	0.37	1,480	Replace Lamp, Remove ballast, Install driver	75w LED 360 Lamp and Driver	1	75	2	0.15	600	0.22	880	$126	0	No New Controls	0	0.0%	0	$0
710	Flag Pole	4000	100w HPS Flood	1	120	1	0.12	480	Replace Fixture	RAB 39w LED Flood	1	39	1	0.04	156	0.08	324	$46	0	No New Controls	0	0.0%	0	$0
	TOTAL					**416**	**48**	**129,505**					**407**	**18**	**47,675**	**30**	**81,830**	**$11,702**			**5**	**1**	**597**	**$85**

APPENDIX F

Location Description	Area (Sq FT)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW_{DC}	Total Annual kWh	Total KW_{AC}	Panel Weight (41.9 lbs)	W/SQFT
Library	10100	SHARP ND-240QCJ	548	17.5	9,612	131.52	153,682	106.5	22,961	13.68

= Proposed PV Roof Layout = Proposed PV Parking Canopy Layout

Notes:

1. Estimated kWH based on the National Renewable Energy Laboratory PVWatts Version 1 Calculator Program.

Project Name: **LGEA Solar PV Project - Library**
Location: **Marlboro, NJ**
Description: **Photovoltaic System 100% Financing - 15 year**

Simple Payback Analysis

	Photovoltaic System 100% Financing - 15 year
Total Construction Cost	$644,917
Annual kWh Production	153,682
Annual Energy Cost Reduction	$21,977
Average Annual SREC Revenue	$29,366

Simple Payback: **12.56** Years

Life Cycle Cost Analysis

Analysis Period (years): 15
Discount Rate: 3%
Average Energy Cost ($/kWh) **$0.143**
Financing Rate: 6.00%
Financing %: 100%
Maintenance Escalation Rate: 3.0%
Energy Cost Escalation Rate: 3.0%
Average SREC Value ($/kWh) $0.191

Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Interest Expense	Loan Principal	Net Cash Flow	Cumulative Cash Flow
0	$0	0	0	0	$0	0	0	0	0
1	$0	153,682	$21,977	$0	$38,421	$37,951	$27,355	($4,909)	($4,909)
2	$0	152,914	$22,636	$0	$38,228	$36,264	$29,042	($4,442)	($9,351)
3	$0	152,149	$23,315	$0	$38,037	$34,472	$30,834	($3,954)	($13,305)
4	$0	151,388	$24,014	$0	$37,847	$32,571	$32,735	($3,445)	($16,750)
5	$0	150,631	$24,735	$1,552	$37,658	$30,552	$34,755	($4,465)	($21,215)
6	$0	149,878	$25,477	$1,544	$29,976	$28,408	$36,898	($11,397)	($32,612)
7	$0	149,129	$26,241	$1,536	$29,826	$26,132	$39,174	($10,775)	($43,387)
8	$0	148,383	$27,028	$1,528	$29,677	$23,716	$41,590	($10,129)	($53,517)
9	$0	147,641	$27,839	$1,521	$29,528	$21,151	$44,155	($9,459)	($62,976)
10	$0	146,903	$28,674	$1,513	$22,035	$18,427	$46,879	($16,109)	($79,086)
11	$0	146,169	$29,535	$1,506	$21,925	$15,536	$49,770	($15,352)	($94,437)
12	$0	145,438	$30,421	$1,498	$21,816	$12,466	$52,840	($14,568)	($109,005)
13	$0	144,710	$31,333	$1,491	$21,707	$9,207	$56,099	($13,757)	($122,762)
14	$0	143,987	$32,273	$1,483	$14,399	$5,747	$59,559	($20,117)	($142,879)
15	$0	143,267	$33,241	$1,476	$14,327	$2,074	$63,232	($19,214)	($162,093)
	Totals:	2,226,269	$408,740	$16,646	$425,406	$334,675	$644,917	($162,093)	($968,285)

Net Present Value (NPV) **($114,352)**