ENERGY AUDIT – FINAL REPORT

LAWRENCE TOWNSHIP
LAWRENCE ROAD FIRE COMPANY
1260 LAWRENCE ROAD
LAWRENCE TOWNSHIP, NJ 08648
ATTN: MR. TREY KEYMOORE

CEG PROPOSAL NO. 9C08127

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I. EXECUTIVE SUMMARY

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

Lawrence Township
Lawrence Road Fire Company
1260 Lawrence 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	$ 11,923
Natural Gas	$ 8,344
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 Controls	$550	$262	2.1
2	Roof Top Unit Replacement – Game Room	$8,581	$162	56.9
3	Air Conditioning Upgrade – Split System Units	$9,248	$252	36.7
4	Programmable Thermostat	$180	$122	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 Controls	-	1,497	-
2	Roof Top Unit Replacement – Game Room	-	-	111
3	Air Conditioning Upgrade – Split System Units	-	1,440	-
4	Programmable Thermostat	-	-	84

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 Lawrence Road Fire Company:

- **ECM #1:** Lighting Controls
- **ECM #4:** Programmable Thermostats

II. INTRODUCTION

This comprehensive energy audit covers the 10,563 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 new operating hours instead of the existing 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 new system wattage instead of the existing 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 after 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.

Description	Average
Electricity	17.5¢/kWh
Natural Gas	$1.46/Therm

Table 3
Electricity Billing Data

MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
1/08	6,720	18	$868
2/08	6,640	26	$914
3/08	5,760	20	$774
4/08	3,920	17	$555
5/08	4,880	26	$713
6/08	6,080	35	$1,424
7/08	8,560	28	$1,714
8/08	6,160	26	$1,383
9/08	4,720	30	$1,180
10/08	3,520	21	$664
11/08	4,640	17	$765
12/08	6,480	18	$969
Totals	**68,080**	**35 Max**	**$11,923**

Figure 1
Electricity Usage Profile

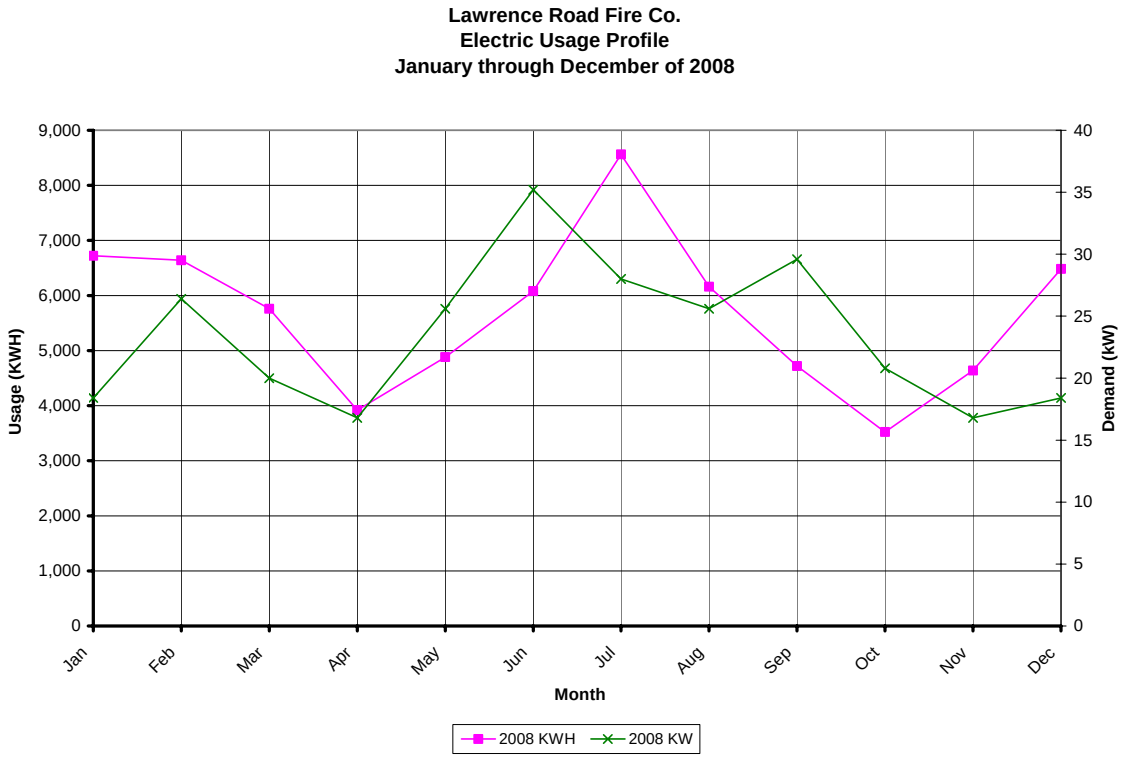
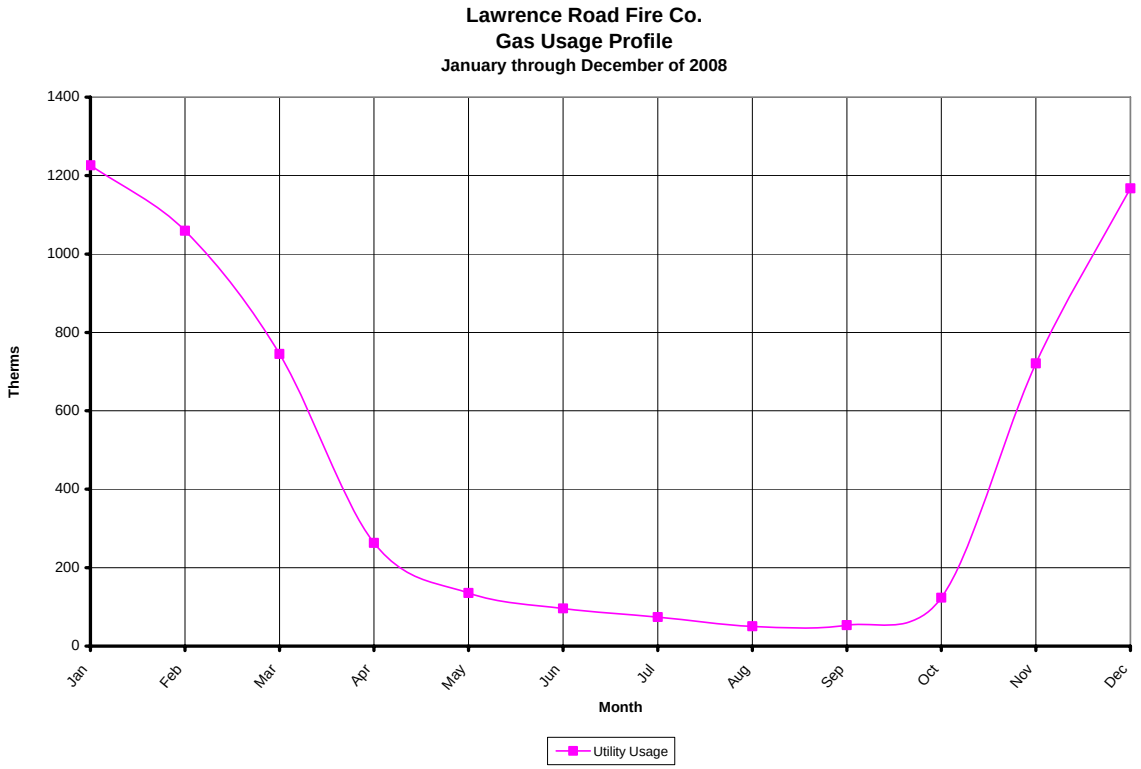


Table 4
Natural Gas Billing Data

MONTH OF USE	CONSUMPTION (THERMS)	TOTAL BILL
1/08	1,226	$1,695
2/08	1,059	$1,564
3/08	745	$1,181
4/08	262.9	$419
5/08	135.5	$246
6/08	95.9	$183
7/08	74.2	$154
8/08	50.3	$86
9/08	53.4	$86
10/08	123.4	$173
11/08	721	$962
12/08	1,167.6	$1,596
Totals	**5,714.2**	**$8,344**

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.

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

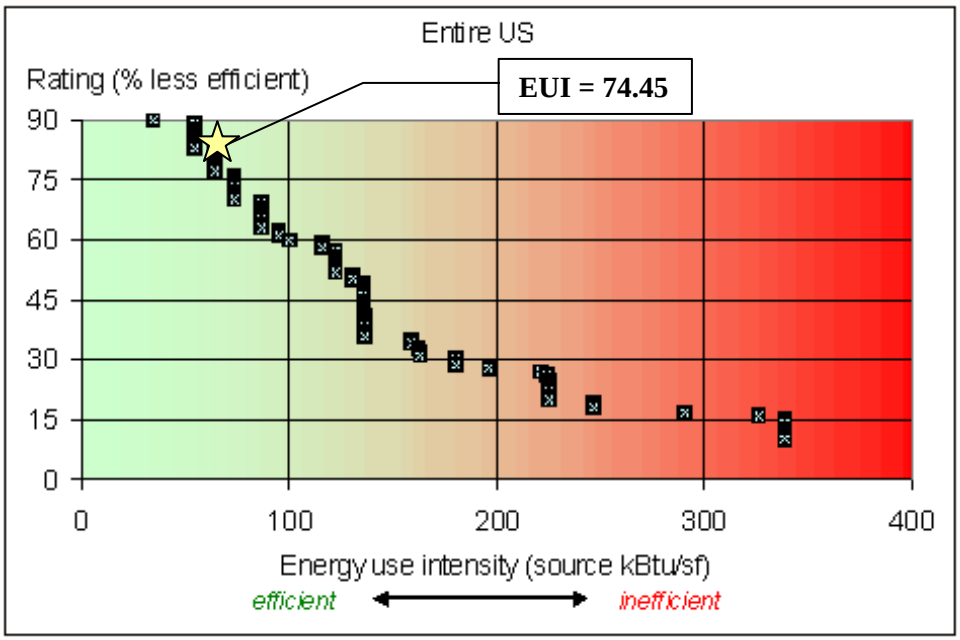
Electric = ((68,080 kWh) * (1000 W/kW) * (3.414 Btu/h / 1 W))/ (1000 Btu/h / 1 kBtu/h)
= 232,425 kBtu/h

Gas = ((5,540 therms) * (100,000 Btu/h / 1 Therm)) / (1000 Btu/h / 1 kBtu/h) = 554,000 kBtu/h

$$Building\ \ EUI = \frac{(232{,}425\ kBtu/h + 554{,}000\ kBtu/h)}{10{,}563\ SF} = \frac{705{,}662\ kBtu/h}{10{,}563\ SF}$$

Lawrence Road Fire Company EUI = 74.45 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 then 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 Lawrence Road 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 74.45 which is low for this type of facility. The lowered the EUI the less energy the facilty uses per squarefoot. A low EUI indicates a more efficient building. The facility runs very efficiently for its size do the the low permenant staff size stationed at the facility on a day to day basis. 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 Lawrence Road Fire Company consists of offices, engine bays, a hall and members lounge and meeting area; totaling approximately 10,563 SF. The Lawrence Road fire house is a one story structure of steel and block construction except the front office section which is two-story. The first section of the facility was built in 1914 with an addition in 1974. The Fire house is normally occupied by one person for 8 hours a day during the week, only the radio room is occupied during this time period. Lawrence Road is a volunteer fire company that only fully operates when an emergency occurs in their response area. Additionally, there is a fire hall that is rented out once or twice a month throughout the year.

Heating System

The two story office and lounge area is heated by a natural gas fired Burnham hot water boiler. Hot water baseboard is mounted along all perimeter walls to heat the space. An abandoned gas fired heating only roof top unit is still mounted on the roof of the fire house. The unit is ducted into the game room and office area of the facility. The existing ductwork could be utilized if the roof top unit was ever to be replaced, with a more efficient alternative.

The engine bay is heated by three (3) gas fired REZNOR unit heaters. The units are mounted above the ceiling and are controlled by standard non-programmable thermostats.

The hall of the fire house is heated by two (2) RUUD 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 typically on a bi-monthly basis.

Domestic Hot Water

Domestic hot water for the restrooms is provided by an AO Smith gas fired hot water heater, with a 74 gallon capacity and an input of 75 MBh. There is an additional 30 gallon water heater serving the utility sink in the engine bay, this is an all electric unit, with a 230W capacity.

Cooling System

The two story office and lounge section of the building is cooled via a window unit mounted on each floor. The make and model was not shown on the unit. Window units are commonly used as a last minute cooling option and are one of the less efficient cooling options available.

The engine room is not air conditioned.

The hall is air conditioned by the two (2) RUUD air handling units mounted on the roof. The capacity of these units is unknown due 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 are manually changed based upon the occupancy of the building.

Lighting

The office areas, lounge and meeting room are lit via 2-foot by 4-foot lay-in fixtures containing 4-foot T8 lamps and electronic ballasts. Standard switching is utilized and there are no other types of lighting controls present.

The engine bays are lit with 4' 2&4-lamp T8 fixtures with electronic ballasts. The lights are switched via standard wall switching. No other lighting controls were being used.

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. Additionally, 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.

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VII. ENERGY CONSERVATION MEASURES

ECM #1: 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. (10,563 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 0.68 Watts/SF. Ten percent of this value is the resultant energy savings due to installation of occupancy sensors:

Savings = 10% x 0.68 Watts/SF x 10,563 SF x 2,080 hrs/yr. = 1,494 kWh x $0.175/kWh

Savings = $262 / 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 10. Total cost to install sensors is $55/unit x 10 units = $550.

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$750
NJ Smart Start Equipment Incentive ($):	($200)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$550*
Total Energy Savings ($ / yr):	*$262*
Simple Payback (yrs):	*2.1*

ECM #2: Roof Top Unit Replacement – Game Room

Description:

The Game Room within the Lawrence Road Fire Co. currently is provided heating and ventilation via a single zone, heating only rooftop unit. The existing heating only rooftop unit is currently inoperable, therefore, the heating and ventilating for the space is not being provided adequately at this time. As a result of the rooftop unit not functioning the gas and electric utility bills do not show the impact that this equipment would have on the respective bills if operational. Based on our survey, the heating only rooftop unit is well beyond its service life as indicated in Chapter 36 of the 2007 ASHRAE Applications Handbook. The estimate service life for a rooftop unit is 15 years.

This energy conservation measure would replace the existing inoperable heating only rooftop unit with a new, efficient heating only rooftop unit. The basis of design for the heating only rooftop unit is a Reznor indirect fired rooftop unit, 75 MBH input or equivalent. The addition of cooling to this unit was reviewed; however, it was more cost effective to include the cooling as described in ECM#3.

Note: ECM#2 is proposed not necessarily as an energy conservation measure but primarily as a means to remedy the heating and ventilation issue within the space. Without the existing heating only rooftop unit operating space heating and ventilation is not being provided as required by the latest building codes.

Energy Savings Calculations:

Existing RTU Heat Exchanger:

Rated Capacity = 75 MBH Natural Gas
Net Efficiency = 70%

Replacement RTU Heat Exchanger:

High Efficiency REZNOR Indirect Fired MUA

Rated Capacity = 75 MBH Natural Gas
Net Efficiency = 81%

Operating Data:

Heating Season Fuel Consumption = 821 Therms
(Based on gas billing data)

Average Cost of Natural Gas = $1.46/Therm

Operating Hours during Heating Season: 1,095 hrs

Energy Savings = Old Heat Exchanger (Htx) Energy Input * ((New Htx Efficiency – Old Htx Efficienccy) / New Htx Efficiency))

$$Energy\ \ Savings = 821\ Therms \times \frac{(0.81 - 0.70)}{(0.81)} = 111\ Therms$$

Cost Savings = Annual Energy Savings x $/Therm

= 111 Therms x $1.46/Therm = $162/ yr.

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$8,581
NJ Smart Start Equipment Incentive ($):	($0)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$8,581*
Total Energy Savings ($ / yr):	*$162*
Simple Payback (yrs):	*52.9*

ECM #3: Air Conditioning Upgrade – Split System

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 two (2) 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 EER of the new equipment will be upwards of 18 EER.

Energy Savings Calculations:

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

Existing Air Conditioning Units

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

Average Cost of Electricity - $0.175/kWh

Proposed High-Efficiency Air Conditioning Unit

Rated Capacity = 2 Tons (x2 Unit)
New Condenser Unit Efficiency = 18 EER

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

$$EnergySavings = \frac{[2\ CoolingTons \times 12{,}000\,Btu/ton \div 1000W/kW]}{[(18EER_{NEW} - 9EER_{OLD})]} \times 0.15 \times 1800 \times 2\ (\#\ of\ units)$$

$$= 1440\ kWh/yr.$$

Cost Savings = (1440 kWh) * $0.175/kWh = $252 / Yr.

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$9,540
NJ Smart Start Equipment Incentive ($):	($292)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$9,248*
Total Energy Savings ($ / yr):	*$252*
Simple Payback (yrs):	*36.7*

ECM #4: Programmable Thermostat

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 F 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

A detailed energy savings calculation can be found in Appendix F that outlines the savings from the use of programmable thermostats.

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$180
NJ Smart Start Equipment Incentive ($):	($0)
Maintenance Savings ($):	($0)
Net Installation Cost ($):	*$180*
Total Energy Savings ($ / yr):	*$122*
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 2,250 S.F. can be utilized for a PV system on the Fire House's roof. A depiction of the area utilized is shown in Appendix G. Using this square footage it was determined that a system size of 35 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 60,119 KWh annually, reducing the overall utility bill by 88% percent. A detailed financial analysis can be found in Appendix G. 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 through December 2008.

Electricity:

Section IV, Figure 1 demonstrates a typical cooling profile, (April –October), complimenting the heating load. It is evident that there is a significant reduction in the On Peak Load from September 2008 to November 2008 and a substantial increase from April 2008 to June 2008. The base-load shaping is important because a flat consumption profile will yield more competitive pricing when trying to procure third party supply.

Natural Gas:

Section IV, Figure 2 demonstrates a typical heating load (November –March), and complimentary cooling load (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 - MD

Lawrence Road Fire Co. **2008**

Account # 62 849 382 6 8

Meter # 728001162

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	6,720	6,640	5,760	3,920	4,880	6,080	8,560	6,160	4,720	3,520	4,640	6,480	68,080	
KW	18	26	20	17	26	35	28	26	30	21	17	18	35	Max
Monthly Load Factor	49%	37%	39%	32%	26%	24%	41%	32%	22%	23%	38%	47%	34%	
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, $	$868	$914	$774	$555	$713	$1,424	$1,714	$1,383	$1,180	$664	$765	$969	$11,923	
$/KWH	$0.129	$0.138	$0.134	$0.141	$0.146	$0.234	$0.200	$0.224	$0.250	$0.189	$0.165	$0.150	**$0.175**	

*Individual delivery and supply costs can not be derived from the provided bills.

Summary of Natural Gas Cost

PSE&G - GSGH Multi Family

Lawrence Road Fire Co. **2008**

Account # 62 849 382 6 8

Meter # 2579612

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	1,189	1,028	723	255	132	93	72	49	52	119	697	1,131	5,540
BTU Factor	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.04	1.03	1.03	1.03	1.03	12
Therms (Burner Tip)	1226.0	1059.0	745.0	262.9	135.5	95.9	74.2	50.3	53.4	123.4	721.0	1167.6	5714.2
Total Distribution Cost	$488	$422	$297	$89	$51	$39	$32	$25	$26	$47	$293	$475	2,283
Cost per Therm	$0.398	$0.399	$0.399	$0.338	$0.373	$0.404	$0.434	$0.497	$0.486	$0.381	$0.406	$0.407	$0.400
Total Commodity Cost	$1,207	$1,142	$884	$330	$195	$145	$122	$61	$60	$126	$669	$1,121	6,061
Cost per Therm	$0.98	$1.08	$1.19	$1.25	$1.44	$1.51	$1.64	$1.20	$1.13	$1.02	$0.93	$0.96	$1.06
Total Cost	$1,695	$1,564	$1,181	$419	$246	$183	$154	$86	$86	$173	$962	$1,596	$8,344
Cost per Therm	$1.382	$1.477	$1.585	$1.592	$1.815	$1.913	$2.078	$1.701	$1.612	$1.402	$1.334	$1.367	**$1.460**

DETAILED COST BREAKDOWN PER ECM

CONCORD ENGINEERING GROUP

LAWRENCE ROAD FIRE COMPANY

ECM 1 LIGHTING CONTROLS

	Qty	Unit Cost $	Material $	Labor $	Total $
Dual - Technology Sensor	10	$75	$750	$0	$750
Total Cost			$750	$0	$750
Utility Incentive - NJ Smart Start					($200)
Total Cost Less Incentive ($20 per Sensor)					$550

ECM 2 RTU REPLACEMENT - GAME ROOM

	Qty	Unit Cost $	Material $	Labor $	Total $
Demolish Exist Rooftop Units; Typ. 2	1	$300	$0	$300	$300
New Heating Only RTU;	1	$7,531	$6,025	$1,506	$7,531
Reznor Indirect Fired MUA (75 MBH Input)					
Gas piping modifications	LS	$750	$500	$250	$750
Total Cost			$6,525	$2,056	$8,581
Utility Incentive - N/A					$0
Total Cost Less Incentive					$8,581
*Gas Piping is assumed to be routed from Kitchen gas piping					

ECM 3 AIR CONDITIONING UPGRADE - SPLIT SYSTEM UNITS

	Qty	Unit Cost $	Material $	Labor $	Total $
New Evap Coil, Condensing Unit;	2	$3,338	$4,450	$2,225	$6,675
Friedrich MC24CF R-410a 18.0 SEER					
New Refrigerant Line Sets (Est. 150 Ft)	2	$1,343	$1,790	$895	$2,685
Condensing Unit Pads	2	$90	$120	$60	$180
Total Cost			$6,360	$3,180	$9,540
Utility Incentive - NJ Smart Start ($73 per ton)					($292)
Total Cost Less Incentive					$9,248

ECM 4 PROGRAMMABLE THERMOSTATS

	Qty	Unit Cost $	Material $	Labor $	Total $
Programable T-stat	1	$120	$120	$60	$180
Total Cost			$120	$60	$180
Utility Incentive - N/A					$0
Total Cost Less Incentive					$180

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

Lawrence Rd. Fire Company

Boilers

Location	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Output (MBh)	Fuel	Efficiency (%)	Vintage	Approx. Age	ASHRAE Service Life	Remaining Life
Lawrence Rd.	Burnham	1	P-205A-WNI	17285160	130	108	Nat. Gas	83%	1988	21	35	14

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
Lawrence Rd.	Unknowr	1	Unknown	-	230 W	-	30	-	Elec.	1999	10	10	0
Lawrence Rd.	AO Smith	1	FC675270	9200439011	75,000	72.82	74	-	Nat. Gas	2004	5	10	5

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
Lawrence Rd.	RUUD	2	URGE-370-150-BBR	D505BBTRAEG0388-0015	-	Gas Fumace	370	277	-	-	-	-	-	2005	4	15	11

AC Condensers

Location	Manufacturer	Qty.	Model #	Serial #	Cooling Capacity	Eff.	Refrigerant	Volts	Phase	Amps	Vintage	Approx. Age	ASHRAE Service Life	Remaining Life
Lawrence Rd.	Coleman	2	AC036X1021G	W0N5701054	2 Ton	9 EER	R-22	208-230	-	-	2001	8	10	2

Unit Heaters

Location	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Output (MBh)	Fuel	Efficiency (%)	Vintage	Approx. Age	ASHRAE Service Life	Remaining Life
Lawrence Rd.	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: 1260 Lawrence Rd.
City: Lawrence Twp.
Building SF: 10,563

"Lawrence Road Fire Company"

DATE: 05/04/2009
KWH COST: $0.175

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 Bay	6	4' 2-Lamp T-8 No Lens Electronic Ballast	2080	61	0.37	761.28	$133.22	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	N/A
2			17	4' 4-Lamp T-8 No Lens Electronic Ballast	2080	122	2.07	4313.92	$754.94	0	No Change	0	0.00	0	$0.00	$140.00	$0.00	0.00	0	$0.00	N/A
3		Day Room	7	2'x4' 4-Lamp T-8 Prism Lens Electronic Ballast	2080	122	0.85	1776.32	$310.86	0	No Change	0	0.00	0	$0.00	$140.00	$0.00	0.00	0	$0.00	N/A
4		Office 1	3	2'x4' 4-Lamp T-8 Prism Lens Electronic Ballast	2080	122	0.37	761.28	$133.22	0	No Change	0	0.00	0	$0.00	$140.00	$0.00	0.00	0	$0.00	N/A
5		Office 2	3	2'x4' 4-Lamp T-8 Prism Lens Electronic Ballast	2080	122	0.37	761.28	$133.22	0	No Change	0	0.00	0	$0.00	$140.00	$0.00	0.00	0	$0.00	N/A
6		Kitchen	9	2'x4' 4-Lamp T-8 Prism Lens Electronic Ballast	2080	122	1.10	2283.84	$399.67	0	No Change	0	0.00	0	$0.00	$140.00	$0.00	0.00	0	$0.00	N/A
7		Hall	12	2'x4' 4-Lamp T-8 Prism Lens Electronic Ballast	2080	122	1.46	3045.12	$532.90	0	No Change	0	0.00	0	$0.00	$140.00	$0.00	0.00	0	$0.00	N/A
8		Members Room	5	2'x4' 4-Lamp T-8 Prism Lens Electronic Ballast	2080	122	0.61	1268.8	$222.04	0	No Change	0	0.00	0	$0.00	$140.00	$0.00	0.00	0	$0.00	N/A
		Totals	62				7.20	14971.8	$2,620.07	0			0.00	0	$0.00		$0.00	0.00	0	$0.00	N/A

Products that earn the ENERGY STAR prevent greenhouse gas emissions by meeting strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the U.S. Department of Energy.
www.energystar.gov

CHANGE FOR THE BETTER WITH ENERGY STAR

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).

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

Total Project Cost	$281,554	System Size (kW)	35.19	Tax Rate	0.0%	
		Utility Rate ($/kWh)	$0.1750			
Net Project Cost	$281,554	Utility Rate Inflation	3.00%			
Percent Financed	**70%**	REC Value ($/kWh)	$0.350			
Capital Outlay	$84,466	Term (years)	**20**			
Financing Principal	$197,088	Rate	**7.0%**			

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Solar Generation (kWh)		60,119	59,818	59,519	59,221	58,925	58,631	58,338	58,046	57,756	57,467	57,180	56,894
Utility Rate per kWh		$0.175	$0.180	$0.186	$0.191	$0.197	$0.203	$0.209	$0.215	$0.222	$0.228	$0.235	$0.242
Federal Tax Credit		$0											
Cash effect of depreciation		$0	$0	$0	$0	$0	$0						
Avoided Utility Pmnt (from Solar Generation)		$10,521	$10,782	$11,050	$11,325	$11,606	$11,895	$12,190	$12,493	$12,804	$13,122	$13,448	$13,782
Revenue from REC Sale		$21,042	$20,936	$20,832	$20,728	$20,624	$20,521	$20,418	$20,316	$20,214	$20,113	$20,013	$19,913
Subtotal		$31,562	$31,719	$31,882	$32,052	$32,230	$32,415	$32,608	$32,809	$33,018	$33,235	$33,461	$33,695
Finance payment		($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)
Interest expense		($13,796)	($13,460)	($13,100)	($12,714)	($12,302)	($11,861)	($11,389)	($10,884)	($10,343)	($9,765)	($9,147)	($8,485)
Operations & Maintenance		$0	$0	$0	$0	$0	$440	$457	$476	$495	$514	$535	$556
Subtotal		($13,796)	($13,460)	($13,100)	($12,714)	($12,302)	($11,421)	($10,932)	($10,408)	($9,849)	($9,251)	($8,612)	($7,928)
Net Savings		$17,766	$18,259	$18,782	$19,338	$19,928	$20,994	$21,677	$22,401	$23,169	$23,984	$24,849	$25,767
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		$17,766	$18,259	$18,782	$19,338	$19,928	$20,994	$21,677	$22,401	$23,169	$23,984	$24,849	$25,767
Principal Payment		($4,808)	($5,144)	($5,504)	($5,889)	($6,302)	($6,743)	($7,215)	($7,720)	($8,260)	($8,838)	($9,457)	($10,119)
Net Cash Flow After Taxes	($84,466)	$12,959	$13,115	$13,278	$13,449	$13,626	$14,251	$14,462	$14,681	$14,909	$15,146	$15,392	$15,647
Cumulative savings before taxes		$17,766	$36,025	$54,808	$74,146	$94,074	$115,068	$136,745	$159,146	$182,315	$206,299	$231,148	$256,915

Year	13	14	15	16	17	18	19	20	21	22	23	24	25
Solar Generation (kWh)	56,609	56,326	56,045	55,764	55,485	55,208	54,932	54,657	54,384	54,112	53,842	53,572	53,304
Utility Rate per kWh	$0.250	$0.257	$0.265	$0.273	$0.281	$0.289	$0.298	$0.307	$0.316	$0.326	$0.335	$0.345	$0.356
Federal Tax Credit													
Subtotal													
Avoided Utility Pmnt (from Solar Generation)	$14,124	$14,475	$14,835	$15,204	$15,582	$15,969	$16,366	$16,772	$17,189	$17,616	$18,054	$18,503	$18,962
Revenue from REC sale	$19,813	$19,714	$19,616	$19,517	$19,420	$19,323	$19,226	$19,130	$19,034	$18,939	$18,845	$18,750	$18,657
Subtotal	$33,938	$34,190	$34,451	$34,721	$35,002	$35,292	$35,592	$35,902	$36,224	$36,556	$36,899	$37,253	$37,619
Finance payment	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	($18,604)	$0	$0	$0	$0	$0
Interest expense	($7,776)	($7,018)	($6,207)	($5,340)	($4,411)	($3,418)	($2,355)	($1,217)	$0	$0	$0	$0	$0
Operations & Maintenance	$579	$602	$626	$651	$677	$704	$732	$761	$792	$824	$857	$891	$926
Subtotal	($7,198)	($6,416)	($5,581)	($4,689)	($3,734)	($2,714)	($1,622)	($456)	$792	$824	$857	$891	$926
Net Savings	$26,740	$27,773	$28,869	$30,033	$31,267	$32,578	$33,970	$35,447	$37,015	$37,379	$37,755	$38,144	$38,546
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	$26,740	$27,773	$28,869	$30,033	$31,267	$32,578	$33,970	$35,447	$37,015	$37,379	$37,755	$38,144	$38,546
Principal Payment	($10,828)	($11,585)	($12,396)	($13,264)	($14,193)	($15,186)	($16,249)	($17,387)	$0	$0	$0	$0	$0
Net Cash Flow After Taxes	$15,913	$16,188	$16,473	$16,769	$17,075	$17,392	$17,720	$18,060	$37,015	$37,379	$37,755	$38,144	$38,546
Cumulative savings before taxes	$283,655	$311,428	$340,298	$370,330	$401,598	$434,176	$468,146	$503,592	$540,608	$577,987	$615,742	$653,886	$692,431
Total Payment	#REF!	#REF!	#REF!										

Internal Rate of Return After Taxes	17%
NPV of After Tax Cash Flows	$85,015
NPV Discount Rate	8.00%

These Figures are estimates for discussion only.

Lawrence Road Fire Company PV Financials
Purchase

Total Project Cost	$281,554	System Size (kW)	35.19	Tax Rate	0.0%
		Utility Rate ($/kWh)	$0.1750		
Net Project Cost	$281,554	Utility Rate Inflation	3.00%		
		REC Value ($/kWh) year 1-25	$0.350		
Capital Outlay	$281,554				

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Solar Generation (kWh)		60,119	59,818	59,519	59,221	58,925	58,631	58,338	58,046	57,756	57,467	57,180	56,894
Utility Rate per kWh		$0.175	$0.180	$0.186	$0.191	$0.197	$0.203	$0.209	$0.215	$0.222	$0.228	$0.235	$0.242
Capital Outlay	($281,554)												
Tax Credit		$0											
Cash effect of depreciation		$0	$0	$0	$0	$0	$0						
Avoided Utility Pmnt (from Solar Generation)		$10,521	$10,782	$11,050	$11,325	$11,606	$11,895	$12,190	$12,493	$12,804	$13,122	$13,448	$13,782
Revenue from REC Sale		$21,042	$20,936	$20,832	$20,728	$20,624	$20,521	$20,418	$20,316	$20,214	$20,113	$20,013	$19,913
Subtotal		$31,562	$31,719	$31,882	$32,052	$32,230	$32,415	$32,608	$32,809	$33,018	$33,235	$33,461	$33,695
Operations & Maintenance		$0	$0	$0	$0	$0	$440	$457	$476	$495	$514	$535	$556
Subtotal		$0	$0	$0	$0	$0	$440	$457	$476	$495	$514	$535	$556
Net Savings		$31,562	$31,719	$31,882	$32,052	$32,230	$32,855	$33,066	$33,285	$33,513	$33,750	$33,996	$34,251
Taxes on net savings		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net Savings after taxes	($281,554)	$31,562	$31,719	$31,882	$32,052	$32,230	$32,855	$33,066	$33,285	$33,513	$33,750	$33,996	$34,251
Cumulative Savings	($281,554)	($249,991)	($218,273)	($186,391)	($154,339)	($122,109)	($89,254)	($56,188)	($22,903)	$10,610	$44,359	$78,355	$112,606

Year	13	14	15	16	17	18	19	20	21	22	23	24	25
Solar Generation (kWh)	56,609	56,326	56,045	55,764	55,485	55,208	54,932	54,657	54,384	54,112	53,842	53,572	53,304
Utility Rate per kWh	$0.250	$0.257	$0.265	$0.273	$0.281	$0.289	$0.298	$0.307	$0.316	$0.326	$0.335	$0.345	$0.356
Avoided Utility Pmnt (from Solar Generation)	$14,124	$14,475	$14,835	$15,204	$15,582	$15,969	$16,366	$16,772	$17,189	$17,616	$18,054	$18,503	$18,962
Revenue from REC sale	$19,813	$19,714	$19,616	$19,517	$19,420	$19,323	$19,226	$19,130	$19,034	$18,939	$18,845	$18,750	$18,657
Subtotal	$33,938	$34,190	$34,451	$34,721	$35,002	$35,292	$35,592	$35,902	$36,224	$36,556	$36,899	$37,253	$37,619
Operations & Maintenance	$579	$602	$626	$651	$677	$704	$732	$761	$792	$824	$857	$891	$926
Subtotal	$579	$602	$626	$651	$677	$704	$732	$761	$792	$824	$857	$891	$926
Net Savings	$34,516	$34,791	$35,077	$35,372	$35,678	$35,996	$36,324	$36,664	$37,015	$37,379	$37,755	$38,144	$38,546
Taxes on net savings	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net savings after taxes	$34,516	$34,791	$35,077	$35,372	$35,678	$35,996	$36,324	$36,664	$37,015	$37,379	$37,755	$38,144	$38,546
Cumulative Savings	$147,122	$181,914	$216,990	$252,362	$288,041	$324,037	$360,361	$397,025	$434,040	$471,419	$509,174	$547,318	$585,864

After Tax IRR	11.0%
NPV of Net Savings After Taxes	$71,651
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
Lawrence Road Fire Company	2250	Sunpower SPR230	153	14.7	2,250	35.19	60,119	5,050	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.