ENERGY AUDIT – FINAL REPORT

LAWRENCE TOWNSHIP
SLACKWOOD FIRE COMPANY

21 SLACK AVENUE
LAWRENCE TOWNSHIP, NJ 08648
ATTN: MR. TREY KEYMOORE

CEG PROPOSAL NO. 9C08127

CONCORD ENGINEERING GROUP

520 SOUTH BURNT MILL ROAD
VOORHEES, NJ 08043
TELEPHONE: (856) 427-0200
FACSIMILE: (856) 427-6529
WWW.CEG-INC.NET

CONTACT: RAYMOND JOHNSON
Cell: (609) 760-4057
rjohnson@ceg-inc.net

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REPORT DISCLAIMER

I. EXECUTIVE SUMMARY

This report presents the findings of an energy audit conducted for:

Lawrence Township
Slackwood Fire Company
21 Slack Road
Lawrenceville, NJ 08648

Municipal Contact Person: Trey Keymoore
Facility Contact Person: Joseph Sliwinski

This audit was performed in connection with the New Jersey Clean Energy Local Government Energy Audit Program. These energy audits are conducted to promote the office of Clean Energy's mission, which is to use innovation and technology to solve energy and environmental problems in a way that improves the State's economy. This can be achieved through the wiser and more efficient use of energy.

The annual energy costs at this facility are as follows:

Electricity	$ 12,990
Natural Gas	$ 4,065
Total	$ 17,055

The potential annual energy cost savings are shown below in Table 1. Be aware that the measures are not additive because of the interrelation of several of the measures. The cost of each measure for this level of auditing is ± 20% until detailed engineering, specifications, and hard proposals are obtained.

Table 1
Energy Conservation Measures (ECM's)

ECM NO.	DESCRIPTION	COST	ANNUAL SAVINGS	SIMPLE PAYBACK (YEARS)
1	Lighting Upgrade	$1,463	$644	2.3
2	Lighting Controls	$825	$373	2.2
3	Boiler Retrofit – Dual Fuel Burner	$8,250	$665	12.4
4	Air Conditioning Upgrade – Split System Units	$11,770	$276	42.6
5	Programmable Thermostats	$360	$244	1.47

The estimated demand and energy savings are shown below in Table 2. The information in this table corresponds to the ECM's in Table 1.

Table 2
Estimated Energy Savings

ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECT DEMAND (KW)	ELECT CONSUMPTION (KWH)	NAT GAS (THERMS)
1	Lighting Upgrade	1.9	3,954	-
2	Lighting Controls	-	2,290	-
3	Boiler Retrofit – Dual Fuel Burner	-	-	160
4	Air Conditioning Upgrade – Split System Units	-	1,092	-
5	Programmable Thermostats	-	0	163

Concord Engineering Group (CEG) strongly recommends the implementation of all ECM's that provide a calculated simple payback at or under seven (7) years. The potential energy and cost savings from these ECM's are too great to pass upon. The following Energy Conservation Measures are recommended for the Slackwood Fire Company:

- **ECM #1:** Lighting Upgrade
- **ECM #2:** Lighting Controls
- **ECM #5:** Programmable Thermostats

II. INTRODUCTION

This comprehensive energy audit covers the 14,881 square foot Fire Company that includes administrative offices, fire hall, restrooms and engine bays.

The first task was to collect and review one year worth of utility energy data for electricity and natural gas. This information was used to analyze operational characteristics, calculate energy benchmarks for comparison to industry averages, estimate savings potential, and establish a baseline to monitor the effectiveness of implemented measures. A computer spreadsheet was used to enter, sum, and calculate benchmarks and to graph utility information (see Appendix A).

The Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year ($BTU/ft^2/yr$) and can be used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting annual consumption of all fuels to BTU's then dividing by the area (gross square footage) of the building. EUI is a good indicator of the relative potential for energy savings. A comparatively low EUI indicates less potential for large energy savings. The gross square footage of the building was provided by the township, in the absence of blueprints.

A building profile was created that included age, occupancy, description, and existing conditions of Architectural and Mechanical Systems. The profile noted the major energy consuming equipment or systems and components that are inherently inefficient. Also, by reviewing the mechanical and electrical drawings and equipment schedules, questions regarding the lighting systems/controls, HVAC zone controls, or setback operations were noted.

The site visit was spent inspecting the actual systems and answering specific questions from the preliminary review. The building manager provided occupancy schedules, O & M practices, the building energy management program, and other information that has an impact on energy consumption.

The post-site work included evaluation of the information gathered during the site visit, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on mechanical, lighting and building envelope improvements.

III. METHOD OF ANALYSIS

The first step in the energy analysis is the site survey. The auditor walks the entire site to inventory the building envelope (roof, windows, etc.), the heating, ventilation, and air conditioning equipment (HVAC), the lighting equipment, other facility-specific equipment, and to gain an understanding of how each facility is used.

The collected data is then processed using engineering calculations, Microsoft Excel spread sheets and Trane Trace 700™ building simulation software that calculate the anticipated energy usage. The actual energy usage is entered directly from the utility bills. The anticipated energy usage is compared to the actual usage. If necessary, corrections are made to the site-collected data until the anticipated energy usage matches the actual usage. This process develops an end-use baseline for all of the fuels used at the facility. This baseline is used to calculate the energy savings for the measures that are recommended in this report.

The savings in this report are not duplicative. The savings for each recommendation may actually be higher if the individual recommendations were installed instead of the entire project. For example, the lighting module calculates the change in wattage and multiplies it by the <u>new</u> operating hours <u>instead of the existing</u> operating hours (if there was a change in the hours at all). The lighting controls module calculates the change in hours and multiplies it by the <u>new</u> system wattage <u>instead of the existing</u> wattage. Therefore, if you chose to install the recommended lighting system but not the lighting controls, the savings achieved with the new lighting system would actually be higher because there would have been no reduction in the hours of use.

The same principal follows for heating, cooling, and temperature recommendations – even with fuel switching. If there are recommendations to change the temperature settings to reduce fuel use, then the savings for the heating/cooling equipment recommendations are reduced, as well. Thermal recommendations (insulation, windows, etc.) are evaluated by taking the difference in the thermal load due to reduced heat transfer. Again, the "thermal load" is the thermal load <u>after</u> the other recommendations have been accounted for.

Lastly, installation costs, refer to Appendix B, are then applied to each recommendation and simple paybacks are calculated. Costs are derived from Means Cost Data, other industry publications, and local contractors and suppliers. The NJ SmartStart Building® program incentives (refer to Appendix C) are calculated for the appropriate ECM's and subtracted from the installed cost prior to calculation of the simple payback. In addition, where applicable, maintenance cost savings are estimated and applied to the net savings.

IV. HISTORIC ENERGY CONSUMPTION/COST

A. Energy Usage / Tariffs

Electric

Table 3 and Figure 1 represent the electrical usage for the surveyed facility from January-08 to December-08. Public Service Electric and Gas Company (PSE&G) provides electricity to the facility under the MD rate. This electric rate has a component for consumption that is measured in kilowatt-hours (kWh). It is calculated by multiplying the wattage of the equipment times the hours that it operates. For example, a 1,000 Watt lamp operating for 5 hours would measure 5,000 Watt-hours. Since one kilowatt is equal to 1,000 Watts, the measured consumption would be 5 kWh. 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 most current rate structure available.

Natural Gas

Table 4 and Figure 2 show the natural gas energy usage for the surveyed fire house from January-08 to December-08. PSE&G supplies the natural gas to the facility under the GSGH Multi Family rate. Below is the average unit cost for the utilities at this facility.

Heating Oil

In addition to electricity and natural gas, heating oil is utilized in the heating hot water boiler. #2 heating oil is purchased from the PETRO Heating and Air Conditioning Services Company. At the beginning of the heating season each year the oil tank is topped off to supply heat for the season. On November 19, 2008 1,154.2 gallons of heating oil was delivered at a cost of $2,812.21.

Description	Average
Electricity	16.3¢/kWh
Natural Gas	$1.49/Therm
#2 Fuel Oil	$2.44/Gallon

Table 3
Electricity Billing Data

MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
1/08	7,680	18	$962
2/08	6,600	20	$870
3/08	7,480	44	$1,051
4/08	5,480	20	$724
5/08	5,360	18	$711
6/08	7,160	25	$1,341
7/08	8,080	26	$1,600
8/08	7,000	32	$1,549
9/08	6,920	24	$1,432
10/08	5,480	21	$913
11/08	6,080	16	$910
12/08	6,360	16	$928
Totals	**79,680**	**44 Max**	**$12,990**

Figure 1
Electricity Usage Profile

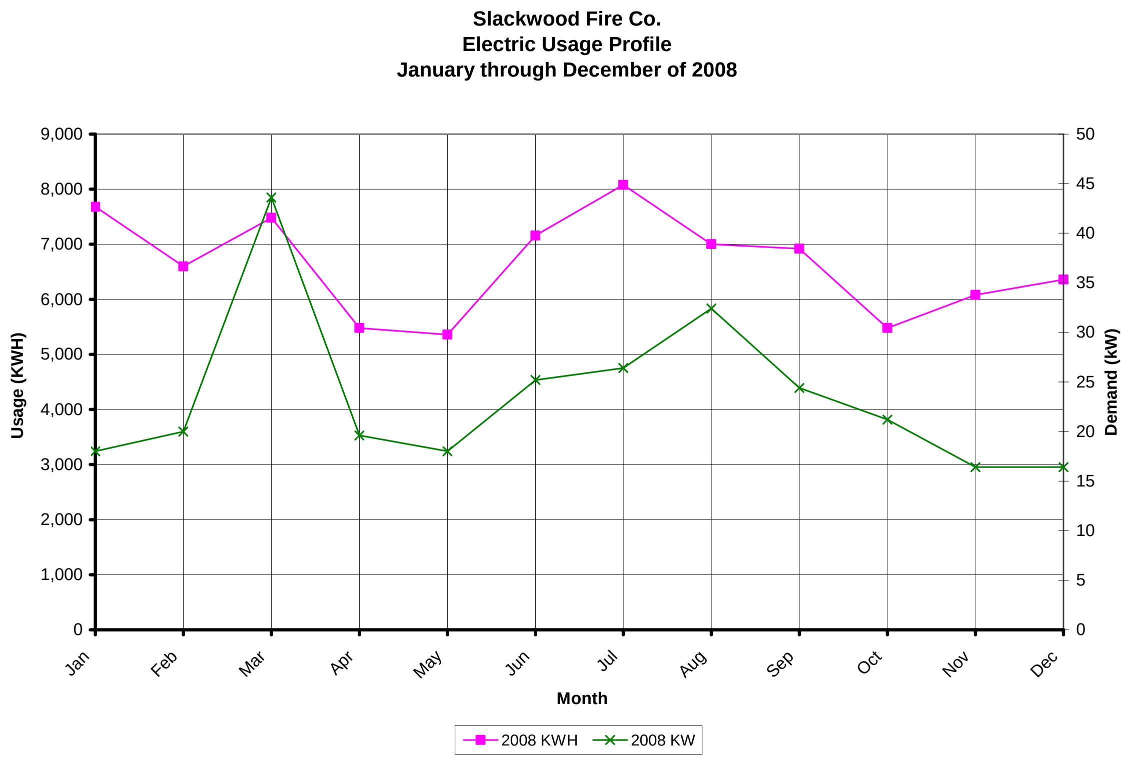
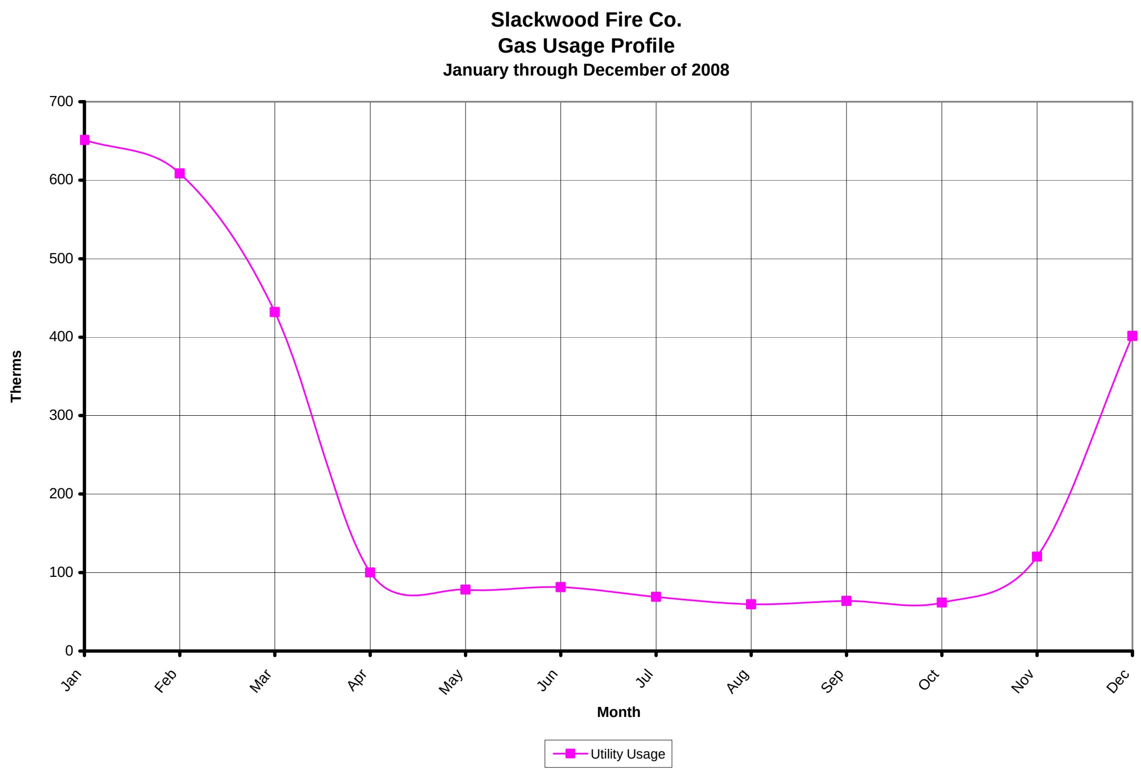


Table 4
Natural Gas Billing Data

MONTH OF USE	CONSUMPTION (THERMS)	TOTAL BILL
1/08	651.1	$901
2/08	608.7	$881
3/08	432	$666
4/08	100.2	$164
5/08	78.2	$141
6/08	81.3	$155
7/08	68.9	$141
8/08	59.7	$108
9/08	63.9	$103
10/08	61.7	$94
11/08	120.3	$167
12/08	401.4	$545
Totals	**2727.4**	**$4,065**

Figure 2
Natural Gas Usage Profile



B. Energy Use Index (EUI)

The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. Their website allows the user to determine how well the client's building energy use intensity (EUI) compares with similar facilities throughout the U.S. and in your specific region or state.

$$Building\ EUI = \frac{(Electric\ Usage\ in\ kBtu/h + Gas\ Usage\ in\ kBtu/h + Heating\ Oil\ kBtu/h)}{Building\ Square\ Footage}$$

Electric = ((79,680 kWh) * (1000 W/kW) * (3.414 Btu/h / 1 W))/ (1000 Btu/h / 1 kBtu/h)
= 272,027 kBtu/h

Gas = ((2727.4 therms) * (100,000 Btu/h / 1 Therm)) / (1000 Btu/h / 1 kBtu/h) = 272,740 kBtu/h

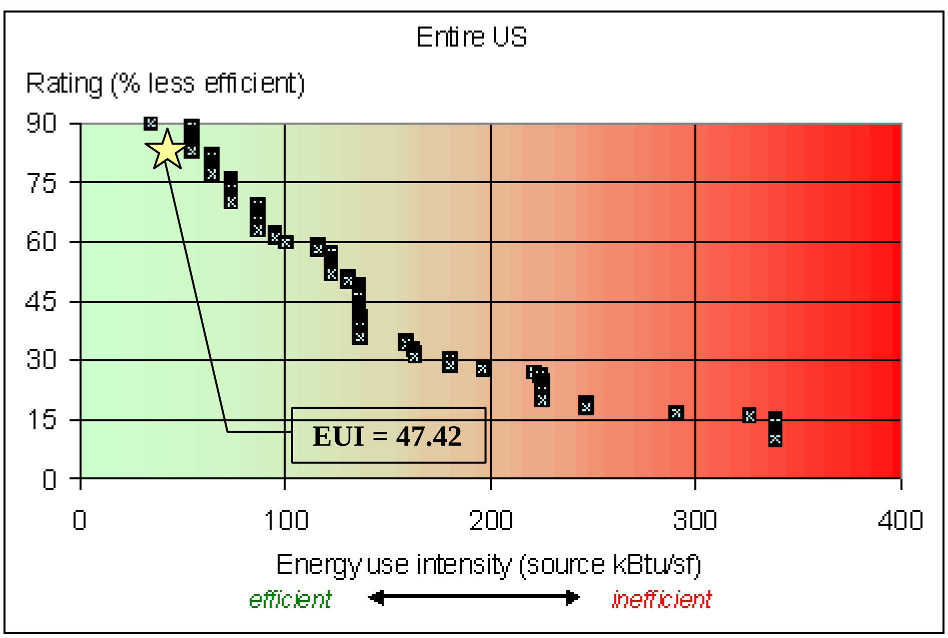
Heating Oil = ((1154.2 gallons) * (139,400 Btu/h / 1 Gallon)) / (1000 Btu/h / 1 kBtu/h)

Heating Oil = 160,895 kBtu/h

$$Building\ EUI = \frac{(272{,}027\ kBtu/h + 272{,}740\ kBtu/h + 160{,}895\ kBtu/h)}{14{,}881\ SF} = \frac{705{,}662\ kBtu/h}{14{,}881\ SF}$$

Slackwood Fire Company EUI = 47.42 kBtu/SF

Figure 3
Energy Use Intensity Distributions:



C. EPA Energy Benchmarking System

The United States Environmental Protection Agency (EPA) in an effort to promote energy management has created a system for benchmarking energy use amongst various end users. The benchmarking tool utilized for this analysis is entitled Portfolio Manager. The Portfolio Manager tool allows you to track and assess energy consumption via the template forms located on the ENERGY STAR website (www.energystar.gov). The importance of benchmarking for local government municipalities is becoming more important as utility costs continue to increase and more emphasis is being placed throughout multiple arenas on carbon reduction, greenhouse gas emissions and other environmental impacts.

In accordance with the Local Government Energy Audit Program, CEG has created an Energy Start account for the municipal in order to allow the municipal access to monitoring their yearly energy usage as it compares to facilities of similar type. The account can be accessed at the following address, the username and password are also listed below:

https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=login.login

Username: Lawrencetwp
Password: lgeaceg2009

Specific building types are detailed on the ENERGY STAR website. Non-typical buildings are covered by an “Other” category. The Lawrence Township Fire Houses fall under this “Other” category. The “Other” category is used if your building type or a section of the building is not represented by one of the specific categories. An Energy Performance Rating cannot be calculated if more than 10% of a building is classified as “Other.” The majority of the Public Works Garage would be classified as “Other” and therefore cannot be given an Energy Performance Rating.

The EUI calculated in the previous section is a good indicator of the energy performance of the Slackwood Fire Company in the absence of the Energy Star Portfolio Manager Program. The EUI distribution, figure 3, is specific for fire houses and police stations. The fire company has an EUI of 47.42 which is off the typical curve for this type of facility. The facility runs very efficiently for its size do to the low permanent staff size stationed at the facility on a day to day basis. That aside there is still room for improvement making the facility more energy efficient and saving more on the utility costs.

V. FACILITY DESCRIPTION

Lawrence Township's Slackwood Fire Company consists of offices, engine bays, a hall and members lounge and meeting area; totaling approximately 14,881 SF. The Slackwood Fire House is a one story structure of steel, brick, and block construction except the front office section which is two-story. The first section of the facility was built in 1907 with additions in the 1950's and 1960's. Typically, the Fire house will be occupied by one or two people for 8 hours a day during the week, only the radio room is occupied during this time period. Slackwood is a volunteer fire company that only fully operates when an emergency occurs in there response area. Additionally, there is a fire hall that is rented out on Sunday twice during the month.

<u>Heating System</u>

The two story office and lounge area is heated by a Singer air handling unit equipped with a hot water coil. Hot water is provided by an oil fired Burnham boiler located in the mechanical space off the engine bay.

The oldest section of the engine bay adjacent to the office area is heated by hot water fan coil units mounted on the ceiling of the garage. These units are supplied with hot water via the Burnham boiler mentioned above. The balance of the engine room is heated by REZNOR gas fired furnaces suspended from the roof structure.

The hall of the fire house is heated by three (3) Trane gas fired air handling units. The units are mounted on the roof of the hall and ducted into the space. The Hall was colder than the rest of the fire house and is typically only heated when the hall is occupied, which is on a bi-monthly basis.

<u>Domestic Hot Water</u>

Domestic hot water for the restrooms is provided by a Bradford White gas fired hot water heater, with a 100 gallon capacity and an input of 88 MBh.

<u>Cooling System</u>

The first floor of the office area is cooled by one Coleman window unit. The upstairs lounge and meeting room are cooled by two (2) Emerson window units that have been mounted in the sidewall of the room.

The engine room is not air conditioned.

The hall is air conditioned by the three (3) Trane air handling units mounted on the roof. The capacity of these units is unknown do to missing nameplate information.

Controls System

There are local thermostats located throughout the facility that control the various heating and air conditioning systems. The heating set point was set at 60ºF to maintain a reasonable working temperature throughout the facility. Cooling set points were not observed at the time of the survey. The use of programmable thermostats was absent from the fire house. The heating and air conditioning set points change based upon the occupancy of the building.

Lighting

The office areas, lounge and meeting room are lit via 2-foot by 2-foot lay-in fixtures containing T8 U-tube lamps and electronic ballasts. Standard switching is utilized and there are no other types of lighting controls present.

The engine bays are lit with 8’ 2-lamp T8 fixtures with electronic ballasts. There are also 4’ 2-lamp T8 fixtures mounted on a few of the side walls throughout the engine area. The lights are switched via standard wall switching.

There are also many incandescent high-hat fixtures throughout the facility. This type of fixture uses a 60W incandescent flood bulb. Switching is done with a standard wall switch.

VI. MAJOR EQUIPMENT LIST

Following the completion of the field survey a detailed equipment list was created. The equipment within this list is considered major energy consuming equipment whose replacement could yield substantial energy savings. In addition, 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 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 Appendix D for the Major Equipment List for this facility.

VII. ENERGY CONSERVATION MEASURES

ECM #1: Lighting Upgrade

Description:

New fluorescent lamps and ballasts are available as direct replacements for the existing lamps and ballasts. A simple change from the old to the new can provide substantial savings. A typical drop-ceiling lay in fixture with four, 4-foot lamps (34 Watt lamps) has a total wattage of about 154 Watts. By retrofitting with new lamps, reflector and electronic ballasts the total wattage would be reduced to about 91 Watts per fixture and the space light levels and light quality would increase by about 15% and 35%, respectively.

CEG recommends a replacement of the existing fixtures containing T12 lamps and magnetic ballasts with fixtures containing T8 lamps and electronic ballasts. The new energy efficient, T8 fixtures will provide adequate lighting and will save the Owner on electrical costs due to the better performance of the electronic ballasts. In addition to functional cost savings, the fixture replacement will also provide operational cost savings. The operational cost savings will be realized through the lesser number of lamps that will be required to be replaced per year. The expected lamp life of a T8 lamp, approximately 30,000 burn-hours, in comparison to the existing T12 lamps, approximately 20,000 burn-hours, will provide the Owner with fewer lamps to replace per year. Based on the operating hours of this portion of the facility, approximately 2080 hours per year, the Owner will be changing approximately 33% less lamps per year.

Energy Savings Calculations:

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

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, the replacement of a T-12 fixture to a T-5 or T-8 fixture warrants the following incentive: T-5 or T-8 (1-2 lamp) = $25 per fixture; T-5 or T-8 (3-4 lamp) = $30 per fixture.

$$\text{Smart Start® } Incentive = (\#\ of\ 1-2\ lamp\ fixtures \times \$\,25) + (\#\ of\ 3-4\ lamp\ fixtures \times \$\,30)$$

$$\text{Smart Start® } Incentive = (16 \times \$\,30) = \$480$$

Maintenance Savings are calculated as follows:

$$Maintenance\ Savings = (\#\ of\ lamps \times \%\ reduction \times \$\ per\ lamp) + Installation\ Labor$$

$$Maintenance\ Savings = (48 \times 33\%\ reduction \times \$\,2.00) + (\$20 \times 16) = \underline{\$352}$$

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$2,295
NJ Smart Start Equipment Incentive ($):	($480)
Maintenance Savings ($):	($352)
Net Installation Cost ($):	*$1,463*
Total Energy Savings ($ / yr):	*$644*
Simple Payback (yrs):	*2.3*

ECM #2: Lighting Controls

Description:

In some areas the lighting is left on unnecessarily. Many times this is due to the idea that it is better to keep the lights on rather than to continuously switch them on and off. The on/off dilemma was studied and it was found that the best option is to turn the lights off whenever possible. Although this does reduce the lamp life, the energy savings far outweigh the lamp replacement costs. The cutoff for when to turn the lights off is around two minutes. If the lights can be off for only a two minute interval, then it pays to shut them off.

Lighting controls come in many forms. Sometimes an additional switch is all it would take. Occupancy sensors detect motion and will switch the lights on when the room is occupied. They can either be mounted in place of the current wall switch, or they can be mounted on the ceiling to cover large areas. Lastly, photocells are a lighting control that sense light levels and will turn the lights off when there is adequate daylight. These are mostly used outside, but they are becoming much more popular in energy-efficient office designs as well.

To determine an estimated savings for lighting controls, we used ASHRAE 90.1-2004 (NJ Energy Code). Appendix G of the referenced standard, states that occupancy sensors have a 10% power adjustment factor for daytime occupancies for buildings over 5,000 SF. CEG recommends the installation of dual technology occupancy sensors in all areas of the facility. (14,881 SF).

Energy Savings Calculations:

From Appendix E of this report, we calculated the lighting power density (Watts/ft^2) of the existing offices, locker rooms, storage rooms, small shops, etc. to be 0.74 Watts/SF. Ten percent of this value is the resultant energy savings due to installation of occupancy sensors:

Savings = 10% x 0.74 Watts/SF x 14,881 SF x 2,080 hrs/yr. = 2,290 kWh x $0.163/kWh

Savings = $373 / yr

Installation cost per dual-technology sensor (Basis: Sensorswitch or equivalent) is $75/unit including material and labor. The SmartStart Buildings® incentive is $20 per control which equates to an installed cost of $55/unit. Total number of rooms to be retrofitted is 15. Total cost to install sensors is $55/unit x 15 units = $825.

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$1,125
NJ Smart Start Equipment Incentive ($):	$300
Maintenance Savings ($):	$0
Net Installation Cost ($):	*$825*
Total Energy Savings ($ / yr):	*$373*
Simple Payback (yrs):	*2.2*

ECM #3: Boiler Retrofit – Dual Fuel Burner

Description:

Substantial savings can be gained through the use of a dual fuel burner. A dual fuel burner allows the building owner the opportunity to choose between using fuel oil or natural gas depending upon the current market price. For example, if fuel oil is cheaper to burn than natural gas then the owner can utilize fuel oil; vice versa. Natural gas systems typically operate 10% more efficiently then there fuel oil counterparts. This efficiency is greatly in part due to inefficiencies within the oil-fired equipment and their accessories. Industry practice for new heating systems design is to utilize natural gas as the heating fuel source unless it is not readily available. Based on our sire survey, natural gas is available and will not require major modifications to incorporate the new dual fuel burner.

This ECM would replace the existing oil-fired burner with a dual-fuel burner of the same capacity. CEG reviewed the possibility of replacing the oil-fired burner with a natural gas burner only; however, keeping the existing oil fired capability of the boiler ensures that heating is always available to the facility in the event of a natural gas outage in the area. Furthermore, replacement of the boiler was reviewed but due to the current age (only 10 years) CEG does not see it fit to demolish the boiler and replace with a new.

Energy Savings Calculations:

A detailed energy savings calculation can be found in Appendix F that outlines the savings from converting the 1,154 gallons of #2 fuel oil to its equivalent amount of natural gas.

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$8,250
NJ Smart Start Equipment Incentive ($):	$0
Maintenance Savings ($):	$0
Net Installation Cost ($):	*$8,250*
Total Energy Savings ($ / yr):	*$665*
Simple Payback (yrs):	*12.4*

* Possible maintenance savings may occur from conversion of oil fired burner to dual fuel fired burner if owner decides to eventually abandon the use of fuel oil in the boiler.

ECM #4: Air Conditioning Upgrade – Split System Units

Description:

Air-conditioning is provided within certain areas of the building via residential-style window air-conditioning units. The existing window air-conditioning units are inefficient with an estimated seasonal energy efficiency ratio (SEER) of 9.0. The NJ State Energy Code (ASHRAE 90.1-2004) mandates a minimum energy efficiency of 10.6 SEER for units of this type. The existing window air-conditioning units are aged and are past their service life as outlined in Chapter 36 of the 2007 ASHRAE Applications Handbook. The estimated service life for a window air-conditioning unit is 10 years.

This energy conservation measure would replace the window-air conditioning units serving the first floor office area and the second floor lounge and meeting room; total three (3) window air-conditioning units. The existing units will be replaced with high energy efficient, ductless split system air-conditioning units with cooling capacities typical of the existing units. The average SEER of the new equipment will be upwards of 18 SEER.

Energy Savings Calculations:

$$EnergySavings = \frac{[CoolingTons \times 12{,}000\,Btu/ton \div 1000W/kW]}{[(EER_{NEW} - EER_{OLD})]} \times Avg.\ Load\ Factor \times Hrs.\ of\ Cooling \times \#\ of\ Units$$

<u>Existing Air Conditioning Units</u>

Rated Capacity = 1.5 Tons (x2 Units), 2 Tons (x1 Unit)
Condenser Unit Efficiency = 9.0 EER
Cooling Season Hrs. of Operation = 1,800 hrs/yr.

Average Cost of Electricity - $0.163/kWh

<u>Proposed High-Efficiency Air Conditioning Unit</u>

Rated Capacity = 1.5 Tons (x2 Units), 2 Tons (x1 Unit)
New Condenser Unit Efficiency = 19 EER (1.5 Ton Units), 18 EER (2 Ton Unit)

$$EnergySavings = \frac{[CoolingTons \times 12{,}000\,Btu/ton \div 1000W/kW]}{[(EER_{NEW} - EER_{OLD})]} \times Avg.LoadFactor \times Hrs.ofCooling$$

$$EnergySavings\ (\text{x2 (1.5) Ton Units}) = \frac{[1.5\,CoolingTons \times 12{,}000\,Btu/ton \div 1000W/kW]}{[(19\,EER_{NEW} - 9\,EER_{OLD})]} \times 0.15 \times 1800 \times 2\ units$$
$$= 972 kWh/yr.$$

$$EnergySavings\ (\text{2 Ton Units}) = \frac{[2\,CoolingTons \times 12{,}000\,Btu/ton \div 1000W/kW]}{[(18\,EER_{NEW} - 9\,EER_{OLD})]} \times 0.15 \times 1800$$
$$= 720 kWh/yr.$$

Total Cost Savings = (972 kWh + 720 kWh) * $0.163/kWh = $276 / Yr.

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$12,135
NJ Smart Start Equipment Incentive ($):	($365)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$11,770*
Total Energy Savings ($ / yr):	*$ 276*
Simple Payback (yrs):	*42.6*

ECM #5: Programmable Thermostats

Description:

Throughout the building there are standard, manual wall thermostats for various HVAC units that provide local control with adjustable settings for the conditioning equipment. These aged, indoor temperature controls are inaccurate due to temperature drift, age, and not having been re-calibrated. These units also do not have unoccupied setback features.

New programmable thermostats are available that utilize programming schedules for occupied and unoccupied times and can be set to vary space temperature at these respective times. In addition, the programmable thermostats can be used in conjunction with a motion sensor. When the space is not occupied the equipment can operate at the unoccupied setpoint. Once the space becomes occupied the motion sensor sends a signal to the thermostat to raise the temperature of the space to the occupied setpoint. This control system approach is ideal for facilities with low occupancy levels such as a volunteer fire house.

This energy conservation measure would replace the various HVAC unit thermostats with programmable 7-day thermostats with night time setback control. The recommended thermostat setpoints for heating are as follows:

Occupied Heating =	60° F
Unoccupied Heating =	55° F

CEG recommends replacement of the existing remote thermostats with Honeywell RTH7500D 7-day programmable thermostat or equivalent.

Energy Savings Calculations:

The energy savings of a 7-day programmable thermostat was calculated by using Energy Star Life Cycle Cost Estimate software for qualified programmable thermostats. The referenced calculator can be found at www.energystar.gov. Refer to Appendix G for the detailed calculation.

Calculated energy savings for heating only = $122/Unit

Cost of a 7-day programmable thermostat (installed) = $180/unit

Simple Payback = 1.47 Years

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$360
NJ Smart Start Equipment Incentive ($):	($0)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$360*
Total Energy Savings ($ / yr):	*$244*
Simple Payback (yrs):	*1.47*

VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policy. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable technologies. A renewable energy source can greatly reduce a building's operating expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy technologies for Lawrence Township, and concluded that there is potential for solar and wind energy generation.

Solar energy produces clean energy and reduces a building's carbon footprint. This is accomplished via photovoltaic panels which will be mounted on all south and southwestern facades of the building. Flat roof, as well as sloped areas can be utilized; flat areas will have the panels turned to an optimum solar absorbing angle. (A structural survey of the roof would be necessary before the installation of PV panels is considered). The state of NJ has instituted a program in which one Solar Renewable Energy Certificate (SREC) is given to the Owner for every 1000 kWh of generation. SREC's can be sold anytime on the market at their current market value. The value of the credit varies upon the current need of the power companies. The average value per credit is around $350, this value was used in our financial calculations. This equates to $0.35 per kWh generated.

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. A roof area of 1,620 S.F. can be utilized for a PV system on the Fire House. A depiction of the area utilized is shown in Appendix H. Using this square footage it was determined that a system size of 25.34 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 43,285 KWh annually, reducing the overall utility bill by 54% percent. A detailed financial analysis can be found in Appendix H. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC's are factored into the payback.

Wind energy production is another option available through the Renewable Energy Incentive Program. Small wind turbines can be utilized to produce clean energy on a per building basis. Cash incentives are available per kWh of electric usage. CEG has reviewed the applicability of wind energy for Lawrence Township and has determined it is not a viable option. Low average wind speeds for the area are not adequate for wind turbine generation. Typical wind turbines start producing energy at 8 mph wind speeds. Lawrence Township averages 4 mph wind speeds making this application impractical.

IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY

Load Profile:

Load Profile analysis was performed to determine the seasonal energy usage of the facility. Irregularities in the load profile will indicate potential problems within the facility. Consequently based on the profile a recommendation will be made to remedy the irregularity in energy usage. For this report, the facility's energy consumption data was gathered in table format and plotted in graph form to create the load profile. Refer to Section IV, Figures 1 and 2 included within this report to reference the respective electricity and natural gas usage load profile for January 2008 through December 2008.

Electricity:

Section III, Figure 1 demonstrates a consistent base-load for the facility. The electric demand peaks in March of 2008 (44 kW) which is not standard for buildings of this type. This peak could be to excess use of all of the equipment within the facility because of large gatherings or similar events; possibly even equipment testing within the facility. In regards to the profile of the electric use, the base-load shaping is important because a flat consumption profiles will yield more competitive pricing when trying to procure third party supply.

Natural Gas:

Section IV, Figure 2 demonstrates a typical heating season (November –March), and complimentary cooling season (April –October). Consequently there is a clear separation between summer and winter loads consistent with Wholesale Energy Pricing. Heating loads carry a much higher average cost because of the higher demand for natural gas during the winter.

Tariff Analysis:

Electricity:

Lawrence Township (LT) receives electrical service through Public Service Electric and Gas Company (PSE&G) on a GLP or MD (General Lighting and Power) rate. This utility tariff is for delivery service for general purposes at secondary distribution voltages. The rate schedule has a Delivery Charge, Societal Benefits Charge, Non-utility Generation Charge, Securitization Charge, System Control Charge, Customer Account Services Charge, Standby Fee, Base Rate Distribution Adjustment Charge, Solar Pilot Recovery Charge and RGGI Charge. The customer can elect to have the Commodity Charge serviced through the utility or by a Third Party Supplier (TPS).

Natural Gas:

LT receives natural gas service through Public Service Electric and Gas Company (PSE&G) on a GSGH utility rate class, when not receiving commodity by a Third Party Supplier. This utility tariff is for firm delivery service for general purposes. This rate schedule has a Delivery Charge, Balancing Charge, Societal Benefits Charge, Realignment Adjustment Charge, Margin Adjustment Charge, RGGI Charge and Customer Account Service Charge. The customer can elect to have the Commodity Charge serviced through the utility or by a Third Party Supplier (TPS). It is pertinent to note, should the TPS not deliver, the customer may receive service from

PSE&G under Emergency Sales Service. Emergency Sales Service carries an extremely high penalty cost of service.

Imbalances occur when Third Party Suppliers are used to supply natural gas, full-delivery is not made, and when a new supplier is contracted or the customer returns to the utility. It is important when utilizing a Third Party Supplier, that an experienced regional supplier is used. Otherwise, imbalances can occur, jeopardizing economics and scheduling.

Recommendations:

CEG recommends a global approach that will be consistent with all facilities within Lawrence Township. CEG's primary observation is seen in Natural Gas. The average price of commodity per dth (dekatherm) for all buildings is $.103. Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. Lawrence could see significant savings if it were to take advantage of these current market prices quickly, before energy increases. Based on last year's historical consumption January – December 2008, and current natural gas rates, estimated savings of over $14,000 per year are seen. (Note: Savings were calculated using Lawrence Township Average Annual Consumption and a variance of $.038 / therm utilizing a fixed one-year commodity contract). CEG recommends aggregating the entire natural gas load to gain the most optimal energy costs. CEG recommends advisement for alternative sourcing and supply of energy on a "managed approach".

CEG's secondary recommendation coincides with Lawrence Township's electric costs. CEG recognized the electric cost is not competitive with current market prices. Based on the current market, Lawrence Township is paying approximately $.0344 per unit above market in the PSE&G territory, and CEG recommends further advisement on these prices. Lawrence Township should also consider procuring energy on its own. CEG recommends alternative sourcing strategies.

CEG recommends that Lawrence Township schedule a meeting with their current utility providers to review their utility charges and current tariff structures for electricity and natural gas. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), Lawrence Township will learn more about the competitive supply process. Lawrence Township can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at www.nj.gov/bpu, and should also consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the data to manage ongoing demand-side management projects. Furthermore, CEG recommends special attention to credit mechanisms, imbalances, balancing charges and commodity charges when meeting with their utility representative. In addition, Lawrence Township should also ask the utility representative about alternative billing options. Some utilities allow for consolidated billing options when utilizing the service of a Third Party Supplier.

X. INSTALLATION FUNDING OPTIONS

CEG has reviewed various funding options for the Owner to utilize in subsidizing the costs for installing the energy conservation measures noted within this report. Below are a few alternative funding methods:

A. *Performance Contracting* – Performance Contracting is an agreement between a local government and a private energy services company (ESCO) that uses future energy savings to pay for the entire cost of a building's energy efficiency retrofits/upgrades. A local government contracts with an ESCO, then the ESCO purchases, installs and maintains energy-saving equipment. According to State Assembly Bill # 1185, a local government may enter into guaranteed energy savings contracts within a 15-year period. An independent energy auditor must prepare the investment grade audit and perform the measurement/verification of the savings.

B. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.

C. *County Improvement Authority* – Several local governments in New Jersey have received funding for energy projects through their County Improvement Authority.

CEG recommends the Owner review the use of the above-listed funding options in addition to utilizing their standard method of financing for facilities upgrades in order to fund the proposed energy conservation measures.

XI. 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. Use cog-belts instead of v-belts on all belt-driven fans, etc. These can reduce electrical consumption of the motor by 2-5%.

D. Reduce lighting in specified areas where the foot candle levels are above 70 in private offices and above 30 in corridor, lobbies, etc.

E. Provide more frequent air filter changes to decrease overall fan horsepower requirements and maintain better IAQ.

F. Recalibrate existing sensors serving the office spaces

G. Install a Vending Miser system to turn off the vending machines in the lunch room when not in use.

H. Clean all light fixtures to maximize light output.

I. Confirm that outside air economizers on the rooftop units that serve the Office Areas are functioning properly to take advantage of free cooling.

Electric Cost Summary
PSE&G - svc MD

Slackwood Fire Co.

2008

Account # 62 849 382 6 8

Meter # 728000287

Month	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	**Total**	
Billing Days	31	28	31	30	31	30	31	31	30	31	30	31	0	
KWH	7,680	6,600	7,480	5,480	5,360	7,160	8,080	7,000	6,920	5,480	6,080	6,360	79,680	
KW	18	20	44	20	18	25	26	32	24	21	16	16	44	Max
Monthly Load Factor	57%	49%	23%	39%	40%	39%	41%	29%	39%	35%	51%	52%	41%	
Electric Delivery, $													$0	
Delivery $/kwh	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	
Electric Supply, $													$0	
Supply $/kwh	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	
Total Cost, $	$962	$870	$1,051	$724	$711	$1,341	$1,600	$1,549	$1,432	$913	$910	$928	$12,990	
$/KWH	$0.125	$0.132	$0.141	$0.132	$0.133	$0.187	$0.198	$0.221	$0.207	$0.167	$0.150	$0.146	**$0.163**	

Summary of Natural Gas Cost

PSE&G - GSG Multi Family

Slackwood Fire Co.

2008

Account # 62 544 028 5 8

Meter # 2875176 & 2859261

Month	Jan-08	Feb-08	Mar-08	Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	**Total**
Billing Days	31	28	31	30	31	30	31	31	30	31	30	31	
Total MCF	631	591	419	97	76	79	67	58	62	60	116	389	2,644
BTU Factor	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.04	1.04	1.03	1.03	1.03	12
Therms (Burner Tip)	651.1	608.7	432.0	100.2	78.2	81.3	68.9	59.7	63.9	61.7	120.3	401.4	2727.4
Total Distribution Cost	$257	$242	$167	$40	$33	$34	$31	$28	$29	$28	$51	$165	1,107
Cost per Therm	$0.395	$0.398	$0.387	$0.399	$0.427	$0.422	$0.444	$0.466	$0.455	$0.461	$0.427	$0.411	$0.406
Total Commodity Cost	$643	$639	$499	$124	$108	$121	$110	$80	$74	$65	$116	$380	2,958
Cost per Therm	$0.99	$1.05	$1.16	$1.24	$1.38	$1.48	$1.60	$1.35	$1.15	$1.06	$0.96	$0.95	$1.08
Total Cost	$901	$881	$666	$164	$141	$155	$141	$108	$103	$94	$167	$545	$4,065
Cost per Therm	$1.383	$1.447	$1.542	$1.636	$1.807	$1.905	$2.043	$1.811	$1.608	$1.519	$1.389	$1.357	**$1.490**

DETAILED COST BREAKDOWN PER ECM

CONCORD ENGINEERING GROUP

SLACKWOOD FIRE COMPANY

ECM 1 LIGHTING UPGRADE

	Qty	Unit Cost $	Material $	Labor $	Total $
Lighting Retrofit	LS	$2,295	$0	$0	$2,295
Total Cost			$0	$0	$2,295
Utility Incentive - NJ Smart Start ($30 per 3-4 lamp fixture)					($480)
Total Cost Less Incentive					$1,815

ECM 2 LIGHTING CONTROLS

	Qty	Unit Cost $	Material $	Labor $	Total $
Dual - Technology Sensor	15	$75	$1,125	$0	$1,125
Total Cost			$1,125	$0	$1,125
Utility Incentive - NJ Smart Start					($300)
Total Cost Less Incentive ($20 per Sensor)					$825

ECM 3 BOILER RETROFIT - DUAL FUEL BURNER

	Qty	Unit Cost $	Material $	Labor $	Total $
New Fual Fuel Burner; Power Flame	1	$8,250	$5,500	$2,750	$8,250
Total Cost			$5,500	$2,750	$8,250
Utility Incentive - N/A					$0
Total Cost Less Incentive					$8,250

*Demolition of Exist. Burner is included in total price.

ECM 4 AIR CONDITIONING UPGRADE - SPLIT SYSTEM UNITS

	Qty	Unit Cost $	Material $	Labor $	Total $
New Evap Coil, Condensing Unit; Friedrich MC18CF R-410a 19.0 SEER	2	$2,813	$3,750	$1,875	$5,625
New Evap Coil, Condensing Unit; Friedrich MC24CF R-410a 18.0 SEER	1	$3,338	$2,225	$1,113	$3,338
New Refrigerant Line Sets (Est. 150 Ft)	3	$968	$1,935	$968	$2,903
Condensing Unit Pads	3	$90	$180	$90	$270
Total Cost			$8,090	$4,045	$12,135
Utility Incentive - NJ Smart Start ($73 per ton)					($365)
Total Cost Less Incentive					$11,770

ECM 5 PROGRAMMABLE THERMOSTATS

	Qty	Unit Cost $	Material $	Labor $	Total $
Programable T-stat	2	$120	$240	$120	$360
Total Cost			$240	$120	$360
Utility Incentive - N/A					$0
Total Cost Less Incentive					$360

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 as of January, 2009:

Electric Chillers

Water-Cooled Chillers	$12 - $170 per ton
Air-Cooled Chillers	$8 - $52 per ton

Gas Cooling

Gas Absorption Chillers	$185 - $400 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 - $93 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

Ground Source Heat Pumps

Closed Loop & Open Loop	$370 per ton

Gas Heating

Gas Fired Boilers < 300 MBH	$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	$300 - $400 per unit

Variable Frequency Drives

Variable Air Volume	$65 - $155 per hp
Chilled-Water Pumps	$60 per hp
Compressors	$5,250 to $12,500 per drive

Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons	$50 per unit
Gas-Fired Water Heaters >50 gallons	$1.00 - $2.00 per MBH
Gas-Fired Booster Water Heaters	$17 - $35 per MBH

Premium Motors

Three-Phase Motors	$45 - $700 per motor

Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	$10 - $30 per fixture, (depending on quantity)
Hard-Wired Compact Fluorescent	$25 - $30 per fixture
Metal Halide w/Pulse Start	$25 per fixture
LED Exit Signs	$10 - $20 per fixture
T-5 and T-8 High Bay Fixtures	$16 - $284 per fixture

Lighting Controls – Occupancy Sensors

Wall Mounted	$20 per control
Remote Mounted	$35 per control
Daylight Dimmers	$25 per fixture
Occupancy Controlled hi-low Fluorescent Controls	$25 per fixture controlled

Lighting Controls – HID or Fluorescent Hi-Bay Controls

Occupancy hi-low	$75 per fixture controlled
Daylight Dimming	$75 per fixture controlled

Other Equipment Incentives

Performance Lighting	$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2004 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive

EXISTING EQUIPMENT LIST

Concord Engineering Group

"Slackwood Fire Company"

Boilers

Location	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Output (MBh)	Fuel	Efficiency (%)	Vintage	Approx. Age	ASHRAE Service Life	Remaining Life
Slackwood	Burnham	1	V904A	64114974	588	483	#2 Fuel Oil	82%	1999	10	35	25

Domestic Hot Water Heater

Location	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Vintage	Approx. Age	ASHRAE Service Life	Remaining Life
Slackwood	Bradford White	1	MI100T10CN	TA4177223	88	92	100	-	Nat. Gas	1999	10	10	0

Air Handling Units

Location	Manufacturer	Qty.	Model #	Serial #	Cooling Coil	Heating Coil	Input (MBh)	Output (MBh)	Fan HP	Fan RPM	Volts	Phase	Amps	Vintage	Approx. Age	ASHRAE Service Life	Remaining Life
Slackwood	Trane	3	Unknown		DX R-22	Gas Furnace	-	-	-	-	-	-	-	1997	12	15	3
Slackwood	Singer	1	D-DHU-331000	0564010-H01-0317	DX R-22	Hot Water	-	-	-	-	-	-	-	1984	25	15	(10.00)

AC Condensers

Location	Manufacturer	Qty.	Model #	Serial #	Cooling Capacity	Eff.	Refrigerant	Volts	Phase	Amps	Vintage	Approx. Age	ASHRAE Service Life	Remaining Life
Slackwood	Emerson	2	18DD44-J	171237	1.5 Ton	9 EER	R-22	208-230	-	-	1994	15	10	(5.00)
Slackwood	Coleman	1	AC036X1021G	W0N5701054	2 Ton	9 EER	R-22	208-230	-	-	2001	8	10	2

Kitchen Hood

Location	Manufacturer	Qty.	Model #	Serial #	Fan HP	Fan RPM	Volts	Phase	Amps	Vintage	Approx. Age	ASHRAE Service Life	Remaining Life
Slackwood	Dayton	1	4YY20	10919762 -0706	-	-	-	-	-	1995	14	25	11
Slackwood	Dayton	1	BTC0906300HB	BB518598B	-	-	-	-	-	1987	22	25	3

Unit Heaters

Location	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Output (MBh)	Fuel	Efficiency (%)	Vintage	Approx. Age	ASHRAE Service Life	Remaining Life
Slackwood	REZNOR	3	No Name Plate	-	-	-	Nat. Gas	80%	1994	15	18	3

INVESTMENT GRADE LIGHTING AUDIT

CONCORD ENERGY SERVICES

CEG Job #: 9C08127
Project: Lawrence Twp. Energy Audit
Address: 21 Slackwood Ave.
City: Lawrence Twp.
Building SF: 14,881

"Slackwood Fire Company"

DATE: 05/04/2009
KWH COST: $0.163

EXISTING LIGHTING									PROPOSED LIGHTING								SAVINGS			
Line No.	Fixture Location	No. eFixts	Fixture eType	Yearly Usage	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	No. rFixts	Retro-Unit rDescription	Watts Used	Total kW	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Payback
1	Engine Bays	20	8' 2-Lamp T-8 No Lens Electronic Ballast	2080	122	2.44	5075.2	$827.26	20	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
2		2	4' 2-Lamp T-8 No Lens Electronic Ballast	2080	61	0.12	253.76	$41.36	2	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
3	Kitchen	15	2'x4' 4-Lamp T-12 Magnetic Ballast	2080	154	2.31	4804.8	$783.18	15	2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux	91	1.37	2839.2	$462.79	$140.00	$2,100.00	0.95	1965.6	$320.39	6.55
4		4	60 W Incandescent	2080	60	0.24	499.2	$81.37	4	13 W CFl Lamp	13	0.05	108.16	$17.63	$2.92	$11.68	0.19	391.04	$63.74	0.18
5	Hall	27	2'x4' 2 Lamp T-8 Prism Lens Electronic Ballast	2080	61	1.65	3425.76	$558.40	27	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
6	Hall Bar	10	60 W Incandescent	2080	60	0.60	1248	$203.42	10	13 W CFl Lamp	13	0.13	270.4	$44.08	$2.92	$29.20	0.47	977.6	$159.35	0.18
7	Men's Room	2	2'x2' 2-Lamp T-8 U-Tube, Prism Lens Electronic Ballast	2080	61	0.12	253.76	$41.36	2	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
8	Women's Room	2	2'x2' 2-Lamp T-8 U-Tube, Prism Lens Electronic Ballast	2080	61	0.12	253.76	$41.36	2	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
9	Rear Engine Bay	12	8' 2-Lamp T-8 No Lens Electronic Ballast	2080	122	1.46	3045.12	$496.35	12	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
10	Game Room	10	2'x2' 2-Lamp T-8 U-Tube, Prism Lens Electronic Ballast	2080	61	0.61	1268.8	$206.81	10	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
11		1	2'x4' 4-Lamp T-12 Magnetic Ballast Prisim Lens	2080	154	0.15	320.32	$52.21	1	2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux	91	0.09	189.28	$30.85	$140.00	$140.00	0.06	131.04	$21.36	6.55
	Dispatch Office	1	2'x2' 2-Lamp T-8 U-Tube, Prism Lens Electronic Ballast	2080	61	0.06	126.88	$20.68	1	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
12	Dispatch Office	5	60 W Incandescent	2080	60	0.30	624	$101.71	5	13 W CFl Lamp	13	0.07	135.2	$22.04	$2.92	$14.60	0.24	488.8	$79.67	0.18
	2nd Flr Meeting Room	10	2'x2' 2-Lamp T-8 U-Tube, Prism Lens Electronic Ballast	2080	61	0.61	1268.8	$206.81	10	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
13	2nd Flr Back Office	3	2'x2' 2-Lamp T-8 U-Tube, Prism Lens Electronic Ballast	2080	61	0.18	380.64	$62.04	3	No change		0.00	0	$0.00		$0.00	0.00	0	$0.00	0.00
	Totals	124				10.99	22848.8	$3,724.35	124			1.70	3542.24	$577.39		$2,295.48	1.90	3954.08	$644.52	3.56

Dual Fuel Burner Savings

Concord Engineering Group

Slackwood Fire Company

21 Slack Ave. Lawrence Township, NJ
#2 Fuel Oil
Tank Size 1500 Gallons

	Jan 2008	Feb 2008	Mar 2008	Apr 2008	May 2008	Jun 2008	Jul 2008	Aug 2008	Sep 2008	Oct 2008	Nov 2008	Dec 2008	Total
Date											11/19/2008		
Delivery Gallons											1,154.2		1,154
Price $2.44 per Gallon	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,816.25	$0.00	$2,816

Cost Benefit to convert to Natural Gas						
#2 Fuel Oil	139	MBtu/gal	$2.44	per gal	$0.01755	per MBtu
Natural Gas	100	MBtu/therm	$1.49	per therm	$0.01490	per MBtu

Current Fuel Oil Usage		
Fuel Oil Annual Usage	1,154	Gallons
Fuel Oil Annual Usage	160,434	MBTU
Fuel Oil Annual Cost	$2,816	

Conversion to Natural Gas		
Natural Gas Annual Usage	160,434	MBTU
Natural Gas Annual Cost	$2,390	
Annual Conversion Savings	**$426**	

Conversion with 10% EFF Increase		
Natural Gas Annual Usage	144,390	MBTU
Natural Gas Annual Cost	$2,151	
Annual Conversion Savings	**$665**	

Life Cycle Cost Estimate for
1 ENERGY STAR Qualified Programmable Thermostat(s)

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Number of Units	1
Initial Cost per ENERGY STAR Unit (retail price)	$180
Initial Cost per Conventional Unit (retail price)	$73
Unit Fuel Cost (Cooling) ($/kWh)	$0.163
Unit Fuel Cost (Heating) ($/Therm)	$1.49

24 Hour Typical Usage Patterns*

	Weekday	Weekend
Nighttime Set-Back/Set-Up Hours	20	20
Daytime Set-Back/Set-Up Hours	0	0
Hours without Set-Back/Set-Up	4	4

Choose your city from the drop-down menu → **City**: NJ-Newark

Heating Season*

Typical Indoor Temperature w/o Set-Back	60
Nighttime Set-Back Temperature (Average)	55
Daytime Set-Back Temperature (Average)	55
Heating System Type	Gas Boiler

Cooling Season*

Typical Indoor Temperature w/o Set-Up	76
Nighttime Set-Up Temperature (Average)	85
Daytime Set-Up Temperature (Average)	76
Cooling System Type	None

**All temperatures are in degrees Fahrenheit. Setpoint is defined as the temperature setting for any given time period. Set-back temperature is defined as the lower setpoint temperature for the energy-savings periods during the heating season, generally nighttime and daytime. Set-up temperature is defined as the higher setpoint temperature for the energy-savings periods during the cooling season, generally nighttime and daytime.*

Annual and Life Cycle Costs and Savings for 1 Programmable Thermostat(s)

	1 ENERGY STAR Unit(s)	1 Conventional Unit(s)	Savings with ENERGY STAR
Annual Energy Costs			
Heating Energy Cost	$561	$683	$122
Heating Energy Consumption (MBTU)	*38*	*46*	*8*
Cooling Energy Cost	$0	$0	$0
Cooling Energy Consumption (MBTU)	*0.0*	*0.0*	*0*
Total	**$561**	**$683**	**$122**
Life Cycle Costs			
Energy Costs	$6,242	$7,599	$1,357
Heating Energy Costs	*$6,242*	*$7,599*	*$1,357*
Heating Energy Consumption (MBTU)	565	688	123
Cooling Energy Costs	$0	$0	$0
Cooling Energy Consumption (MBTU)	0	0	0
Purchase Price for 1 Unit(s)	*$180*	*$73*	*-$107*
Total	**$6,422**	**$7,672**	**$1,250**

Simple payback of initial cost (years) **0.9**

Summary of Benefits for 1 Programmable Thermostat(s)

Initial cost difference	**$107**
Life cycle savings	**$1,357**
Net life cycle savings (life cycle savings - additional cost)	**$1,250**
Life cycle energy saved (MBTU)-includes both Heating and Cooling	**123**
Simple payback of additional cost (years)	**0.9**
Life cycle air pollution reduction (lbs of CO_2)	**14,372**
Air pollution reduction equivalence (number of cars removed from the road for a year)	**1**
Air pollution reduction equivalence (acres of forest)	**1**
Savings as a percent of retail price	**694%**

Assumptions for Programmable Thermostats

Category	Value		Data Source
Heating/Cooling System Efficiencies			
Gas Furnace	84.0		LBNL 2004, Average of ENERGY STAR and Conventional
Gas Boiler	82.5		LBNL 2004, Average of ENERGY STAR and Conventional
Oil Furnace	84.0		LBNL 2004, Average of ENERGY STAR and Conventional
Oil Boiler	82.5		LBNL 2004, Average of ENERGY STAR and Conventional
Baseline Energy Consumption (MBTU)			
Gas Furnace	54.1		DOE 2001
Gas Boiler	56.1		DOE 2001
Oil Furnace	68.7		DOE 2001
Oil Boiler	71.2		DOE 2001
Central Air Conditioner	9.5		DOE 2001
Reference Degree Days (Heating/Cooling)			
Gas Furnace	4,255		DOE 2001
Gas Boiler	4,255		DOE 2001
Oil Furnace	5,339		DOE 2001
Oil Boiler	5,339		DOE 2001
Central Air Conditioner		1701	DOE 2001
Typical Indoor Temperature (Heating Season)	70		ENERGY STAR Programmable Thermostat Eligibility Criteria. Pre-programmed settings for heating include a morning and evening temperature ≤70°F and an adjustment of at least 8 °F (≤62°F) during daytime and nighttime.
Typical Indoor Temperature (Cooling Season)	78		ENERGY STAR Programmable Thermostat Eligibility Criteria. Pre-programmed settings for cooling include a morning and evening temperature ≥78°F and an adjustment of at least 7 °F (≥85°F) during daytime and an adjustment of at least 4°F (≥82°F) at nighttime.
Energy Prices			
Natural Gas ($/Therm)	$1.2700	$/Therm	EIA 2008
Fuel Oil ($/Gallon)	$2.6800	$/gal	EIA 2008
Electric Price (Residential)	$0.1059	$/kWh	EIA 2008
Usage			
Nighttime Hours	8		Default shipped setting, ENERGY STAR specification
Daytime Hours	10		Default shipped setting, ENERGY STAR specification
Carbon Dioxide Emissions Factors			
Oil Carbon Emission Factor	161.27	lbs CO_2/MBtu	EPA 2007
Gas Carbon Emission Factor	116.97	lbs CO_2/MBtu	EPA 2007
Electricity Carbon Emission Factor	1.54	lbs CO_2/kWh	EPA 2008
Thermostat Savings			
Savings per Degree of Setback (Heating Season)	3%		Industry Data 2004
Savings per Degree of Setback (Cooling Season)	6%		Industry Data 2004
Thermostat Lifetime	15	years	LBNL 2007
Initial Cost			
ENERGY STAR Programmable Thermostat	$92		Industry Data 2008
Conventional Thermostat	$73		Industry Data 2008
CO_2 Equivalents			
Annual CO_2 sequestration per forested acre	9,700	lbs CO_2/acre-yr	EPA 2007
Annual CO_2 emissions for "average" passenger car	12,037	lbs CO_2/acre-yr	EPA 2007
Discount Rate			
Commercial and Residential Discount Rate (real)	4%		A real discount rate of 4 percent is assumed, which is roughly equivalent to the nominal discount rate of 7 percent (4 percent real discount rate + 3 percent inflation rate).

Slackwood Fire Company PV Financials
Self Financed 70%-20 Year Term-7.0% Interest Rate

Total Project Cost	$202,719	System Size (kW)	25.34	Tax Rate	0.0%
		Utility Rate ($/kWh)	$0.1630		
Net Project Cost	$202,719	Utility Rate Inflation	3.00%		
Percent Financed	**70%**	REC Value ($/kWh)	$0.350		
Capital Outlay	$60,816	Term (years)	**20**		
Financing Principal	$141,903	Rate	**7.0%**		

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Solar Generation (kWh)		43,285	43,069	42,854	42,639	42,426	42,214	42,003	41,793	41,584	41,376	41,169	40,963
Utility Rate per kWh		$0.163	$0.168	$0.173	$0.178	$0.183	$0.189	$0.195	$0.200	$0.206	$0.213	$0.219	$0.226
Federal Tax Credit		$0											
Cash effect of depreciation		$0	$0	$0	$0	$0	$0						
Avoided Utility Pmnt (from Solar Generation)		$7,056	$7,231	$7,411	$7,595	$7,783	$7,977	$8,175	$8,378	$8,586	$8,800	$9,018	$9,243
Revenue from REC Sale		$15,150	$15,074	$14,999	$14,924	$14,849	$14,775	$14,701	$14,628	$14,554	$14,482	$14,409	$14,337
Subtotal		$22,205	$22,305	$22,409	$22,519	$22,633	$22,752	$22,876	$23,006	$23,141	$23,281	$23,428	$23,580
Finance payment		($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)
Interest expense		($9,933)	($9,691)	($9,432)	($9,154)	($8,857)	($8,540)	($8,200)	($7,836)	($7,447)	($7,031)	($6,585)	($6,109)
Operations & Maintenance		$0	$0	$0	$0	$0	$317	$329	$342	$356	$370	$385	$401
Subtotal		($9,933)	($9,691)	($9,432)	($9,154)	($8,857)	($8,223)	($7,871)	($7,494)	($7,091)	($6,661)	($6,200)	($5,708)
Net Savings		$12,272	$12,614	$12,978	$13,364	$13,775	$14,529	$15,005	$15,512	$16,050	$16,621	$17,227	$17,872
Taxes on net savings (no tax on principle payment)		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net savings after taxes		$12,272	$12,614	$12,978	$13,364	$13,775	$14,529	$15,005	$15,512	$16,050	$16,621	$17,227	$17,872
Principal Payment		($3,461)	($3,704)	($3,963)	($4,240)	($4,537)	($4,855)	($5,195)	($5,558)	($5,947)	($6,364)	($6,809)	($7,286)
Net Cash Flow After Taxes	($60,816)	$8,811	$8,910	$9,015	$9,124	$9,238	$9,674	$9,811	$9,954	$10,102	$10,257	$10,418	$10,586
Cumulative savings before taxes		$12,272	$24,886	$37,864	$51,228	$65,004	$79,532	$94,538	$110,049	$126,099	$142,720	$159,948	$177,819

Year	13	14	15	16	17	18	19	20	21	22	23	24	25
Solar Generation (kWh)	40,759	40,555	40,352	40,150	39,950	39,750	39,551	39,353	39,157	38,961	38,766	38,572	38,379
Utility Rate per kWh	$0.232	$0.239	$0.247	$0.254	$0.262	$0.269	$0.277	$0.286	$0.294	$0.303	$0.312	$0.322	$0.331
Federal Tax Credit													
Subtotal													
Avoided Utility Pmnt (from Solar Generation)	$9,472	$9,708	$9,949	$10,196	$10,449	$10,709	$10,975	$11,248	$11,528	$11,814	$12,108	$12,408	$12,717
Revenue from REC sale	$14,266	$14,194	$14,123	$14,053	$13,982	$13,912	$13,843	$13,774	$13,705	$13,636	$13,568	$13,500	$13,433
Subtotal	$23,738	$23,902	$24,072	$24,249	$24,432	$24,622	$24,818	$25,022	$25,232	$25,450	$25,676	$25,909	$26,150
Finance payment	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	($13,395)	$0	$0	$0	$0	$0
Interest expense	($5,599)	($5,053)	($4,469)	($3,844)	($3,176)	($2,461)	($1,695)	($876)	$0	$0	$0	$0	$0
Operations & Maintenance	$417	$433	$451	$469	$487	$507	$527	$548	$570	$593	$617	$641	$667
Subtotal	($5,182)	($4,620)	($4,019)	($3,376)	($2,689)	($1,954)	($1,168)	($328)	$570	$593	$617	$641	$667
Net Savings	$18,556	$19,282	$20,054	$20,873	$21,743	$22,668	$23,650	$24,694	$25,802	$26,043	$26,292	$26,550	$26,817
Taxes on net savings (no tax on principle payment)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net savings after taxes	$18,556	$19,282	$20,054	$20,873	$21,743	$22,668	$23,650	$24,694	$25,802	$26,043	$26,292	$26,550	$26,817
Principal Payment	($7,796)	($8,342)	($8,925)	($9,550)	($10,219)	($10,934)	($11,699)	($12,518)	$0	$0	$0	$0	$0
Net Cash Flow After Taxes	$10,760	$10,940	$11,128	$11,323	$11,525	$11,734	$11,951	$12,175	$25,802	$26,043	$26,292	$26,550	$26,817
Cumulative savings before taxes	$196,375	$215,657	$235,710	$256,583	$278,326	$300,994	$324,644	$349,338	$375,140	$401,184	$427,476	$454,026	$480,843

Internal Rate of Return After Taxes	16%
NPV of After Tax Cash Flows	$54,842
NPV Discount Rate	8.00%

These Figures are estimates for discussion only.

Slackwood Fire Company PV Financials
Purchase

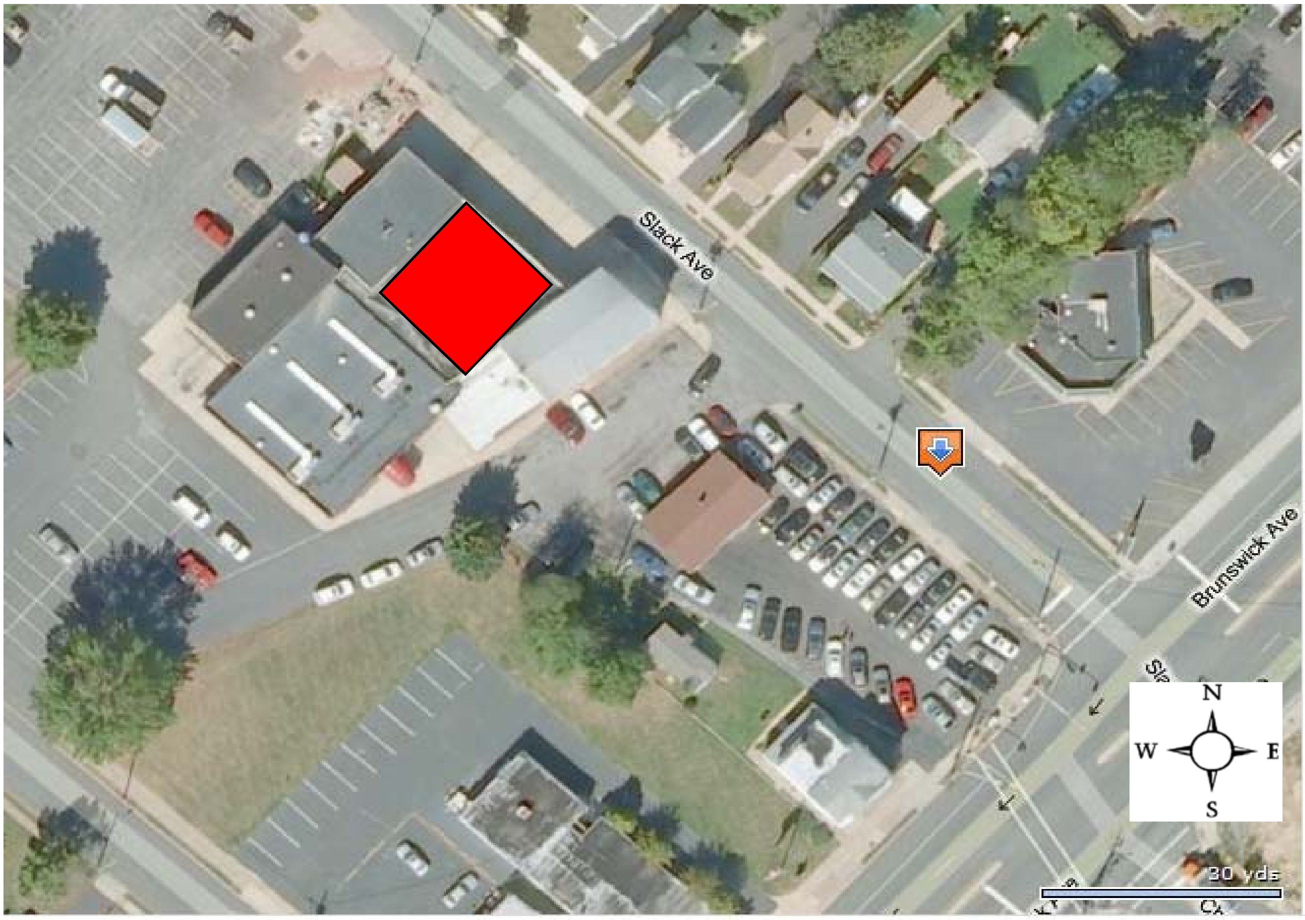
Total Project Cost	$202,719	System Size (kW)	25.34	Tax Rate	0.0%
		Utility Rate ($/kWh)	$0.1630		
Net Project Cost	$202,719	Utility Rate Inflation	3.00%		
		REC Value ($/kWh) year 1-25	$0.350		
Capital Outlay	$202,719				

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Solar Generation (kWh)		43,285	43,069	42,854	42,639	42,426	42,214	42,003	41,793	41,584	41,376	41,169	40,963
Utility Rate per kWh		$0.163	$0.168	$0.173	$0.178	$0.183	$0.189	$0.195	$0.200	$0.206	$0.213	$0.219	$0.226
Capital Outlay	($202,719)												
Tax Credit		$0											
Cash effect of depreciation		$0	$0	$0	$0	$0	$0						
Avoided Utility Pmnt (from Solar Generation)		$7,056	$7,231	$7,411	$7,595	$7,783	$7,977	$8,175	$8,378	$8,586	$8,800	$9,018	$9,243
Revenue from REC Sale		$15,150	$15,074	$14,999	$14,924	$14,849	$14,775	$14,701	$14,628	$14,554	$14,482	$14,409	$14,337
Subtotal		$22,205	$22,305	$22,409	$22,519	$22,633	$22,752	$22,876	$23,006	$23,141	$23,281	$23,428	$23,580
Operations & Maintenance		$0	$0	$0	$0	$0	$317	$329	$342	$356	$370	$385	$401
Subtotal		$0	$0	$0	$0	$0	$317	$329	$342	$356	$370	$385	$401
Net Savings		$22,205	$22,305	$22,409	$22,519	$22,633	$23,068	$23,205	$23,348	$23,497	$23,652	$23,813	$23,980
Taxes on net savings		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net Savings after taxes	($202,719)	$22,205	$22,305	$22,409	$22,519	$22,633	$23,068	$23,205	$23,348	$23,497	$23,652	$23,813	$23,980
Cumulative Savings	($202,719)	($180,513)	($158,208)	($135,799)	($113,280)	($90,648)	($67,579)	($44,374)	($21,026)	$2,471	$26,123	$49,936	$73,917

Year	13	14	15	16	17	18	19	20	21	22	23	24	25
Solar Generation (kWh)	40,759	40,555	40,352	40,150	39,950	39,750	39,551	39,353	39,157	38,961	38,766	38,572	38,379
Utility Rate per kWh	$0.232	$0.239	$0.247	$0.254	$0.262	$0.269	$0.277	$0.286	$0.294	$0.303	$0.312	$0.322	$0.331
Avoided Utility Pmnt (from Solar Generation)	$9,472	$9,708	$9,949	$10,196	$10,449	$10,709	$10,975	$11,248	$11,528	$11,814	$12,108	$12,408	$12,717
Revenue from REC sale	$14,266	$14,194	$14,123	$14,053	$13,982	$13,912	$13,843	$13,774	$13,705	$13,636	$13,568	$13,500	$13,433
Subtotal	$23,738	$23,902	$24,072	$24,249	$24,432	$24,622	$24,818	$25,022	$25,232	$25,450	$25,676	$25,909	$26,150
Operations & Maintenance	$417	$433	$451	$469	$487	$507	$527	$548	$570	$593	$617	$641	$667
Subtotal	$417	$433	$451	$469	$487	$507	$527	$548	$570	$593	$617	$641	$667
Net Savings	$24,154	$24,335	$24,523	$24,717	$24,919	$25,128	$25,345	$25,570	$25,802	$26,043	$26,292	$26,550	$26,817
Taxes on net savings	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net savings after taxes	$24,154	$24,335	$24,523	$24,717	$24,919	$25,128	$25,345	$25,570	$25,802	$26,043	$26,292	$26,550	$26,817
Cumulative Savings	$98,071	$122,406	$146,929	$171,646	$196,565	$221,694	$247,039	$272,609	$298,412	$324,455	$350,747	$377,297	$404,114

After Tax IRR	10.6%
NPV of Net Savings After Taxes	$45,220
NPV Discount Rate	8.00%

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
Slackwood Fire Company	1620	Sunpower SPR230	110.2	14.7	1,620	25.34	43,285	3,636	15.64



.= Proposed PV Layout

Notes:
1. Estimated kWH based on 4.68 hours full output per day per 365 day year. Actual kWH will vary day to day.