
# ENERGY AUDIT – FINAL REPORT

## LAWRENCE TOWNSHIP
## LAWRENCEVILLE FIRE COMPANY
**64 PHILLIPS AVENUE**
**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
Lawrenceville Fire Company
64 Phillips Avenue
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 | $ 17,501 |
| Natural Gas | $ 13,078 |
| Total | $ 30,579 |

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

**Table 1**
**Energy Conservation Measures (ECM's)**

| ECM NO. | DESCRIPTION | COST | ANNUAL SAVINGS | SIMPLE PAYBACK (YEARS) |
|---|---|---|---|---|
| 1 | Lighting Upgrade - Garage/Engine Bay | $3,712 | $593 | 6.3 |
| 2 | Lighting Upgrade – Office/Lounge and Hall | $8,148 | $3,381 | 2.4 |
| 3 | Lighting Controls – Office/Lounge | $990 | $480 | 2.06 |
| 4 | AHU Replacement – Hall Units | $8,900 | $1,624 | 5.48 |
| 5 | A/C Upgrade – Condensing Unit Replacement | $54,732 | $2,671 | 20.5 |
| 6 | Programmable Thermostats | $1,800 | $3,130 | 0.6 |

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

**Table 2**
**Estimated Energy Savings**

| ECM NO. | DESCRIPTION | ANNUAL UTILITY REDUCTION | | |
|---|---|---|---|---|
| | | ELECT DEMAND (KW) | ELECT CONSUMPTION (KWH) | NAT GAS (THERMS) |
| 1 | Lighting Upgrade - Garage/Engine Bay | 1.76 | 3,660 | - |
| 2 | Lighting Upgrade – Office/Lounge and Hall | 10.03 | 20,871 | - |
| 3 | Lighting Controls – Office/Lounge | - | 2,963 | - |
| 4 | AHU Replacement – Hall Units | - | 10,024 | - |
| 5 | A/C Upgrade – Condensing Unit Replacement | - | 16,487 | - |
| 6 | Programmable Thermostats | - | 7,340 | 1,500 |

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 Lawrenceville Fire Company:

**ECM #1:** Lighting Upgrade - Garage/Engine Bay

**ECM #2:** Lighting Upgrade – Office/Lounge and Hall

**ECM #3:** Lighting Controls – Office/Lounge

**ECM #4:** AHU Replacement – Hall Units

**ECM #6:** Programmable Thermostats

# II. INTRODUCTION

This comprehensive energy audit covers the 15,845 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 ED / GLP 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 | 16.2¢/kWh |
| Natural Gas | $1.45/Therm |

**Table 3**
**Electricity Billing Data**

| MONTH OF USE | CONSUMPTION KWH | DEMAND | TOTAL BILL |
|---|---|---|---|
| 1/08 | 11,610 | 28 | $1,438 |
| 2/08 | 9,855 | 26 | $1,275 |
| 3/08 | 7,890 | 25 | $1,029 |
| 4/08 | 6,900 | 24 | $906 |
| 5/08 | 7,770 | 29 | $1,050 |
| 6/08 | 7,500 | 34 | $1,630 |
| 7/08 | 8,895 | 38 | $1,891 |
| 8/08 | 7,575 | 37 | $1,733 |
| 9/08 | 8,265 | 32 | $1,731 |
| 10/08 | 7,890 | 31 | $1,221 |
| 11/08 | 15,180 | 26 | $2,320 |
| 12/08 | 8,910 | 24 | $1,277 |
| **Totals** | **108,240** | **38 Max** | **$17,501** |

**Figure 1**
**Electricity Usage Profile**

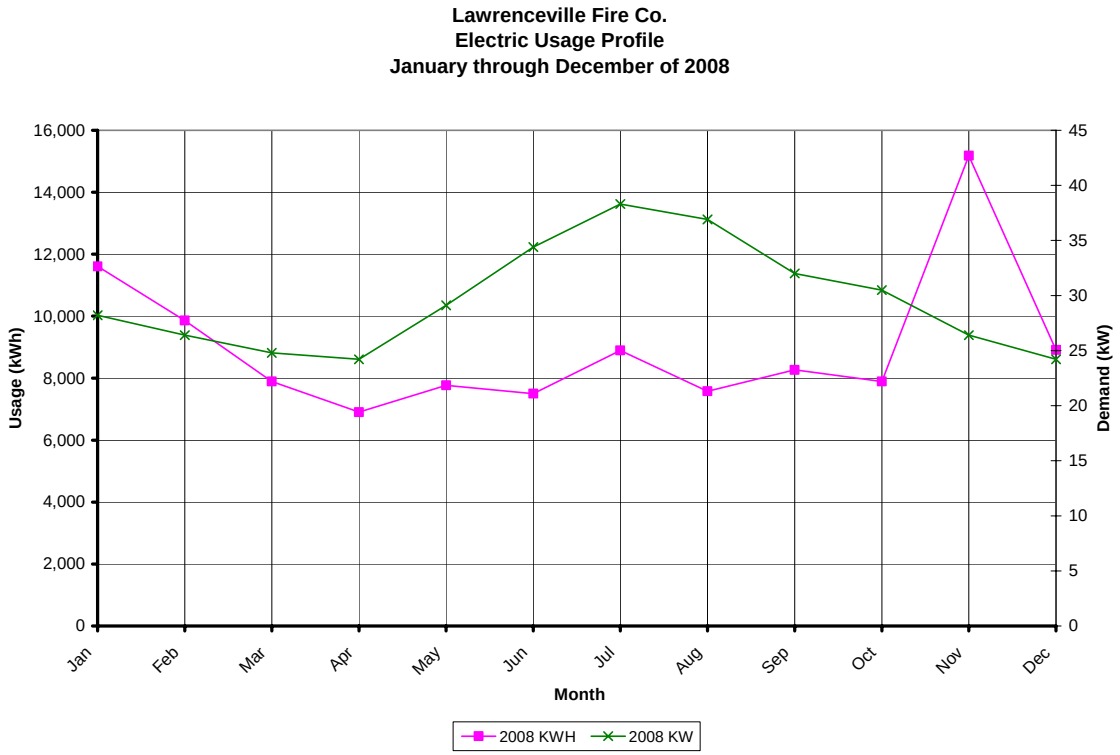
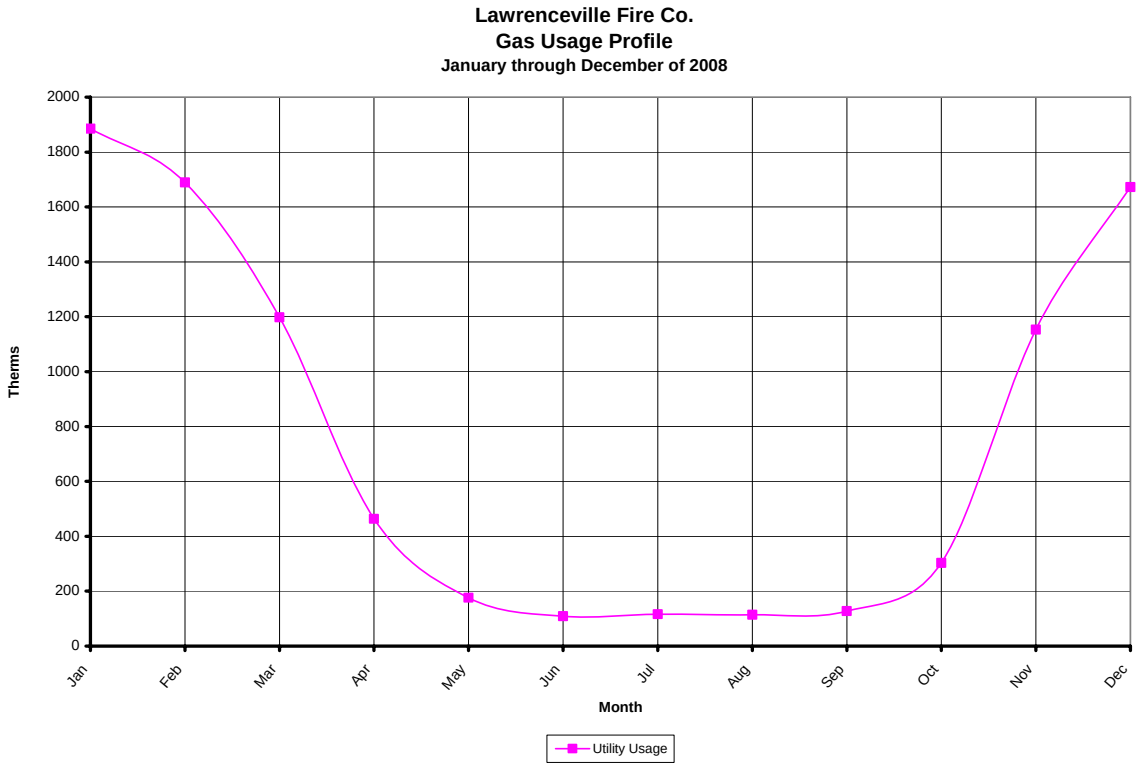


**Table 4**
**Natural Gas Billing Data**

| MONTH OF USE | CONSUMPTION (THERMS) | TOTAL BILL |
|---|---|---|
| 1/08 | 1,885.4 | $2,602 |
| 2/08 | 1,689.7 | $2,496 |
| 3/08 | 1,197.8 | $1,894 |
| 4/08 | 463.3 | $730 |
| 5/08 | 176.2 | $317 |
| 6/08 | 108.4 | $206 |
| 7/08 | 116.0 | $236 |
| 8/08 | 114.3 | $183 |
| 9/08 | 127.7 | $192 |
| 10/08 | 303.2 | $410 |
| 11/08 | 1,153.1 | $1,531 |
| 12/08 | 1,672.1 | $2,280 |
| **Totals** | **9,007** | **$13,078** |

**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.

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

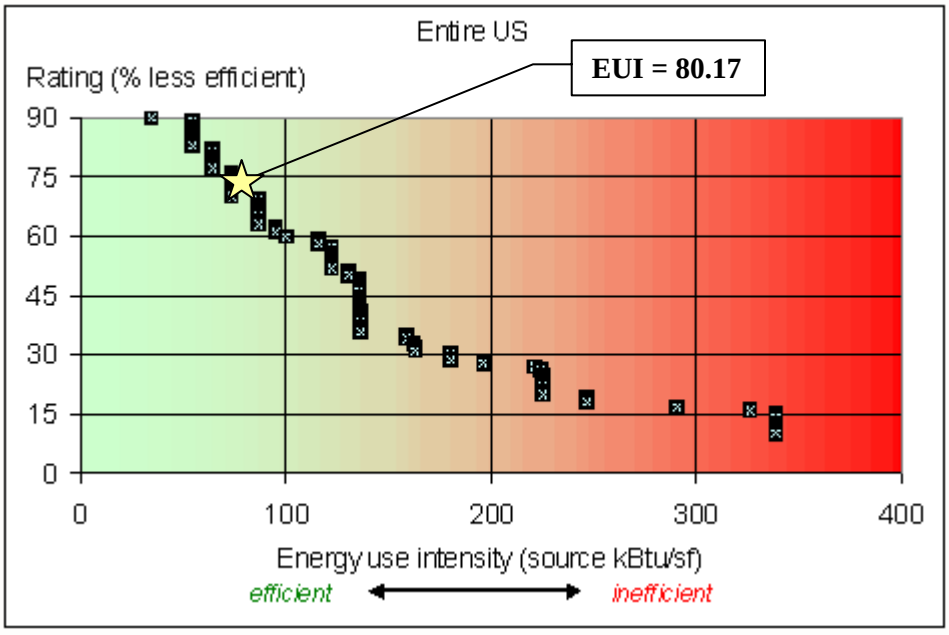
Electric = ((108,240 kWh) * (1000 W/kW) * (3.414 Btu/h / 1 W))/ (1000 Btu/h / 1 kBtu/h)
= 369,531 kBtu/h

Gas = ((9,007 therms) * (100,000 Btu/h / 1 Therm)) / (1000 Btu/h / 1 kBtu/h) = 900,700 kBtu/h

$$Building\ \ EUI = \frac{(369{,}531\ kBtu/h + 900{,}700\ kBtu/h)}{15{,}845\ SF} = \frac{1{,}270{,}231\ kBtu/h}{15{,}845\ SF}$$

Lawrenceville Fire Company EUI = 80.17 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 80.17 which is low for this type of facility. The lower 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 due to the low permanant 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 Lawrenceville Fire Company consists of offices, engine bays, a hall and members lounge and meeting area; totaling approximately 15,845 SF. The engine garage is a metal frame building with well insulated walls and ceiling. The remainder of the building making up the offices, lounge and hall is a two story and constructed of typical brick and block construction. The first section of the facility was built in 1964 with an addition in 1988. The Fire House is normally occupied by a few people for 8 hours a day during the week. Lawrenceville 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 York air handling units with natural gas fired furnaces. Forced hot air is ducted throughout this part of the facility. There are ten (10) of these units in various sizes serving the space. All units are individually ducted to their point of termination.

The engine bay is heated by six (6) Modine Gas fired furnaces that are ceiling mounted. Three of the units have a 200 MBH capacity and three (3) have a 75 MBH capacity.

The hall of the fire house is heated by horizontal York air handling units located above the drop ceiling. These units serve the heating needs in the space with an electric heating element.

Domestic Hot Water

Domestic hot water needs for the facility are provided by a Bradford White 50 gallon hot water heater. This units has an input of 40 MBh.

Cooling System

The two story office and lounge area is cooled by the same York Air handling units that provide heating for the space. These parts of the building are cooled by multiple air handling units that are ducted throughout the facility. There are ten (10) air handling units in various sizes serving the above mentioned space. Each unit has its own condensing unit located on the exterior of the facility.

The engine room is not air conditioned.

The hall of the fire house is cooled by horizontal, York air handling units mounted above the drop ceiling. These air handling units provide all cooling needs for the space. Condensing units are roof mounted on a 1 story roof adjacent to the hall.

Controls System

There are local thermostats located throughout the facility that control the various heating and air conditioning systems. The heating set points were set at 70ºF 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

All areas throughout the facility with the exception of the engine bay are lighted with standard T-12 Fluorescent fixtures. Fixture types vary throughout the facility from 2'x4' lay-in fixtures to standard 1&2-lamp 4' fixtures commonly found in storage areas and stairwells. Standard switching is used throughout; no observation of lighting controls was noted.

The engine bays are lit with 250 watt Metal Halide High Bay fixtures. There are sixteen (16) of these units in the engine bay and would be ideal candidates for T-5 F-Bay lighting. Standard switching is utilized for operation.

# 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 for this facility.

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# VII. ENERGY CONSERVATION MEASURES

## ECM #1: Lighting Upgrade – Garage / Engine Bay

**Description:**

The medium-bay areas which consist of the Engine Bay are poorly lit with a standard Metal Halide system that is plagued by flickering, dim light and distracting humming from the existing ballasts. The existing inefficient lighting system is antiquated and not providing adequate lighting levels for the personnel to work efficiently.

CEG recommends upgrading to an energy-efficient T-5 lighting system that includes new lighting fixtures with electronic ballasts. The T-5 HO (HO meaning High Output) lamps are rated for 30,000 hours versus the 10,000 hours of the Metal Halide lamps so there would be a savings in replacement cost and labor. The operating hours of this portion of the facility are approximately 2080 hours per year. In addition, the T-5 HO lamps have better lighting quality and lumen maintenance.

This measure replaces all the Metal Halide fixtures in the Engine Bay with a well-designed T-5 lighting system.

**Energy Savings Calculations:**

A detailed Investment Grade Lighting Audit can be found in Appendix E, Line No. 1 that outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start® Program Incentives are calculated as follows:

From Appendix C, the replacement of a Metal Halide fixture to a T-5 or T-8 HO fixture warrants the following incentive: $50 per fixture. Actual incentive value may vary pending application review.

$$\text{Smart Start®}\ Incentive = (\#\ of\ \ Metal\ \ Halide\ \ fixtures \times\ \$150)$$

$$\text{Smart Start®}\ Incentive = (16 \times\ \$\ 50) = \$800$$

A detailed maintenance savings calculation can be found in Appendix F. The calculation details the estimated cost of the metal halide system as well as the T5HO system.

**Energy Savings Summary:**

| **ECM #1 - ENERGY SAVINGS SUMMARY** | |
|---|---|
| **Installation Cost ($):** | $4,800 |
| **NJ Smart Start Equipment Incentive ($):** | ($800) |
| **Maintenance Savings ($):** | ($288) |
| **Net Installation Cost ($):** | *$3,712* |
| **Total Energy Savings ($ / yr):** | *$593.05* |
| **Simple Payback (yrs):** | *6.3* |

## ECM #2: Lighting Upgrade – Office / Lounge and Hall

**Description:**

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

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

**Energy Savings Calculations:**

A detailed Investment Grade Lighting Audit can be found in Appendix E that outlines the proposed retrofits, costs, savings, and payback periods. This ECM also includes replacing all incandescent lamps with their compact fluorescent equivalent.

NJ Smart Start® Program Incentives are calculated as follows:

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

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

$$\text{Smart Start®}\ Incentive = (18 \times\ \$\,25) + (80 \times\ \$\,30) = \$2{,}850$$

Maintenance Savings are calculated as follows:

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

$$Maintenance\ Savings\ (3-4\ lamp\ fixtures) = (320 \times 25\%\ reduction \times \$\ 2.00) + (\$20 \times 80) = \$1{,}760$$

$$Maintenance\ Savings\ (1-2\ lamp\ fixtures) = (36 \times 50\%\ reduction \times \$\ 2.00) + (\$20 \times 9) = \$216$$

**Energy Savings Summary:**

| **ECM #2 - ENERGY SAVINGS SUMMARY** | |
|---|---|
| **Installation Cost ($):** | $12,974 |
| **NJ Smart Start Equipment Incentive ($):** | ($2,850) |
| **Maintenance Savings ($):** | ($1,976) |
| **Net Installation Cost ($):** | *$8,148* |
| **Total Energy Savings ($ / yr):** | *$3,381* |
| **Simple Payback (yrs):** | *2.4* |

## ECM #3: Lighting Controls – Office / Lounge

**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 other then the Engine Garage and the Hall. (Approximately 7,922 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 1.80 Watts/SF. Ten percent of this value is the resultant energy savings due to installation of occupancy sensors:

Savings = 10% x 1.80 Watts/SF x 7,922 SF x 2,080 hrs/yr. = 2965 kWh x $0.162/kWh

Savings = $480 / 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 18. Total cost to install sensors is $55/unit x 18 units = $990.

**Energy Savings Summary:**

| **ECM #3 - ENERGY SAVINGS SUMMARY** | |
|---|---|
| **Installation Cost ($):** | $1,350 |
| **NJ Smart Start Equipment Incentive ($):** | ($360) |
| **Maintenance Savings ($):** | ($0) |
| **Net Installation Cost ($):** | *$990* |
| **Total Energy Savings ($ / yr):** | *$480* |
| **Simple Payback (yrs):** | *2.06* |

## ECM #4: AHU Replacement – Hall Units

**Description:**

This ECM will replace the two (2) existing air handling units serving the hall area. The current two (2) York air handling units use an electric heating coil to condition the air in the space. Due to the presence of natural gas on site CEG recommends the replacement of these electric units with gas fired units similar to the units serving the remainder of the facility.

Electric heating elements are technically 100% efficient but due to the high cost of electric these units become incredibly expensive to operate. The prices can be compared on a $/MBtu basis where electricity costs $0.047 /MBtu versus natural gas at $0.0129 /MBtu. The following calculations show the potential energy savings from this ECM.

Replacement of the existing AHU's with York 80 MBH Natural Gas input, 90% + thermal efficiency or equivalent was used for the basis of design.

**Energy Savings Calculations:**

Heating Degree Days = 5,325°F – day/yr.

Total room area to be retrofitted = 5,220 SF (Assuming a 60'x 30' room with a 9' ceiling)

Uavg. = 0.0714 Btu/hr – $ft^2$ - °F (Average U-Value of the walls ceiling and floor)

Annual Energy Savings (Heating) = 24 hrs/day * Room Area * (Uavg) * HDD

Annual Energy Savings (Heating) = 24 hrs/day * 5,220 Sf * (0.0714) * 5,325 HDD

Annual Energy Savings (Heating) = 47,632 MBTu

Electric Heating Cost = 47,632MBTu * $0.047 /MBtu = $2,238

Natural Gas Heating Cost = 47,632MBTu * $0.0129 /MBtu = $614

Heating Savings = $2,238 - $614 = $1,624

**Energy Savings Summary:**

| **ECM #4 - ENERGY SAVINGS SUMMARY** | |
|---|---|
| **Installation Cost ($):** | $9,500 |
| **NJ Smart Start Equipment Incentive ($):** | ($600) |
| **Maintenance Savings ($):** | ($0) |
| **Net Installation Cost ($):** | *$8,900* |
| **Total Energy Savings ($ / yr):** | *$1,624* |
| **Simple Payback (yrs):** | *5.48* |

## ECM #5: Air Conditioning Upgrade – Condensing Units Replacement

**Description:**

Nine (9) of the ten (10) air handling units providing air conditioning for the interior spaces have outdated inefficient condensing units. These units are at the end of their expected service life and are very inefficient. As outlined in Chapter 36 of the 2007 ASHRAE Applications Handbook, the estimated service life for air-cooled condensers and coils is 20 years.

This energy conservation measure would replace the evaporator coil in each air handler unit along with a new high-efficiency condenser unit. Basis of design for replacement is York LX series condensing units and matching cased evaporator coils or equivalent.

**Energy Savings Calculations:**

$$Energy\ Savings = \frac{((Tons\ Cooling \times 12{,}000 BTU\ /\ Ton) \div (1000 Btu)}{(New\ SEER - Old\ SEER)} \times Avg.\ Load\ Factor \times Hrs.\ of\ Cooling \times No.\ of\ Units$$

Existing Condensing Units

Rated Capacity = Various Tonnage See Appendix D
Condenser Unit Efficiency = 9.0 SEER
Cooling Season Hrs. of Operation = 1,800 hrs/yr.

Average Cost of Electricity - $0.162/kWh

Proposed High-Efficiency Condensing Unit

Rated Capacity = Various Tonnage See Appendix D
New Condenser Unit Efficiency = 14.5 SEER

Example For One (1) 4-Ton Unit Replacement

$$Energy\ Savings = \frac{((4\ Tons \times 12{,}000 BTU\ /\ Ton) \div (1000 Btu)}{(14.5\ SEER - 9\ SEER)} \times 0.15 \times 1{,}800 \times 1$$

Cost Savings = 2,356 kWh x $0.162/kWh = $382 / Yr.

Refer to Appendix B for the detailed cost breakdown of all condensing units and their associated installation costs.

**Energy Savings Summary:**

| **ECM #5 - ENERGY SAVINGS SUMMARY** | |
|---|---|
| **Installation Cost ($):** | $56,813 |
| **NJ Smart Start Equipment Incentive ($):** | ($2,081) |
| **Maintenance Savings ($):** | ($0) |
| **Net Installation Cost ($):** | *$54,732* |
| **Total Energy Savings ($ / yr):** | *$2,671* |
| **Simple Payback (yrs):** | *20.5* |

## ECM #6: Programmable Thermostat

**Description:**

Throughout the building there are standard, manual wall thermostats for various HVAC units and local control with adjustable settings on the unit ventilators. These old, pneumatic indoor temperature controls are inaccurate due to temperature drift, age, and not having been re-calibrated. These units also do not have night time setback features.

This energy conservation measure would replace the various HVAC unit thermostats and unit ventilator local controls with programmable 7-day thermostats and night time setback control.

Based on the following setpoints,

| | |
|---|---|
| Occupied Heating = | 70° F |
| Occupied Cooling = | 76° F |
| Unoccupied Heating = | 60° F |
| Unoccupied Cooling = | 85° F |

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

**Energy Savings Calculations:**

The energy savings of a 7-day programmable thermostat was calculated by using Energy Star Life Cycle Cost Estimate software for qualified programmable thermostats. The referenced calculator can be found at www.energystar.gov. Refer to Appendix G for the detailed calculation. CEG recommends the installation of one (1) programmable thermostat per air handling unit, total of ten (10) units.

Calculated energy savings = $313/Unit

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

Simple Payback = 0.6 Years

**Energy Savings Summary:**

| **ECM #6 - ENERGY SAVINGS SUMMARY** | |
|---|---|
| **Installation Cost ($):** | $1,800 |
| **NJ Smart Start Equipment Incentive ($):** | ($0) |
| **Maintenance Savings ($):** | ($0) |
| **Net Installation Cost ($):** | *$1,800* |
| **Total Energy Savings ($ / yr):** | *$3,130* |
| **Simple Payback (yrs):** | *0.6* |

# 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 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). Parking lots can also be utilized for the installation of a solar array. A truss system can be installed that is high enough to park a vehicle under the array, this way no parking lot area is lost. 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 area of the building and its grounds for the building being audited for the purposes of determining the potential for the installation of a PV system. An area of 1,650 S.F. can be utilized for the PV system in the Fire House's parking lot. A depiction of the area utilized is shown in Appendix H. Using this square footage it was determined that a system size of 25 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 44,087 KWh annually, reducing the overall utility bill by 40% percent. A detailed financial analysis can be found in Appendix H. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC's are factored into the payback.

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

# IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY

**Load Profile:**

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

Electricity:

Section IV, Figure 1 demonstrates a typical cooling profile, (June - August), however, there are kilowatt-hour peaks in November and December that represent more hours the facility is being used during these times. The majority of the utility consumption within the facility is steady throughout the year which creates a flat base-load. The base-load shaping is important because a flat consumption profiles will yield more competitive pricing.

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 ED (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**

**Lawrenceville Fire Co.** **2008**

**Account # 62 878 221 5 5**

**Meter # 278005314**

| 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 | 11,610 | 9,855 | 7,890 | 6,900 | 7,770 | 7,500 | 8,895 | 7,575 | 8,265 | 7,890 | 15,180 | 8,910 | 108,240 | |
| KW | 28 | 26 | 25 | 24 | 29 | 34 | 38 | 37 | 32 | 31 | 26 | 24 | 38 | Max |
| Monthly Load Factor | 55% | 56% | 43% | 40% | 36% | 30% | 31% | 28% | 36% | 35% | 80% | 49% | 43% | |
| Electric Delivery, $ | $ 382 | $ 335 | $ 283 | $ 258 | $ 297 | $ 605 | $ 688 | $ 635 | $ 600 | $ 306 | $ 570 | $ 321 | $5,280 | |
| Delivery $/kwh | $0.033 | $0.034 | $0.036 | $0.037 | $0.038 | $0.081 | $0.077 | $0.084 | $0.073 | $0.039 | $0.038 | $0.036 | $0.049 | |
| Electric Supply, $ | $ 1,056 | $ 940 | $ 746 | $ 648 | $ 753 | $ 1,026 | $ 1,203 | $ 1,099 | $ 1,131 | $ 916 | $ 1,750 | $ 955 | $12,221 | |
| Supply $/kwh | $0.091 | $0.095 | $0.095 | $0.094 | $0.097 | $0.137 | $0.135 | $0.145 | $0.137 | $0.116 | $0.115 | $0.107 | $0.113 | |
| Total Cost, $ | $1,438 | $1,275 | $1,029 | $906 | $1,050 | $1,630 | $1,891 | $1,733 | $1,731 | $1,221 | $2,320 | $1,277 | $17,501 | |
| $/KWH | $0.124 | $0.129 | $0.130 | $0.131 | $0.135 | $0.217 | $0.213 | $0.229 | $0.209 | $0.155 | $0.153 | $0.143 | **$0.162** | |

# Summary of Natural Gas Cost

**PSE&G - GSGH Multi Family**

**Lawrenceville Fire Co.** **2008**

**Account # 62 878 221 5 5**

**Meter # 2597634**

| 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 | 1,829 | 1,640 | 1,162 | 449 | 171 | 105 | 112 | 110 | 123 | 293 | 1,115 | 1,620 | 8,732 |
| 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) | 1885.4 | 1689.7 | 1197.8 | 463.3 | 176.2 | 108.4 | 116.0 | 114.3 | 127.7 | 303.2 | 1153.1 | 1672.1 | 9007.0 |
| Total Distribution Cost | $745 | $668 | $473 | $149 | $63 | $42 | $45 | $44 | $48 | $101 | $461 | $674 | 3,514 |
| Cost per Therm | $0.395 | $0.395 | $0.395 | $0.321 | $0.356 | $0.392 | $0.386 | $0.387 | $0.378 | $37.340 | $0.400 | $0.403 | $0.390 |
| Total Commodity Cost | $1,857 | $1,827 | $1,421 | $581 | $254 | $164 | $191 | $139 | $144 | $309 | $1,070 | $1,606 | 9,564 |
| Cost per Therm | $0.98 | $1.08 | $1.19 | $1.25 | $1.44 | $1.51 | $1.64 | $1.22 | $1.13 | $1.02 | $0.93 | $0.96 | $1.06 |
| Total Cost | $2,602 | $2,496 | $1,894 | $730 | $317 | $206 | $236 | $183 | $192 | $410 | $1,531 | $2,280 | $13,078 |
| Cost per Therm | $1.380 | $1.477 | $1.581 | $1.576 | $1.798 | $1.901 | $2.029 | $1.606 | $1.507 | $1.354 | $1.328 | $1.364 | **$1.452** |

.= Utility Information Not Provided

# DETAILED COST BREAKDOWN PER ECM

CONCORD ENGINEERING GROUP

## LAWRENCEVILLE TOWNSHIP FIRE COMPANY

### ECM 1 LIGHTING UPGRADE - GARAGE / ENGINE BAY AREA

| | Qty | Unit Cost $ | Material $ | Labor $ | Total $ |
|---|---|---|---|---|---|
| Lighting Retrofit | 16 | $300 | $200 | $100 | $4,800 |
| Total Cost | | | $200 | $100 | $4,800 |
| Utility Incentive - NJ Smart Start ($50 per fixture) | | | | | ($800) |
| Total Cost Less Incentive | | | | | $4,000 |

### ECM 2 LIGHTING UPGRADE - OFFICE/LOUNGE AREA

| | Qty | Unit Cost $ | Material $ | Labor $ | Total $ |
|---|---|---|---|---|---|
| Lighting Retrofit | 153 | - | $0 | $0 | $12,974 |
| Total Cost | | | $0 | $0 | $12,974 |
| Utility Incentive - NJ Smart Start ($25 per 1-2 lamp fixture; $30 per 3-4 lamp fixture) | | | | | ($2,850) |
| Total Cost Less Incentive | | | | | $10,124 |

* See Appendix E for detailed cost per fixture type.

### ECM 3 LIGHTING CONTROLS - OFFICE/LOUNGE AREA

| | Qty | Unit Cost $ | Material $ | Labor $ | Total $ |
|---|---|---|---|---|---|
| Dual - Technology Sensor | 18 | $75 | $1,350 | $0 | $1,350 |
| Total Cost | | | $1,350 | $0 | $1,350 |
| Utility Incentive - NJ Smart Start | | | | | ($360) |
| Total Cost Less Incentive ($20 per Sensor) | | | | | $990 |

### ECM 4 AHU REPLACEMENT - HALL UNITS

| | Qty | Unit Cost $ | Material $ | Labor $ | Total $ |
|---|---|---|---|---|---|
| Demolish Exist Furnace; Typ. 2 | 2 | $300 | $0 | $600 | $600 |
| New Sealed Combustion Hi-Eff Furnace; | 2 | $2,850 | $3,800 | $1,900 | $5,700 |
| York 80 MBH input, 90%+ Efficiency | | | | | |
| New Gas Piping (Est. 150 Ft) | LS | $2,000 | $1,000 | $1,000 | $2,000 |
| PVC Combustion Air & Vent Piping | 2 | $600 | $900 | $300 | $1,200 |
| Total Cost | | | $5,700 | $3,800 | $9,500 |
| Utility Incentive - NJ Smart Start ($300 per Furnace) | | | | | ($600) |
| Total Cost Less Incentive | | | | | $8,900 |

*Gas Piping is assumed to be routed from Kitchen gas piping

**ECM 5 AIR CONDITIONING UPGRADE - CONDENSING UNITS AND EVAPORATOR COILS**

| | Qty | Unit Cost $ | Material $ | Labor $ | Total $ |
|---|---|---|---|---|---|
| Demolish Exist Evap Coil; Typ. 9 | 9 | $65 | $0 | $585 | $585 |
| Demolish Exist Refrig Piping; Typ. 9 | 9 | $200 | $0 | $1,800 | $1,800 |
| New Evap Coil, Condensing Unit; York LX Series 14.5 SEER R-410a 2-Ton | 2 | $3,525 | $2,350 | $1,175 | $7,050 |
| New Evap Coil, Condensing Unit; York LX Series 14.5 SEER R-410a 2.5-Ton | 1 | $3,788 | $2,525 | $1,263 | $3,788 |
| New Evap Coil, Condensing Unit; York LX Series 14.5 SEER R-410a 3-Ton | 2 | $5,115 | $3,410 | $1,705 | $10,230 |
| New Evap Coil, Condensing Unit; York LX Series 14.5 SEER R-410a 4-Ton | 4 | $5,190 | $3,460 | $1,730 | $20,760 |
| New Refrigerant Line Sets (Est. 150 Ft) | 9 | $1,310 | $6,120 | $5,670 | $11,790 |
| Condensing Unit Pads | 9 | $90 | $540 | $270 | $810 |
| Total Cost | | | $18,405 | $14,198 | $56,813 |
| Utility Incentive - NJ Smart Start ($73 per ton) | | | | | ($2,081) |
| Total Cost Less Incentive | | | | | $54,732 |

**ECM 6 PROGRAMMABLE THERMOSTATS**

| | Qty | Unit Cost $ | Material $ | Labor $ | Total $ |
|---|---|---|---|---|---|
| Programable T-stat | 10 | $120 | $1,200 | $600 | $1,800 |
| Total Cost | | | $1,200 | $600 | $1,800 |
| Utility Incentive - N/A | | | | | $0 |
| Total Cost Less Incentive | | | | | $1,800 |

# 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

### Lawrenceville Fire Company

## Domestic Hot Water Heater

| Location | Manufacturer | Qty. | Model # | Serial # | Input (MBh) | Recovery (gal/h) | Capacity (gal) | Efficiency (%) | Fuel | Approx. Age | ASHRAE Service Life | Remaining Life |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lawrenceville | Bradford White | 1 | MI5036FBN | - | 40 | 43 | 50 | 80% | Nat. Gas | 10 | 12 | 2 |

## Air Handling Units

| Location | Manufacturer | Qty. | Model # | Serial # | Cooling Coil | Heating Coil | Input (MBh) | Output (MBh) | Fan HP | Fan RPM | Volts | Phase | Approx. Age | ASHRAE Service Life | Remaining Life |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lawrenceville | York | 1 | P3UGD12N06501B | EFVM200890 | DX | Gas Furnace | 85 | 66.3 | - | 1075 | 208-230 | 1 | 15 | 18 | 3 |
| Lawrenceville | York | 1 | P3CGD12N08001B | EGVM258156 | DX | Gas Furnace | 80 | 62.4 | - | 1075 | 208-230 | 1 | 15 | 18 | 3 |
| Lawrenceville | York | 1 | P3UGD12N10501B | ENTM428335 | DX | Gas Furnace | 105 | 81.9 | - | 1075 | 208-230 | 1 | 15 | 18 | 3 |
| Lawrenceville | York | 3 | P3UGD16N10501B | EFVM207620 | DX | Gas Furnace | 105 | 81.9 | - | 1075 | 208-230 | 1 | 15 | 18 | 3 |
| Lawrenceville | York | 2 | N2AHD16A06C | MCX5142251 | DX | Electric | | - | - | 1075 | 208-230 | 1 | 15 | 18 | 3 |
| Lawrenceville | York | 1 | P3UGD12N06501B | EFUM200891 | DX | Gas Furnace | 65 | 50.7 | - | 1075 | 208-230 | 1 | 15 | 18 | 3 |
| Lawrenceville | York | 1 | D2YS024N4506A | ENWM598964 | DX R-22 | Gas Furnace | 55 | 45 | - | 1075 | 208-230 | 1 | 15 | 18 | 3 |

## AC Condensers

| Location | Manufacturer | Qty. | Model # | Serial # | Cooling Capacity | Eff. | Refrigerant | Volts | Phase | Amps | Approx. Age | ASHRAE Service Life | Remaining Life |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lawrenceville | York | 1 | H2CB048S25A | MDXM153666 | 4 Ton | 9.0 SEER | R-22 | - | - | - | 15 | 20 | 5 |
| Lawrenceville | York | 1 | No Name Plate | - | 2 Ton | 9.0 SEER | R-22 | - | - | - | 15 | 20 | 5 |
| Lawrenceville | Heil | 1 | H2A3486KA100 | E062516538 | 4 Ton | 13 SEER | R-22 | - | - | - | 3 | 20 | 17 |
| Lawrenceville | York | 1 | H1C8030506C | MHUM379403 | 2.5 Ton | 9.0 SEER | R-22 | - | - | - | 15 | 20 | 5 |
| Lawrenceville | York | 3 | A2C8048064 | - | 4 Ton | 9.0 SEER | R-22 | - | - | - | 15 | 20 | 5 |
| Lawrenceville | York | 2 | H26B036508A | - | 3 Ton | 9.0 SEER | R-22 | - | - | - | 15 | 20 | 5 |
| Lawrenceville | York | 1 | No Name Plate | - | 1.5 Ton | 9.0 SEER | R-22 | - | - | - | 15 | 20 | 5 |

## Unit Heaters

| Location | Manufacturer | Qty. | Model # | Serial # | Input (MBh) | Output (MBh) | Vintage | Efficiency (%) | Fuel | Approx. Age | ASHRAE Service Life | Remaining Life |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lawrenceville | Modine | 3 | 15012910900 | - | 200 | 152 | 1988 | 76% | Nat. Gas | 24 | 18 | 6 |
| Lawrenceville | Modine | 3 | 330112010588 | - | 75 | 57.75 | 1988 | 77% | Nat. Gas | 24 | 18 | 6 |

# INVESTMENT GRADE LIGHTING AUDIT

## CONCORD ENERGY SERVICES

**CEG Job #:** 9C08127
**Project:** Lawrence Twp. Energy Audit
**Address:** 64 Phillips Ave.
**City:** Lawrence Twp.
**Building SF:** 15,845

**"Lawrenceville Fire Company"**

**DATE: 05/20/2009**
**KWH COST:** $0.162

| 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 | 16 | High-Bay Metal Halide Fixture | 2080 | 292 | 4.67 | 9717.76 | $1,574.28 | 16 | 3-Lamp T-5 HO Cooper F-Bay | 182 | 2.91 | 6056.96 | $981.23 | $300.00 | $4,800.00 | 1.76 | 3660.8 | $593.05 | 8.09 |
| 2 | | Equipment Mez. | 4 | 8' 2-LampT-12 No Lens Magnetic Ballast | 2080 | 210 | 0.84 | 1747.2 | $283.05 | 8 | 4' 1-Lamp T-8 Cooper Metalux, Electronic Ballast | 30 | 0.24 | 499.2 | $80.87 | $100.00 | $800.00 | 0.60 | 1248 | $202.18 | 3.96 |
| 3 | | Engine Bay Storage | 5 | 4' 2-Lamp T-12 No Lens Magnetic Ballast | 2080 | 78 | 0.39 | 811.2 | $131.41 | 5 | 4' 1-Lamp T-8 Cooper Metalux, Electronic Ballast | 30 | 0.15 | 312 | $50.54 | $100.00 | $500.00 | 0.24 | 499.2 | $80.87 | 6.18 |
| 4 | | Stairs | 3 | 4' 2-Lamp T-12 No Lens Magnetic Ballast | 2080 | 78 | 0.23 | 486.72 | $78.85 | 3 | 4' 1-Lamp T-8 Cooper Metalux, Electronic Ballast | 30 | 0.09 | 187.2 | $30.33 | $100.00 | $300.00 | 0.14 | 299.52 | $48.52 | 6.18 |
| 5 | | | 1 | 8' 2-LampT-12 No Lens Magnetic Ballast | 2080 | 210 | 0.21 | 436.8 | $70.76 | 2 | 4' 1-Lamp T-8 Cooper Metalux, Electronic Ballast | 30 | 0.06 | 124.8 | $20.22 | $100.00 | $200.00 | 0.15 | 312 | $50.54 | 3.96 |
| 6 | | Hall | 12 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 1.85 | 3843.84 | $622.70 | 12 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 1.09 | 2271.36 | $367.96 | $140.00 | $1,680.00 | 0.76 | 1572.48 | $254.74 | 6.59 |
| 7 | | | 25 | 120 W Incandescent High-hat | 2080 | 120 | 3.00 | 6240 | $1,010.88 | 25 | 30 W CFL Lamp | 30 | 0.75 | 1560 | $252.72 | $4.88 | $122.00 | 2.25 | 4680 | $758.16 | 0.16 |
| 8 | | Coat Room | 5 | 75 W Incandescent High-hat | 2080 | 75 | 0.38 | 780 | $126.36 | 5 | 18 W CFL Lamp | 18 | 0.09 | 187.2 | $30.33 | $3.75 | $18.75 | 0.29 | 592.8 | $96.03 | 0.20 |
| 9 | | Men's Room | 3 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.46 | 960.96 | $155.68 | 3 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.27 | 567.84 | $91.99 | $140.00 | $420.00 | 0.19 | 393.12 | $63.69 | 6.59 |
| 10 | | Women's Room | 3 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.46 | 960.96 | $155.68 | 3 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.27 | 567.84 | $91.99 | $140.00 | $420.00 | 0.19 | 393.12 | $63.69 | 6.59 |
| 11 | | Kitchen | 4 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.62 | 1281.28 | $207.57 | 4 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.36 | 757.12 | $122.65 | $140.00 | $560.00 | 0.25 | 524.16 | $84.91 | 6.59 |
| | | Area Behind Hall | 9 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 1.39 | 2882.88 | $467.03 | 9 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.82 | 1703.52 | $275.97 | $140.00 | $1,260.00 | 0.57 | 1179.36 | $191.06 | 6.59 |
| 12 | | Entrance and Stairs | 2 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.31 | 640.64 | $103.78 | 2 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.18 | 378.56 | $61.33 | $140.00 | $280.00 | 0.13 | 262.08 | $42.46 | 6.59 |
| | | Laundry | 4 | 60 W Incandescent | 2080 | 60 | 0.24 | 499.2 | $80.87 | 4 | 13 W CFL Lamp | 13 | 0.05 | 108.16 | $17.52 | $2.92 | $11.68 | 0.19 | 391.04 | $63.35 | 0.18 |

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13 | | Game room | 15 | 75 W Incandescent High-hat | 2080 | 75 | 1.13 | 2340 | $379.08 | 15 | 18 W CFL Lamp | 18 | 0.27 | 561.6 | $90.98 | $3.75 | $56.25 | 0.86 | 1778.4 | $288.10 | 0.20 |
| 14 | | Meeting Room | 6 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.92 | 1921.92 | $311.35 | 6 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.55 | 1135.68 | $183.98 | $140.00 | $840.00 | 0.38 | 786.24 | $127.37 | 6.59 |
| 15 | | Hallway | 10 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 1.54 | 3203.2 | $518.92 | 10 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.91 | 1892.8 | $306.63 | $140.00 | $1,400.00 | 0.63 | 1310.4 | $212.28 | 6.59 |
| 16 | | Office 1 | 2 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.31 | 640.64 | $103.78 | 2 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.18 | 378.56 | $61.33 | $140.00 | $280.00 | 0.13 | 262.08 | $42.46 | 6.59 |
| 17 | | Office 2 | 2 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.31 | 640.64 | $103.78 | 2 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.18 | 378.56 | $61.33 | $140.00 | $280.00 | 0.13 | 262.08 | $42.46 | 6.59 |
| 18 | | Office 3 | 2 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.31 | 640.64 | $103.78 | 2 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.18 | 378.56 | $61.33 | $14.00 | $28.00 | 0.13 | 262.08 | $42.46 | 0.66 |
| 19 | | Chief's Office | 4 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.62 | 1281.28 | $207.57 | 4 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.36 | 757.12 | $122.65 | $140.00 | $560.00 | 0.25 | 524.16 | $84.91 | 6.59 |
| 20 | | Weight Room | 9 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 1.39 | 2882.88 | $467.03 | 9 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.82 | 1703.52 | $275.97 | $140.00 | $1,260.00 | 0.57 | 1179.36 | $191.06 | 6.59 |
| 21 | | Men's Room | 2 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.31 | 640.64 | $103.78 | 2 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.18 | 378.56 | $61.33 | $140.00 | $280.00 | 0.13 | 262.08 | $42.46 | 6.59 |
| 22 | | Women's Room | 2 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.31 | 640.64 | $103.78 | 2 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.18 | 378.56 | $61.33 | $140.00 | $280.00 | 0.13 | 262.08 | $42.46 | 6.59 |
| 23 | | Bunk Room | 6 | 60 W Incandescent | 2080 | 60 | 0.36 | 748.8 | $121.31 | 6 | 13 W CFL Lamp | 13 | 0.08 | 162.24 | $26.28 | $2.92 | $17.52 | 0.28 | 586.56 | $95.02 | 0.18 |
| 24 | | Break Room | 4 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.62 | 1281.28 | $207.57 | 4 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.36 | 757.12 | $122.65 | $140.00 | $560.00 | 0.25 | 524.16 | $84.91 | 6.59 |
| 25 | | Radio Room | 4 | 2'x4' 4-Lamp T-12 Prism Lens Magnetic Ballast | 2080 | 154 | 0.62 | 1281.28 | $207.57 | 4 | 2'x4' 3-Lamp T-8 Prism Lens Electronic Ballast Cooper Metalux | 91 | 0.36 | 757.12 | $122.65 | $140.00 | $560.00 | 0.25 | 524.16 | $84.91 | 6.59 |
| | | | | | | | | | | | | | | | | | | | | | |
| | | **Totals** | 164 | | | | 23.77 | 49433.3 | $8,008.19 | 169 | | | 11.97 | 24901.8 | $4,034.09 | | $17,774.20 | 11.79 | 24531.5 | $3,974.11 | 4.47 |

Insert Logo Here

# Annual Maintenance Cost Estimator: Existing System

Input
Output

## Customer Information

Project Name:
Lawrenceville Fire Company

Contact:
Chris Cipriani

## Facility Information

| | |
|---|---|
| Annual Operating Hours | 2,080 |

## System Information

| | | |
|---|---|---|
| Description of System | | Existing Metal Halide System |
| Quantity | | 16 |
| Type of Lamp | | HID, 250W MH |
| Lamp Life (hrs) | | 10000 |
| Cost of Lamp | $ | 22.44 |
| Number of Lamps Per Fixture | | 1 |
| Labor Cost to Spot Relamp per Lamp | $ | 95.00 |
| Annual Lamp Maintenance Cost | $ | 352.32 |
| Quantity of Lamps Replaced Annually | | 3 |
| Ballast Type | | Electronic HID |
| Ballast Life (hrs) | | 80000 |
| Cost of Ballast | $ | 80.00 |
| Number of Ballasts Per Fixture | | 1 |
| Labor Cost Change a Ballast | $ | 150.00 |
| Annual Ballast Maintenance Cost | | 0 |
| Quantity of Ballasts Replaced Annually | | 0 |
| Annual Maintenance Cost of System | $ | 352.32 |

Note: These are estimated savings only based on a number of variables and assumptions that could change over time. The actual savings derived may be higher or lower.

Insert Logo Here

# Annual Maintenance Cost Estimator: Existing System

Input
Output

| Customer Information | | Facility Information | |
|---|---|---|---|
| Project Name: Lawrenceville Fire Company | | | |
| Contact: Chris Cipriani | | Annual Operating Hours | 2,080 |

| System Information | | |
|---|---|---|
| Description of System | | T5HO Replacement |
| Quantity | | 16 |
| Type of Lamp | | Fluorescent, T5 HO |
| Lamp Life (hrs) | | 30000 |
| Cost of Lamp | $ | 6.20 |
| Number of Lamps Per Fixture | | 3 |
| Labor Cost to Spot Relamp per Lamp | $ | 35.00 |
| Annual Lamp Maintenance Cost | $ | 123.60 |
| Quantity of Lamps Replaced Annually | | 3 |
| Ballast Type | | Instant Start LPF |
| Ballast Life (hrs) | | 80000 |
| Cost of Ballast | $ | 25.00 |
| Number of Ballasts Per Fixture | | 1 |
| Labor Cost Change a Ballast | $ | 150.00 |
| Annual Ballast Maintenance Cost | | 0 |
| Quantity of Ballasts Replaced Annually | | 0 |
| Annual Maintenance Cost of System | $ | 123.60 |

Note: These are estimated savings only based on a number of variables and assumptions that could change over time. The actual savings derived may be higher or lower.

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) | $0.162 |
| Unit Fuel Cost (Heating) ($/Therm) | $1.29 |

**24 Hour Typical Usage Patterns***

| | Weekday | Weekend |
|---|---|---|
| Nighttime Set-Back/Set-Up Hours | 16 | 24 |
| Daytime Set-Back/Set-Up Hours | 0 | 0 |
| Hours without Set-Back/Set-Up | 8 | 0 |

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

**Heating Season***

| | |
|---|---|
| Typical Indoor Temperature w/o Set-Back | 70 |
| Nighttime Set-Back Temperature (Average) | 60 |
| Daytime Set-Back Temperature (Average) | 60 |
| 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) | 85 |
| Cooling System Type | Central AC |

**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 | $653 | $847 | $194 |
| *Heating Energy Consumption (MBTU)* | *51* | *66* | *15* |
| Cooling Energy Cost | $206 | $325 | $119 |
| *Cooling Energy Consumption (MBTU)* | *4.3* | *6.8* | *3* |
| **Total** | **$859** | **$1,172** | **$313** |
| **Life Cycle Costs** | | | |
| Energy Costs | $9,549 | $13,029 | $3,480 |
| Heating Energy Costs | *$7,262* | *$9,414* | *$2,152* |
| *Heating Energy Consumption (MBTU)* | 758 | 983 | 225 |
| Cooling Energy Costs | $2,287 | $3,615 | $1,328 |
| *Cooling Energy Consumption (MBTU)* | 65 | 102 | 38 |
| Purchase Price for 1 Unit(s) | *$180* | *$73* | *-$107* |
| **Total** | **$9,729** | **$13,102** | **$3,373** |
| | | Simple payback of initial cost (years) | **0.3** |

## Summary of Benefits for 1 Programmable Thermostat(s)

| | |
|---|---|
| Initial cost difference | **$107** |
| Life cycle savings | **$3,480** |
| Net life cycle savings (life cycle savings - additional cost) | **$3,373** |
| Life cycle energy saved (MBTU)-includes both Heating and Cooling | **262** |
| Simple payback of additional cost (years) | **0.3** |
| Life cycle air pollution reduction (lbs of $CO_2$) | **37,348** |
| Air pollution reduction equivalence (number of cars removed from the road for a year) | **3** |
| Air pollution reduction equivalence (acres of forest) | **4** |
| Savings as a percent of retail price | **1874%** |

## 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). |

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

| | | | | | |
|---|---|---|---|---|---|
| Total Project Cost | $206,473 | System Size (kW) | 25.81 | Tax Rate | 0.0% |
| | | Utility Rate ($/kWh) | $0.1750 | | |
| Net Project Cost | $206,473 | Utility Rate Inflation | 3.00% | | |
| Percent Financed | **70%** | REC Value ($/kWh) | $0.350 | | |
| Capital Outlay | $61,942 | Term (years) | **20** | | |
| Financing Principal | $144,531 | Rate | **7.0%** | | |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar Generation (kWh) | | 44,087 | 43,867 | 43,647 | 43,429 | 43,212 | 42,996 | 42,781 | 42,567 | 42,354 | 42,142 | 41,932 | 41,722 |
| 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) | | $7,715 | $7,907 | $8,103 | $8,305 | $8,511 | $8,723 | $8,939 | $9,162 | $9,389 | $9,623 | $9,862 | $10,107 |
| Revenue from REC Sale | | $15,430 | $15,353 | $15,277 | $15,200 | $15,124 | $15,049 | $14,973 | $14,898 | $14,824 | $14,750 | $14,676 | $14,603 |
| Subtotal | | $23,146 | $23,260 | $23,380 | $23,505 | $23,635 | $23,771 | $23,913 | $24,060 | $24,213 | $24,372 | $24,538 | $24,709 |
| Finance payment | | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) |
| Interest expense | | ($10,117) | ($9,870) | ($9,606) | ($9,324) | ($9,021) | ($8,698) | ($8,352) | ($7,981) | ($7,585) | ($7,161) | ($6,707) | ($6,222) |
| Operations & Maintenance | | $0 | $0 | $0 | $0 | $0 | $322 | $335 | $349 | $363 | $377 | $392 | $408 |
| Subtotal | | ($10,117) | ($9,870) | ($9,606) | ($9,324) | ($9,021) | ($8,375) | ($8,016) | ($7,633) | ($7,222) | ($6,784) | ($6,315) | ($5,814) |
| Net Savings | | $13,029 | $13,390 | $13,774 | $14,181 | $14,614 | $15,396 | $15,896 | $16,427 | $16,991 | $17,589 | $18,223 | $18,896 |
| 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 | | $13,029 | $13,390 | $13,774 | $14,181 | $14,614 | $15,396 | $15,896 | $16,427 | $16,991 | $17,589 | $18,223 | $18,896 |
| Principal Payment | | ($3,526) | ($3,772) | ($4,036) | ($4,319) | ($4,621) | ($4,945) | ($5,291) | ($5,661) | ($6,058) | ($6,482) | ($6,935) | ($7,421) |
| Net Cash Flow After Taxes | ($61,942) | $9,503 | $9,618 | $9,737 | $9,862 | $9,993 | $10,451 | $10,605 | $10,766 | $10,933 | $11,107 | $11,287 | $11,475 |
| Cumulative savings before taxes | | $13,029 | $26,418 | $40,192 | $54,373 | $68,987 | $84,383 | $100,279 | $116,707 | $133,698 | $151,286 | $169,509 | $188,404 |

| Year | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar Generation (kWh) | 41,513 | 41,306 | 41,099 | 40,894 | 40,689 | 40,486 | 40,283 | 40,082 | 39,882 | 39,682 | 39,484 | 39,286 | 39,090 |
| 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) | $10,358 | $10,615 | $10,879 | $11,149 | $11,427 | $11,710 | $12,001 | $12,300 | $12,605 | $12,919 | $13,240 | $13,569 | $13,906 |
| Revenue from REC sale | $14,530 | $14,457 | $14,385 | $14,313 | $14,241 | $14,170 | $14,099 | $14,029 | $13,959 | $13,889 | $13,819 | $13,750 | $13,681 |
| Subtotal | $24,888 | $25,072 | $25,264 | $25,462 | $25,668 | $25,881 | $26,101 | $26,328 | $26,564 | $26,807 | $27,059 | $27,319 | $27,587 |
| Finance payment | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | ($13,643) | $0 | $0 | $0 | $0 | $0 |
| Interest expense | ($5,703) | ($5,147) | ($4,552) | ($3,916) | ($3,235) | ($2,506) | ($1,727) | ($893) | $0 | $0 | $0 | $0 | $0 |
| Operations & Maintenance | $424 | $441 | $459 | $477 | $496 | $516 | $537 | $558 | $581 | $604 | $628 | $653 | $679 |
| Subtotal | ($5,278) | ($4,705) | ($4,093) | ($3,438) | ($2,738) | ($1,990) | ($1,190) | ($334) | $581 | $604 | $628 | $653 | $679 |
| Net Savings | $19,609 | $20,367 | $21,171 | $22,024 | $22,929 | $23,891 | $24,911 | $25,994 | $27,145 | $27,411 | $27,687 | $27,972 | $28,267 |
| 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 | $19,609 | $20,367 | $21,171 | $22,024 | $22,929 | $23,891 | $24,911 | $25,994 | $27,145 | $27,411 | $27,687 | $27,972 | $28,267 |
| Principal Payment | ($7,940) | ($8,496) | ($9,091) | ($9,727) | ($10,408) | ($11,137) | ($11,916) | ($12,750) | $0 | $0 | $0 | $0 | $0 |
| Net Cash Flow After Taxes | $11,669 | $11,871 | $12,080 | $12,297 | $12,522 | $12,754 | $12,995 | $13,244 | $27,145 | $27,411 | $27,687 | $27,972 | $28,267 |
| Cumulative savings before taxes | $208,014 | $228,381 | $249,552 | $271,576 | $294,505 | $318,396 | $343,307 | $369,301 | $396,446 | $423,857 | $451,544 | $479,516 | $507,783 |

| | |
|---|---|
| Internal Rate of Return After Taxes | 17% |
| NPV of After Tax Cash Flows | $62,345 |
| NPV Discount Rate | 8.00% |

These Figures are estimates for discussion only.

## Lawrenceville Fire Company PV Financials
## Purchase

| | | | | | |
|---|---|---|---|---|---|
| Total Project Cost | $206,473 | System Size (kW) | 25.81 | Tax Rate | 0.0% |
| | | Utility Rate ($/kWh) | $0.1750 | | |
| Net Project Cost | $206,473 | Utility Rate Inflation | 3.00% | | |
| | | REC Value ($/kWh) year 1-25 | $0.350 | | |
| Capital Outlay | $206,473 | | | | |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar Generation (kWh) | | 44,087 | 43,867 | 43,647 | 43,429 | 43,212 | 42,996 | 42,781 | 42,567 | 42,354 | 42,142 | 41,932 | 41,722 |
| 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 | ($206,473) | | | | | | | | | | | | |
| Tax Credit | | $0 | | | | | | | | | | | |
| Cash effect of depreciation | | $0 | $0 | $0 | $0 | $0 | $0 | | | | | | |
| Avoided Utility Pmnt (from Solar Generation) | | $7,715 | $7,907 | $8,103 | $8,305 | $8,511 | $8,723 | $8,939 | $9,162 | $9,389 | $9,623 | $9,862 | $10,107 |
| Revenue from REC Sale | | $15,430 | $15,353 | $15,277 | $15,200 | $15,124 | $15,049 | $14,973 | $14,898 | $14,824 | $14,750 | $14,676 | $14,603 |
| Subtotal | | $23,146 | $23,260 | $23,380 | $23,505 | $23,635 | $23,771 | $23,913 | $24,060 | $24,213 | $24,372 | $24,538 | $24,709 |
| Operations & Maintenance | | $0 | $0 | $0 | $0 | $0 | $322 | $335 | $349 | $363 | $377 | $392 | $408 |
| Subtotal | | $0 | $0 | $0 | $0 | $0 | $322 | $335 | $349 | $363 | $377 | $392 | $408 |
| Net Savings | | $23,146 | $23,260 | $23,380 | $23,505 | $23,635 | $24,094 | $24,248 | $24,409 | $24,576 | $24,750 | $24,930 | $25,118 |
| Taxes on net savings | | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Net Savings after taxes | ($206,473) | $23,146 | $23,260 | $23,380 | $23,505 | $23,635 | $24,094 | $24,248 | $24,409 | $24,576 | $24,750 | $24,930 | $25,118 |
| Cumulative Savings | ($206,473) | ($183,327) | ($160,067) | ($136,687) | ($113,182) | ($89,546) | ($65,453) | ($41,204) | ($16,796) | $7,780 | $32,530 | $57,460 | $82,578 |

| Year | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Solar Generation (kWh) | 41,513 | 41,306 | 41,099 | 40,894 | 40,689 | 40,486 | 40,283 | 40,082 | 39,882 | 39,682 | 39,484 | 39,286 | 39,090 |
| 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) | $10,358 | $10,615 | $10,879 | $11,149 | $11,427 | $11,710 | $12,001 | $12,300 | $12,605 | $12,919 | $13,240 | $13,569 | $13,906 |
| Revenue from REC sale | $14,530 | $14,457 | $14,385 | $14,313 | $14,241 | $14,170 | $14,099 | $14,029 | $13,959 | $13,889 | $13,819 | $13,750 | $13,681 |
| Subtotal | $24,888 | $25,072 | $25,264 | $25,462 | $25,668 | $25,881 | $26,101 | $26,328 | $26,564 | $26,807 | $27,059 | $27,319 | $27,587 |
| Operations & Maintenance | $424 | $441 | $459 | $477 | $496 | $516 | $537 | $558 | $581 | $604 | $628 | $653 | $679 |
| Subtotal | $424 | $441 | $459 | $477 | $496 | $516 | $537 | $558 | $581 | $604 | $628 | $653 | $679 |
| Net Savings | $25,312 | $25,514 | $25,723 | $25,940 | $26,164 | $26,397 | $26,638 | $26,887 | $27,145 | $27,411 | $27,687 | $27,972 | $28,267 |
| Taxes on net savings | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Net savings after taxes | $25,312 | $25,514 | $25,723 | $25,940 | $26,164 | $26,397 | $26,638 | $26,887 | $27,145 | $27,411 | $27,687 | $27,972 | $28,267 |
| Cumulative Savings | $107,890 | $133,403 | $159,126 | $185,066 | $211,230 | $237,627 | $264,264 | $291,151 | $318,296 | $345,707 | $373,394 | $401,367 | $429,633 |

| | |
|---|---|
| After Tax IRR | 11.0% |
| NPV of Net Savings After Taxes | $52,544 |
| 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 |
|---|---|---|---|---|---|---|---|---|---|
| Lawrenceville Fire Company | 1650 | Sunpower SPR230 | 112 | 14.7 | 1,650 | 25.81 | 44,087 | 3,703 | 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.