



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

CONCORD ENGINEERING GROUP



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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 $\pm 20\%$ 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/ft²/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.

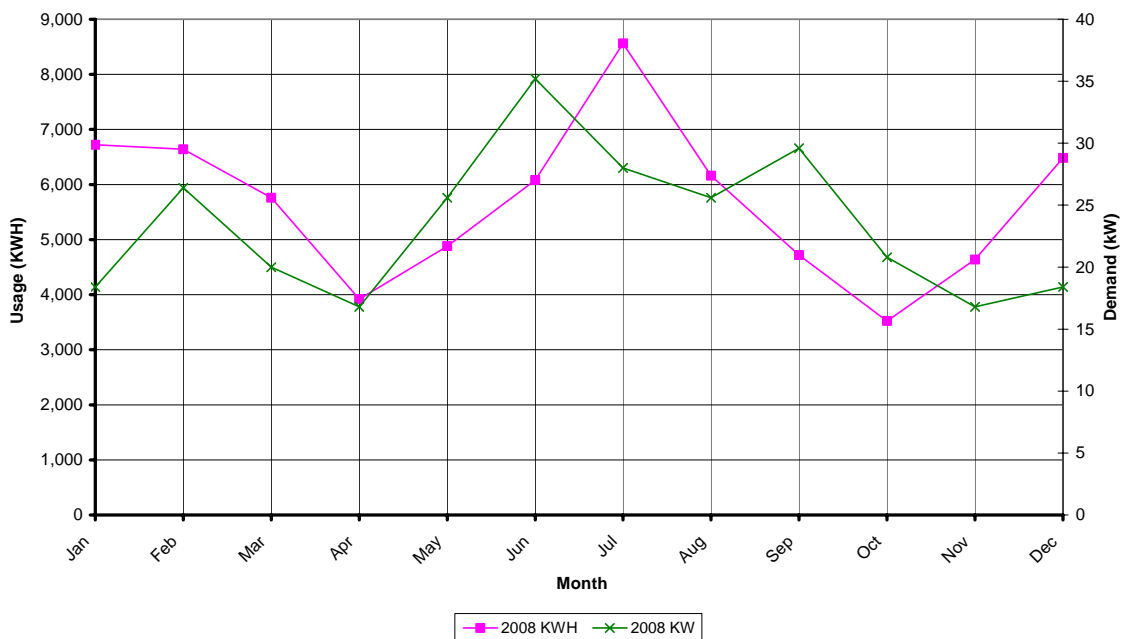
<u>Description</u>	<u>Average</u>
Electricity	17.5¢/kWh
Natural Gas	\$1.46/Therm

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

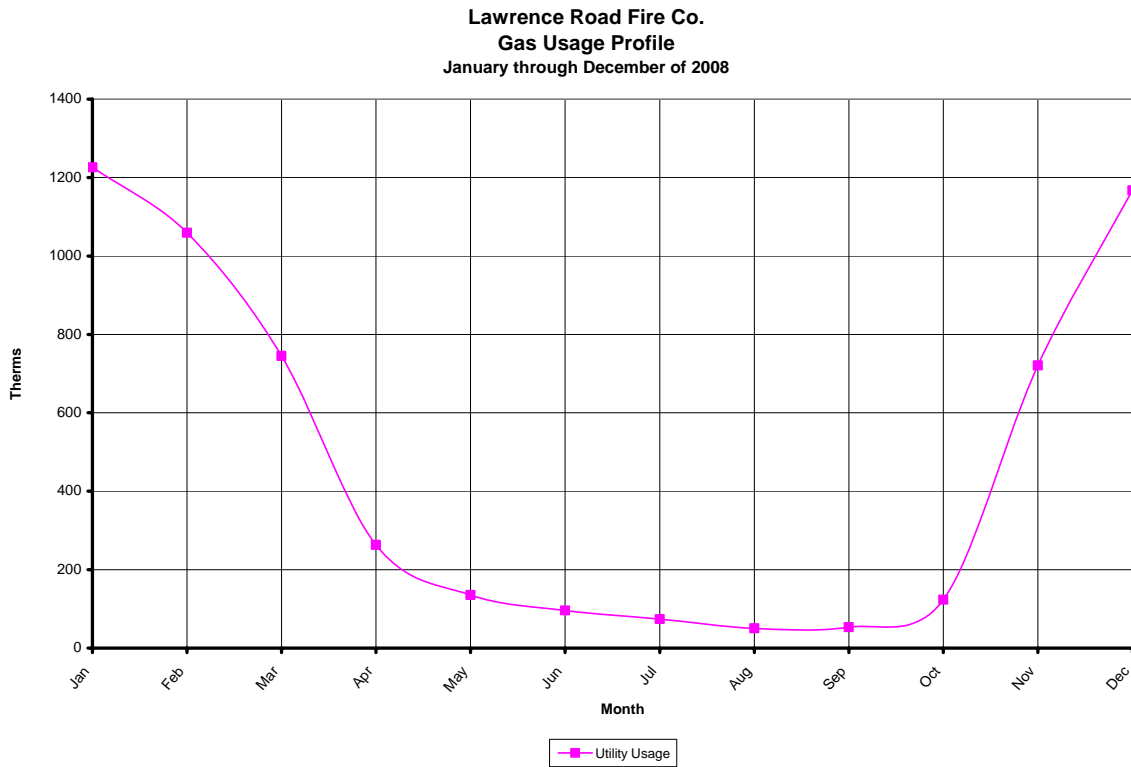
Lawrence Road Fire Co.
Electric Usage Profile
January through December of 2008



**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.

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

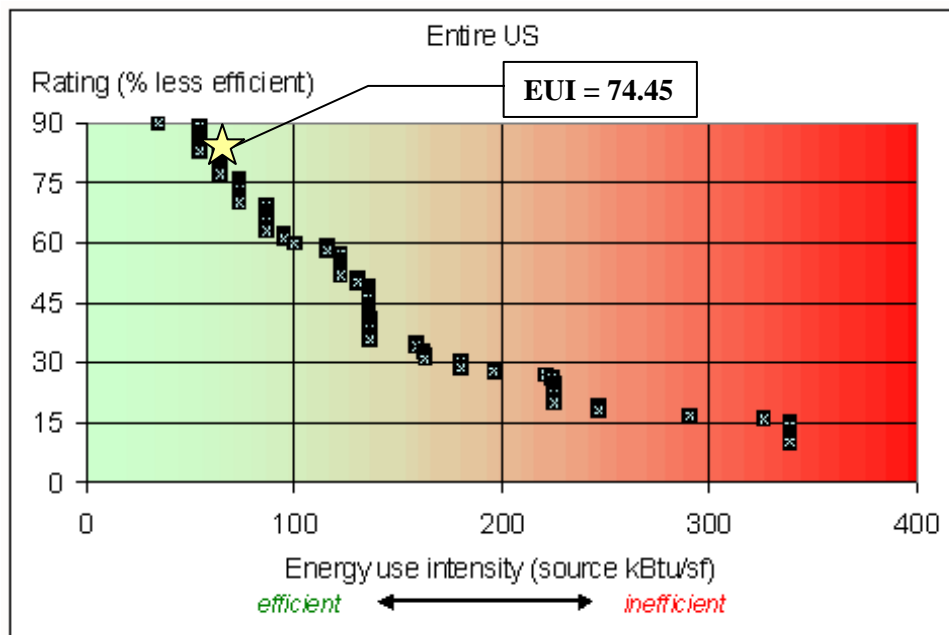
$$\begin{aligned} \text{Electric} &= ((68,080 \text{ kWh}) * (1000 \text{ W/kW}) * (3.414 \text{ Btu/h / 1 W})) / (1000 \text{ Btu/h / 1 kBtu/h}) \\ &= 232,425 \text{ kBtu/h} \end{aligned}$$

$$\text{Gas} = ((5,540 \text{ therms}) * (100,000 \text{ Btu/h / 1 Therm})) / (1000 \text{ Btu/h / 1 kBtu/h}) = 554,000 \text{ kBtu/h}$$

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

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 Star 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 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 facility uses per squarefoot. A low EUI indicates a more efficient building. The facility runs very efficiently for its size do the the low permanent 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.

Electric Cost Summary

PSE&G - MD

Lawrence Road Fire Co.
Account # 62 849 382 6 8
Meter # 728001162

2008

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
Monthly Load Factor	49%	37%	39%	32%	26%	24%	41%	32%	22%	23%	38%	47%	34%
Electric Delivery, \$	\$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
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
Electric Supply, \$	\$868	\$914	\$774	\$555	\$713	\$1,424	\$1,714	\$1,383	\$1,180	\$664	\$765	\$969	\$11,923
Supply \$/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
Total Cost, \$													
\$/KWH													

*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.

Account # 62 849 382 6 8

Meter # 2579612

2008

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	<u>\$750</u>	<u>\$0</u>	<u>\$750</u>
Total Cost			\$750	\$0	\$750
Utility Incentive - NJ Smart Start					<u>(\$200)</u>
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					<u>\$0</u>
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	<u>\$120</u>	<u>\$60</u>	<u>\$180</u>
Total Cost			\$6,360	\$3,180	\$9,540
Utility Incentive - NJ Smart Start (\$73 per ton)					<u>(\$292)</u>
Total Cost Less Incentive					\$9,248

ECM 4 PROGRAMMABLE THERMOSTATS

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



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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
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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
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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	I7285160	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.	Unknown	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	D505BBTAEAG0388-0015	-	Gas Furnace	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. of Fixtures	Fixture eType	Yearly Usage	Wants Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	No. of rFixts	Retro-Unit rDescription	Wants 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	\$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	\$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	\$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	\$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	\$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	\$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	\$0.00	\$140.00	\$0.00	0.00	0	\$0.00	N/A
Totals						7.20	14971.8	\$2,620.07	0			0.00	0	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	<input type="text" value="1"/>	24 Hour Typical Usage Patterns*		
Initial Cost per ENERGY STAR Unit (retail price)	<input type="text" value="\$180"/>		Weekday	Weekend
Initial Cost per Conventional Unit (retail price)	<input type="text" value="\$73"/>		Nighttime Set-Back/Set-Up Hours	<input type="text" value="20"/> <input type="text" value="20"/>
Unit Fuel Cost (Cooling) (\$/kWh)	<input type="text" value="\$0.163"/>		Daytime Set-Back/Set-Up Hours	<input type="text" value="0"/> <input type="text" value="0"/>
Unit Fuel Cost (Heating) (\$/Therm)	<input type="text" value="\$1.49"/>	Hours without Set-Back/Set-Up	<input type="text" value="4"/> <input type="text" value="4"/>	
Choose your city from the drop-down menu		City	<input type="text" value="NJ-Newark"/>	
Heating Season*		Cooling Season*		
Typical Indoor Temperature w/o Set-Back	<input type="text" value="60"/>	Typical Indoor Temperature w/o Set-Up	<input type="text" value="76"/>	
Nighttime Set-Back Temperature (Average)	<input type="text" value="55"/>	Nighttime Set-Up Temperature (Average)	<input type="text" value="85"/>	
Daytime Set-Back Temperature (Average)	<input type="text" value="55"/>	Daytime Set-Up Temperature (Average)	<input type="text" value="76"/>	
Heating System Type	<input type="text" value="Gas Boiler"/>	Cooling System Type	<input type="text" value="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		DOE 2001
Typical Indoor Temperature (Heating Season)	70	1701 ENERGY STAR Programmable Thermostat Eligibility Criteria. Pre-programmed settings for heating include a morning and evening temperature $\leq 70^{\circ}\text{F}$ and an adjustment of at least 8°F ($\leq 62^{\circ}\text{F}$) 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 $\geq 78^{\circ}\text{F}$ and an adjustment of at least 7°F ($\geq 85^{\circ}\text{F}$) during daytime and an adjustment of at least 4°F ($\geq 82^{\circ}\text{F}$) 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
CO₂ 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
Net Project Cost	\$281,554
Percent Financed	70%
Capital Outlay	\$84,466
Financing Principal	\$197,088

System Size (kW) 35.19
Utility Rate (\$/kWh) \$0.1750
Utility Rate Inflation 3.00%
REC Value (\$/kWh) \$0.350
Term (years) 20
Rate 7.0%

Tax Rate 0.0%

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	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	\$0.242
Federal Tax Credit	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Cash effect of depreciation	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$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	\$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	\$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	\$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)	(\$18,604)
Interest expense	(\$13,796)	(\$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	\$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)	(\$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	\$25,767
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	\$17,766	\$18,259	\$18,782	\$19,338	\$19,928	\$20,994	\$21,677	\$22,401	\$23,169	\$23,984	\$24,849	\$25,767	\$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)	(\$10,119)
Net Cash Flow After Taxes	\$12,959	\$13,115	\$13,278	\$13,449	\$13,626	\$14,251	\$14,462	\$14,681	\$14,909	\$15,146	\$15,392	\$15,647	\$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	\$256,915

(\$84,466)


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	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Subtotal	\$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
Avoided Utility Pmnt (from Solar Generation)	\$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
Revenue from REC sale	\$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
Subtotal	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)	(\$18,604)
Finance payment	(\$7,776)	(\$7,018)	(\$6,207)	(\$5,340)	(\$4,411)	(\$3,418)	(\$2,355)	(\$1,217)	\$0	\$0	\$0	\$0	\$0
Interest expense	\$579	\$602	\$626	\$651	\$677	\$704	\$732	\$761	\$792	\$824	\$857	\$891	\$926
Operations & Maintenance	(\$7,198)	(\$6,416)	(\$5,581)	(\$4,689)	(\$3,734)	(\$2,714)	(\$1,622)	(\$456)	\$792	\$824	\$857	\$891	\$926
Subtotal	\$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	\$18,315	\$18,587	\$18,866	\$19,150	\$19,439
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!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#REF!	#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.

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.