# EAST HANOVER TOWNSHIP SCHOOL DISTRICT

# BOARD OF EDUCATION OFFICE

**20 SCHOOL AVENUE**
**EAST HANOVER, NJ 07936**

# FACILITY ENERGY REPORT

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## I. HISTORIC ENERGY CONSUMPTION/COST

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

| | |
|---|---|
| Electric Utility Provider: | Jersey Central Power & Light |
| Electric Utility Rate Structure: | General Service Secondary |
| Third Party Supplier: | First Energy Solutions & Direct Energy Business |

| | |
|---|---|
| Natural Gas Utility Provider: | Public Service Electric & Gas |
| Utility Rate Structure: | General Service Gas (GSG) |
| Third Party Supplier: | Hess Corporation |

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

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

**Table 1**
**Electricity Billing Data**

**ELECTRIC USAGE SUMMARY**

Utility Provider: JCP&L
Rate: General Service Secondary 3 Phase
Meter No: G79658928 / S34964497
Account No: 100 004 887 723 / 100 004 887 814
Third Party Utility Provider: Direct Energy
TPS Meter / Acct No: -

| MONTH OF USE | CONSUMPTION KWH | DEMAND KW | TOTAL BILL |
|---|---|---|---|
| Dec-12 | 3,539 | 8.8 | $438 |
| Jan-13 | 4,605 | 10.2 | $486 |
| Feb-13 | 4,677 | 10.2 | $485 |
| Mar-13 | 3,494 | 8.7 | $427 |
| Apr-13 | 2,262 | 18.1 | $316 |
| May-13 | 2,341 | 17.0 | $349 |
| Jun-13 | 2,785 | 19.4 | $399 |
| Jul-13 | 3,635 | 20.9 | $502 |
| Aug-13 | 2,392 | 16.4 | $351 |
| Sep-13 | 2,491 | 18.0 | $355 |
| Oct-13 | 3,966 | 15.6 | $504 |
| Nov-13 | 1,487 | 17.1 | $265 |
| **Totals** | **37,674** | **20.9 Max** | **$4,877** |

**AVERAGE DEMAND** **15.0 KW average**
**AVERAGE RATE** **$0.129** **$/kWh**

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

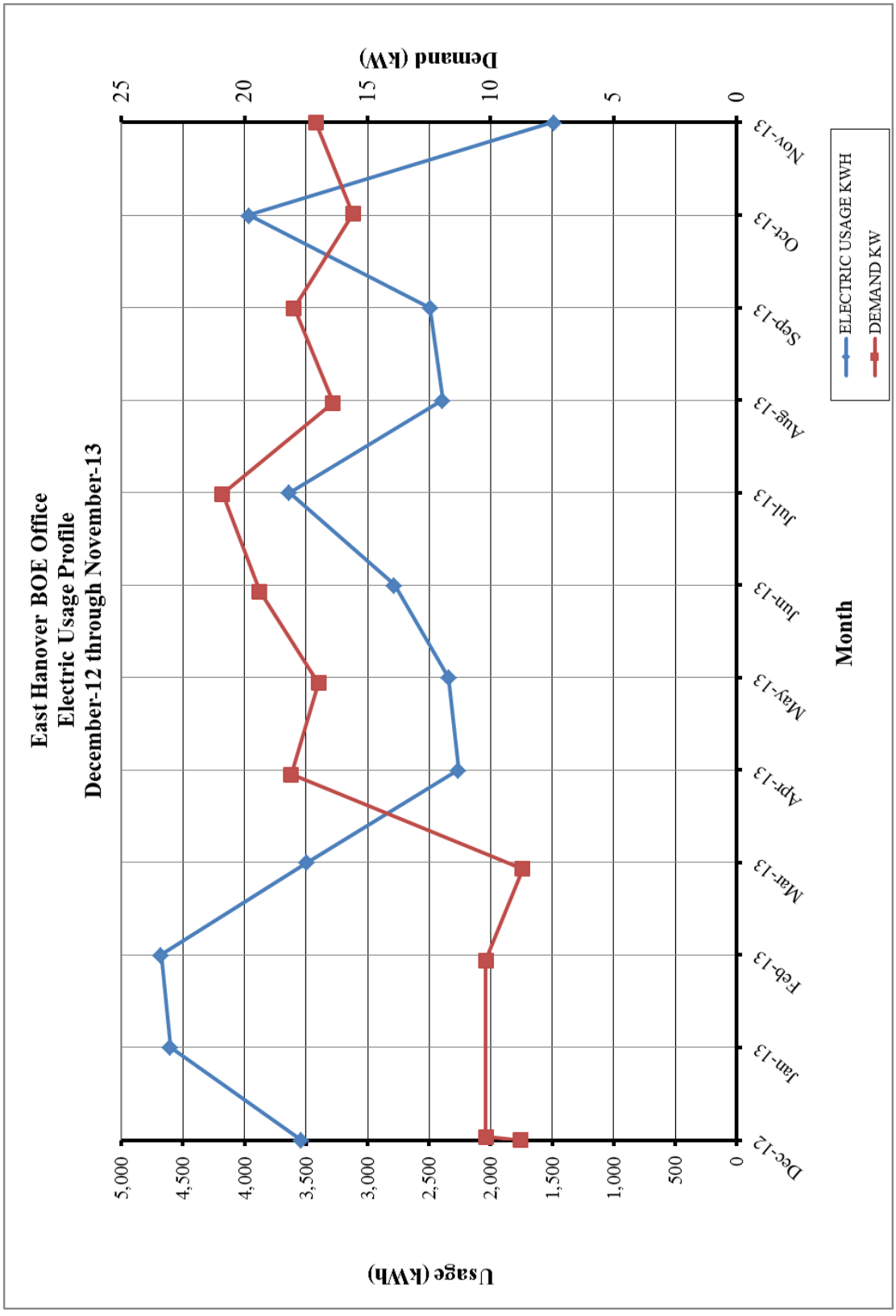
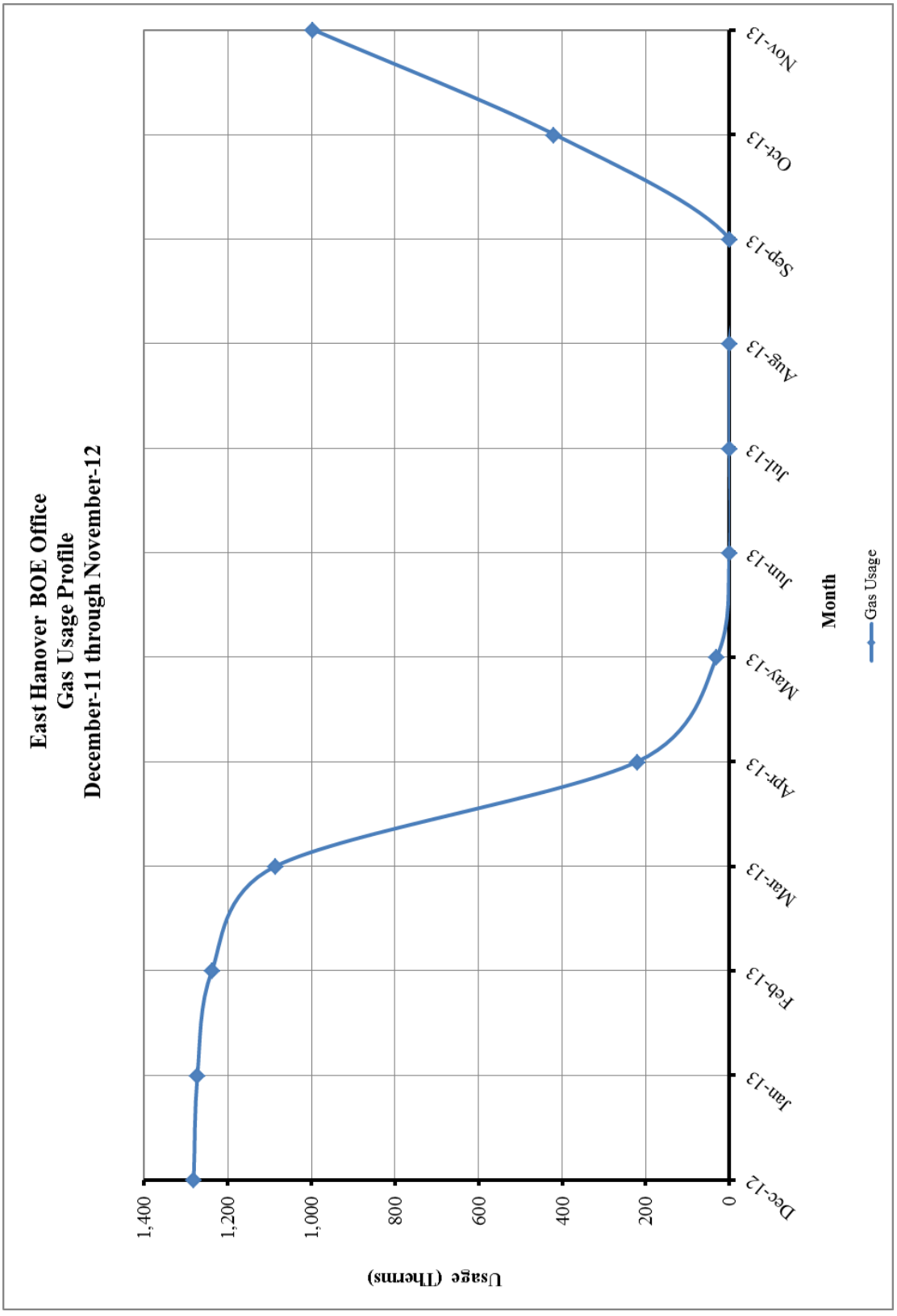


**Table 2**
**Natural Gas Billing Data**

| NATURAL GAS USAGE SUMMARY | | |
|---|---|---|
| Utility Provider: PSE&G | | |
| Rate: GSG | | |
| Meter No: 1792623 | | |
| Account No: 66 562 352 04 | | |
| Third Party Utility Provider: HESS | | |
| TPS Meter No: 526148/526157 | | |
| **MONTH OF USE** | **CONSUMPTION (THERMS)** | **TOTAL BILL** |
| Dec-12 | 1,281.57 | $1,255.36 |
| Jan-13 | 1,272.79 | $1,236.00 |
| Feb-13 | 1,237.99 | $1,210.73 |
| Mar-13 | 1,085.12 | $945.24 |
| Apr-13 | 219.76 | $209.32 |
| May-13 | 30.55 | $39.46 |
| Jun-13 | 0.00 | $11.27 |
| Jul-13 | 0.00 | $11.27 |
| Aug-13 | 0.00 | $11.27 |
| Sep-13 | 0.00 | $11.27 |
| Oct-13 | 419.69 | $415.59 |
| Nov-13 | 996.10 | $971.00 |
| **TOTALS** | **6,543.56** | **$6,327.78** |
| **AVERAGE RATE:** | **$0.97** | **$/THERM** |

**Figure 2**
**Natural Gas Usage Profile**



## II. FACILITY DESCRIPTION

The Board of Education office is located at 20 School Avenue in East Hanover, New Jersey. The 7,083 SF combined building was built at different times. The original building was built in 1930 and the addition in 1971. The original facility is a 2-story building comprised of the Superintendent's offices and the School District maintenance shops and storage in the basement. The 1971 addition is a one-story building that includes the secretary offices, Business Administrator's office, a conference room, special services offices, a boiler room, a lunch room, a work room, and Board Secretary's office.

Occupancy Profile

The typical hours of operation for the BOE offices are Monday through Friday between 8:00 am and 5:00 pm with custodial staff on site afterhours till approximately 8:00 pm. The Board of Education office operates continually throughout the year.

Building Envelope

Exterior walls for the original BOE office are stucco over wood, plaster walls with no insulation. The windows in the 1930 building are original, in very poor condition and leak. The use of thermal insulation in building walls and aluminum windows with Low-E high-performance insulating glass contribute in reducing the annual energy cost. Additionally, it helps in extending the periods of thermal comfort without reliance on mechanical air-conditioning especially during the fall and spring periods. The magnitude of energy savings as a result of using thermal insulation and high-performance window systems vary according to the building type, the climatic conditions at which the building is located as well as the type, thickness, and location of the insulating material used.

*It is strongly recommended that the School District investigate the options for upgrading the window system and adding insulation to the exterior walls.*

The exterior walls in the addition are concrete block with stucco finish and some wall insulation. The windows throughout the 1971 offices are in good condition and are double pane, operable, ¼" glass with aluminum frames. The roof of the lower addition is a flat, built-up rubber roof where all of the mechanical rooftop equipment is placed. The roof of the two-story building is an A-frame with asphalt shingles. The amount of insulation below the roof is unknown.

HVAC Systems

The BOE offices are heated by a central hot water boiler plant located in the boiler room of the addition. Hot water is provided by a Weil-McLain Model HG-9 gas-fired, cast iron sectional boiler rated for an input capacity of 445 MBH and an output capacity of 356 MBH (new). The boiler was manufactured in 1971, is in very poor condition, and well beyond its service life along with using more gas than a high-efficiency modular unit. Hot water is pumped to the various fin-tube radiators in the 1971 addition via two (2) Bell & Gossett in-line pumps with ¾ HP motors and the original 2-story building via two (2) Bell & Gossett in-line pumps with ½ HP motors.

The facility has four (4) packaged rooftop units as follows:

| Unit Tag | Area Served | Mfg. | Type |
|---|---|---|---|
| RTU-1 | Superintendent Offices | York | Electric Packaged |
| RTU-2 | Secretaries Offices/BA Office | York | Electric Packaged |
| RTU-3 | Large Conference Room | WeatherKing | Electric Packaged |
| RTU-4 | Special Services | Luxaire | Gas/Electric Packaged |

In addition, there is a new Energy Star rated window air-conditioning unit (10,000 BTUH) for the work room/server room with an EER = 10.8.

Exhaust System

Toilet exhaust air is relieved through roof mounted exhaust fans with small fractional horsepower fan motors.

HVAC System Controls

The boiler, hot water pumps, three-way valves are controlled by a Barber Colman electronic 2-input controller. The balance of the HVAC systems within the building are controlled by programmable thermostats except the Special Services and Maintenance Shops which do not have programmable thermostats.

Domestic Hot Water

Domestic hot water for the facility restrooms/janitor sink is provided by a Rheem 15-gallon electric water heater and several Rheem electric water heaters that have a storage capacity of 6 gallons for the individual restrooms.

Lighting

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

## III. MAJOR EQUIPMENT LIST

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

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

## IV. ENERGY CONSERVATION MEASURES

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

**Table 1**
**ECM Financial Summary**

| ENERGY CONSERVATION MEASURES (ECM's) | | | | | |
|---|---|---|---|---|---|
| **ECM NO.** | **DESCRIPTION** | **NET INSTALLATION COST[A]** | **ANNUAL SAVINGS[B]** | **SIMPLE PAYBACK (Yrs)** | **SIMPLE LIFETIME ROI** |
| ECM #1 | Lighting Upgrade - General | $11,445 | $612 | 18.7 | -19.8% |
| ECM #2 | Lighting Controls Upgrade | $1,475 | $101 | 14.6 | 2.7% |
| ECM #3 | Boiler OA Reset Controls | $6,312 | $825 | 7.7 | 96.0% |
| ECM #4 | Boiler Replacement | $42,646 | $1,189 | 35.9 | -30.3% |
| ECM #5 | Programmable Thermostats | $2,248 | $414 | 5.4 | 176.2% |
| ECM #6 | Split System Replacement | $8,724 | $236 | 37.0 | -59.4% |
| ECM #7 | Water Conservation | $6,480 | $1,283 | 5.1 | 197.0% |
| **RENEWABLE ENERGY MEASURES (REM's)** | | | | | |
| **ECM NO.** | **DESCRIPTION** | **NET INSTALLATION COST** | **ANNUAL SAVINGS** | **SIMPLE PAYBACK (Yrs)** | **SIMPLE LIFETIME ROI** |
| REM #1 | 5.76 kW PV System | $28,895 | $2,130 | 13.6 | 10.6% |

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

**Table 2**
**ECM Energy Summary**

| ENERGY CONSERVATION MEASURES (ECM's) | | | | |
|---|---|---|---|---|
| ECM NO. | DESCRIPTION | ANNUAL UTILITY REDUCTION | | |
| | | ELECTRIC DEMAND (KW) | ELECTRIC CONSUMPTION (KWH) | NATURAL GAS (THERMS) |
| ECM #1 | Lighting Upgrade - General | 1.86 | 4,742 | 0 |
| ECM #2 | Lighting Controls Upgrade | 0.0 | 784 | 0 |
| ECM #3 | Boiler OA Reset Controls | 0.0 | 0 | 851 |
| ECM #4 | Boiler Replacement | 0.0 | 0 | 1,226 |
| ECM #5 | Programmable Thermostats | 0.0 | 0 | 426 |
| ECM #6 | Split System Replacement | 1.7 | 1,830 | 0 |
| ECM #7 | Water Conservation | 0.0 | 5,059 | 0 |
| **RENEWABLE ENERGY MEASURES (REM's)** | | | | |
| ECM NO. | DESCRIPTION | ANNUAL UTILITY REDUCTION | | |
| | | ELECTRIC DEMAND (KW) | ELECTRIC CONSUMPTION (KWH) | NATURAL GAS (THERMS) |
| REM #1 | 5.76 kW PV System | 5.8 | 6,656 | 0 |

**Table 3**
**ECM Emissions Summary**

| ENERGY CONSERVATION MEASURES (ECM's) | | | | |
|---|---|---|---|---|
| ECM NO. | DESCRIPTION | GREENHOUSE GAS EMISSIONS REDUCTION | | |
| | | $CO_2$ EMISSIONS (LBS) | $NO_X$ EMISSIONS (LBS) | $SO_2$ EMISSIONS (LBS) |
| ECM #1 | Lighting Upgrade - General | 7,208 | 13 | 31 |
| ECM #2 | Lighting Controls Upgrade | 1,192 | 2 | 5 |
| ECM #3 | Boiler OA Reset Controls | 9,957 | 8 | 0 |
| ECM #4 | Boiler Replacement | 14,344 | 11 | 0 |
| ECM #5 | Programmable Thermostats | 9,793 | 8 | 0 |
| ECM #6 | Split System Replacement | 2,782 | 5 | 12 |
| ECM #7 | Water Conservation | 7,690 | 14 | 33 |

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

**Table 4**
**Facility Project Summary**

| FACILITY PROJECT SUMMARY TABLE | | | | | |
|---|---|---|---|---|---|
| **ENERGY CONSERVATION MEASURES** | **ANNUAL ENERGY SAVINGS ($)** | **PROJECT COST ($)** | **SMART START INCENTIVES** | **CUSTOMER COST** | **SIMPLE PAYBACK** |
| Lighting Upgrade - General | $612 | $11,445 | $0 | $11,445 | 18.7 |
| Lighting Controls Upgrade | $101 | $1,600 | $125 | $1,475 | 14.6 |
| Boiler OA Reset Controls | $825 | $6,312 | $0 | $6,312 | 7.7 |
| Boiler Replacement | $1,189 | $43,346 | $700 | $42,646 | 35.9 |
| Programmable Thermostats | $414 | $2,248 | $0 | $2,248 | 5.4 |
| Split System Replacement | $236 | $9,000 | $276 | $8,724 | 37.0 |
| Water Conservation | $1,283 | $6,480 | $0 | $6,480 | 5.1 |
| **Total Project** | **$4,660** | **$80,431** | **$1,101** | **$79,330** | **17.0** |

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

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

## ECM #1: Lighting Upgrade – General

**Description:**

The majority of the interior lighting throughout the East Hanover Board Office is provided with fluorescent fixtures with older generation, 32W T8 lamps and electronic ballasts. These can be retrofitted to LED style lamps.

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

**Energy Savings Calculations:**

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

| LIGHTING UPGRADE SAVINGS SUMMARY | |
|---|---|
| **DESCRIPTION** | **SAVINGS** |
| Electric Demand Savings (kW) | 1.9 |
| Electric Usage Savings (kWh) | 4,742 |
| Electric Cost Savings ($) | $612 |

**Energy Savings Summary:**

| ECM #1 - ENERGY SAVINGS SUMMARY | |
|---|---|
| **Installation Cost ($):** | $11,445 |
| **NJ Smart Start Equipment Incentive ($):** | $0 |
| **Net Installation Cost ($):** | $11,445 |
| **Maintenance Savings ($/Yr):** | $0 |
| **Energy Savings ($/Yr):** | $612 |
| **Total Yearly Savings ($/Yr):** | $612 |
| **Estimated ECM Lifetime (Yr):** | 15 |
| **Simple Payback** | 18.7 |
| **Simple Lifetime ROI** | -19.8% |
| **Simple Lifetime Maintenance Savings** | $0 |
| **Simple Lifetime Savings** | $9,180 |
| **Internal Rate of Return (IRR)** | -3% |
| **Net Present Value (NPV)** | ($4,138.98) |

## ECM #2: Lighting Controls Upgrade – Occupancy Sensors

**Description:**

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

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

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

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

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

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

**Energy Savings Calculations:**

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

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

| LIGHTING CONTROLS SAVINGS SUMMARY | |
|---|---|
| **DESCRIPTION** | **SAVINGS** |
| Electric Demand Savings (kW) | 0.0 |
| Electric Usage Savings (kWh) | 784 |
| Electric Cost Savings ($) | $101 |

**Rebates and Incentives:**

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

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

**Energy Savings Summary:**

| ECM #2 - ENERGY SAVINGS SUMMARY | |
|---|---|
| **Installation Cost ($):** | $1,600 |
| **NJ Smart Start Equipment Incentive ($):** | $125 |
| **Net Installation Cost ($):** | $1,475 |
| **Maintenance Savings ($/Yr):** | $0 |
| **Energy Savings ($/Yr):** | $101 |
| **Total Yearly Savings ($/Yr):** | $101 |
| **Estimated ECM Lifetime (Yr):** | 15 |
| **Simple Payback** | 14.6 |
| **Simple Lifetime ROI** | 2.7% |
| **Simple Lifetime Maintenance Savings** | $0 |
| **Simple Lifetime Savings** | $1,515 |
| **Internal Rate of Return (IRR)** | 0% |
| **Net Present Value (NPV)** | ($269.27) |

## ECM #3: Boiler OA Reset Controls

**Description:**

Currently, the boiler at the BOE Building is staged on and off to maintain a fixed hot water set point. This temperature was most likely selected during engineering and was designed to meet the heat load for the building on the coldest days of the year. Maintaining this set point can result in wasted energy and improper heating of the spaces in the building. Controlling the temperature of the boiler supply water based on the temperature of the air outside the building can improve fuel use efficiency, as well as help maintain more accurate space temperatures.

This ECM replaces the existing Barber Colman boiler control with Heat Timer HWRQ Platinum controls and sensors. These sensors have the ability to stage the existing heating hot water boiler on and off and reset the heating water supply temperature based on outside air temperature.

**Energy Savings Calculation:**

The New Jersey Board of Public Utilities, in the Protocols to Measure Resource Savings, has set the savings associated with adding fuel use economizing controls to boilers at 13% of the annual heating fuel use.

| OUTSIDE AIR RESET CONTROLS | | | |
|---|---|---|---|
| **ECM INPUTS** | **EXISTING** | **PROPOSED** | **SAVINGS** |
| **ECM INPUTS** | No Controller | OA Reset Controller | |
| **Existing Boiler Usage (Therms)** | 6,544.00 | 6,544.00 | |
| **Estimated Savings (%)** | 0% | 13% | |
| **Natural Gas Cost ($/Therm)** | $0.97 | $0.97 | |
| **ENERGY SAVINGS CALCULATIONS** | | | |
| **ECM RESULTS** | **EXISTING** | **PROPOSED** | **SAVINGS** |
| **Natural Gas Usage (Therms)** | 6,544 | 5,693 | 851 |
| **Natural Gas Savings ($)** | $6,348 | $5,522 | $825 |
| **COMMENTS:** | Estimated savings percentage obtained from NJBPU New Jersey Clean Energy Program Protocols. | | |

**Energy Savings Summary:**

| ECM #3 - ENERGY SAVINGS SUMMARY | |
|---|---|
| **Installation Cost ($):** | $6,312 |
| **NJ Smart Start Equipment Incentive ($):** | $0 |
| **Net Installation Cost ($):** | $6,312 |
| **Maintenance Savings ($/Yr):** | $0 |
| **Energy Savings ($/Yr):** | $825 |
| **Total Yearly Savings ($/Yr):** | $825 |
| **Estimated ECM Lifetime (Yr):** | 15 |
| **Simple Payback** | 7.7 |
| **Simple Lifetime ROI** | 96.0% |
| **Simple Lifetime Maintenance Savings** | $0 |
| **Simple Lifetime Savings** | $12,375 |
| **Internal Rate of Return (IRR)** | 10% |
| **Net Present Value (NPV)** | $3,536.50 |

## ECM # 4: Boiler Replacement

**Description:**

The BOE offices are heated by a central hot water boiler plant located in the boiler room of the addition. Hot water is provided by a Weil-McLain Model HG-9 gas-fired, cast iron sectional boiler rated for an input capacity of 445 MBH and a rated output capacity of 356 MBH when new. The boiler was manufactured in 1971, is in very poor condition, and beyond its service life along with using more gas than a high-efficiency modular unit.

CEG recommends replacing this boiler with a 400 MBH high-efficiency condensing hot water boiler. Condensing boilers can substantially improve the operating efficiency of the heating system of the building. A condensing boiler's peak efficiency tops out at 99% depending on return water temperature. The natural gas to water efficiency for a 400 MBH boiler with digital burner controls is approximately 92% over its operating range and with the advanced controls and a 5:1 turn down ratio.

This energy conservation measure will replace the existing Weil-McLain gas-fired, cast iron, sectional boiler serving the facility with a high-efficiency, modular, condensing heating hot water boiler. Calculation is based on the following equipment: Lochinvar Knight XL, modular, condensing hot water boiler or equivalent.

**Energy Savings Calculations:**

Gas consumption of the boiler plant is gathered in order to calculate the estimated heat output of the existing boilers. It is confirmed that the boiler is for space heating only and does not provide domestic hot water heating.

The annual gas consumption is used in a reverse calculation in the below equations to obtain proposed annual gas consumption based on improved efficiency. Calculations are summarized in the table below.

$$\text{Annual Output, MMBTU} = \frac{\text{Consumption (Therms)} \times 100{,}000 \frac{\text{BTU}}{\text{Therm}} \times \text{ Current Boiler Effc}}{1{,}000{,}000}$$

$$\text{Proposed Gas Consumption, Therms} = \frac{\text{Annual Output (MMBTU)} \times 1{,}000{,}000}{100{,}000 \frac{\text{BTU}}{\text{Therm}} \times \text{ New Boiler Efficiency}}$$

| HIGH EFFICIENCY BOILER CALCULATIONS | | | |
|---|---|---|---|
| **ECM INPUTS** | **EXISTING** | **PROPOSED** | **SAVINGS** |
| **ECM INPUTS** | Existing Cast Iron Boilers | New High Efficiency Boilers | |
| **Existing Nat Gas (Therms)** | 5,126 | | |
| **Boiler Efficiency (%)** | 70.0% | 92.0% | 22% |
| **Nat Gas Heat Value (BTU/Therm)** | 100,000 | 100,000 | |
| **Equivalent Building Heat Usage (MMBTUs)** | 359 | 359 | |
| **Gas Cost ($/Therm)** | $0.97 | $0.97 | |
| **ENERGY SAVINGS CALCULATIONS** | | | |
| **ECM RESULTS** | **EXISTING** | **PROPOSED** | **SAVINGS** |
| **Natural Gas Usage (Therms)** | 5,126 | 3,900 | 1,226 |
| **Energy Cost ($)** | $4,973 | $3,783 | $1,189 |
| **COMMENTS:** | Boiler Efficiency Based on age of boiler, and average of both boilers | | |

**Energy Savings Summary:**

| ECM #4 - ENERGY SAVINGS SUMMARY | |
|---|---|
| **Installation Cost ($):** | $43,346 |
| **NJ Smart Start Equipment Incentive ($):** | $700 |
| **Net Installation Cost ($):** | $42,646 |
| **Maintenance Savings ($/Yr):** | $0 |
| **Energy Savings ($/Yr):** | $1,189 |
| **Total Yearly Savings ($/Yr):** | $1,189 |
| **Estimated ECM Lifetime (Yr):** | 25 |
| **Simple Payback** | 35.9 |
| **Simple Lifetime ROI** | -30.3% |
| **Simple Lifetime Maintenance Savings** | $0 |
| **Simple Lifetime Savings** | $29,725 |
| **Internal Rate of Return (IRR)** | -3% |
| **Net Present Value (NPV)** | ($21,941.93) |

## ECM #5: Four (4) Additional 7-Day Programmable Thermostats

**Description:**

The Special Services Department offices and Maintenance Shop are not properly controlled. The two (2) thermostats in the perimeter offices which control the hot water fin-tube radiators are not working properly since they are old, out of calibration, and do not have programmable capabilities. The hot water radiators that heat the Maintenance Shop run continuously even when the space is not occupied. Also, the thermostats in the Maintenance Shop are old, not calibrated, and also do not have programmable capabilities.

This ECM would install four high-end, 7-day programmable thermostats with nighttime temperature setback capabilities.

**Energy Savings Calculations:**

Energy savings calculations are derived from the annual energy consumption of the system based on total heating capacity and efficiency of the system. The calculation uses the number of annual heating degree days and the estimated hours of setback during the unoccupied period on each day. Energy savings is the difference between the energy consumption of the unit at always occupied mode and partly occupied mode.

Heating design day temperature conditions: $\mathrm{Ti} = 65°\mathrm{F}$
$\mathrm{To} = 60°\mathrm{F}$

$$\text{Non Set Back Heating Energy} = \frac{\text{Heat Load} \times \mathrm{HDD}_{65°\mathrm{F}} \times 24\frac{\mathrm{Hr}}{\mathrm{Day}}}{(\mathrm{Ti}) \times 100{,}000\frac{\mathrm{BTU}}{\mathrm{Therm}}} \times \frac{\text{Non Set Back Hrs/ Week}}{168 \text{ Hrs per Week}}$$

$$\text{Set Back Heating Energy} = \frac{\text{Heat Load} \times \mathrm{HDD}_{60°\mathrm{F}} \times 24\frac{\mathrm{Hr}}{\mathrm{Day}}}{(\mathrm{To}) \times 100{,}000\frac{\mathrm{BTU}}{\mathrm{Therm}}} \times \frac{\text{Set Back Hrs per Week}}{168 \text{ Hrs per Week}}$$

$$\text{Heating Cost Savings} = \text{Energy Savings (Therms)} \times \text{Cost of Gas}\left(\frac{\$}{\mathrm{Therm}}\right)$$

| HEATING ENERGY CALCULATIONS | | | |
|---|---|---|---|
| **ECM INPUTS** | **EXISTING** | **PROPOSED** | **SAVINGS** |
| **ECM INPUTS** | Standard Controls | Programmable TStat (5°F Setback) | |
| **Area of the Space (SF)** | 7,083 | 7,083 | |
| **Estimated Unit Heat Load (BTU/SF)** | 40 | 40 | |
| **Estimated Total Heat Load (BTU)** | 283,320 | 283,320 | |
| **Design Day Interior Temp. (°F)** | 65 | 60 | |
| **Design Day Ambient Temp. (°F)** | 15 | 15 | |
| **Heating Degree Days (65°F Base)** | 4,889 | 4,889 | |
| **Heating Degree Days (60°F Base)** | 3,778 | 3,778 | |
| **Hours of setback per week** | 0 | 128 | |
| **Heating Fuel Value** | 100,000 | 100,000 | |
| **Gas Cost ($/Therm)** | $0.97 | $0.97 | |
| **ENERGY SAVINGS CALCULATIONS** | | | |
| **ECM RESULTS** | **EXISTING** | **PROPOSED** | **SAVINGS** |
| **Total Heating Energy Consumption (Therms)** | 4,092 | 3,665 | 426 |
| **Heating Energy Cost ($)** | $3,969 | $3,555 | $414 |
| **COMMENTS:** | Degree Days based on Newark Int Airport | | |

**Energy Savings Summary:**

| ECM #5 - ENERGY SAVINGS SUMMARY | |
|---|---|
| **Installation Cost ($):** | $2,248 |
| **NJ Smart Start Equipment Incentive ($):** | $0 |
| **Net Installation Cost ($):** | $2,248 |
| **Maintenance Savings ($/Yr):** | $0 |
| **Energy Savings ($/Yr):** | $414 |
| **Total Yearly Savings ($/Yr):** | $414 |
| **Estimated ECM Lifetime (Yr):** | 15 |
| **Simple Payback** | 5.4 |
| **Simple Lifetime ROI** | 176.2% |
| **Simple Lifetime Maintenance Savings** | $0 |
| **Simple Lifetime Savings** | $6,210 |
| **Internal Rate of Return (IRR)** | 17% |
| **Net Present Value (NPV)** | $2,694.31 |

## ECM #6: Replace York Split System Unit with High Efficiency Unit

**Description:**

The BOE Building has a York Model DCHB-T036 packaged rooftop air conditioning only unit which serves some of the interior spaces and is in very poor condition. The estimated existing unit efficiency is 8.5 SEER. This 3-Ton split unit has surpassed its ASHRAE service life expectancy of 15 years. Replacing this unit with a newer more efficient unit would result in significant energy savings.

The unit currently installed has lower efficiency compared to a modern high-efficiency unit. New units provide higher full load and part load efficiencies due to advances in inverter motor technologies, higher efficiency refrigerants such as R410A which would be used in place of R22 that is currently used in the unit.

This ECM includes replacement of this older rooftop unit with a new higher efficiency rooftop. It is recommended to fully evaluate the capacity needed for the new rooftop unit prior to moving forward with this ECM. A summary of the unit replacement for this ECM can be found in the table below:

| IMPLEMENTATION SUMMARY | | | | | |
|---|---|---|---|---|---|
| **ECM INPUTS** | **SERVICE FOR** | **NUMBER OF UNITS** | **COOLING CAPACITY, BTU/HR** | **TOTAL CAPACITY, TONS** | **REPLACE UNIT WITH** |
| **RTU** | Packaged Rooftop | 1 | 36,000 | 3.0 | Trane 4TCY4036B |
| **Total** | | **1** | **36,000** | **3.0** | |

The high-efficiency rooftop used as the basis for the calculation is a Trane Model 4TCY4036B with a SEER=14. The unit pricing and install cost were estimated based on current rates quotes and labor rates. The payback may change based on actual unit pricing and installed costs if the ECM is implemented.

**Energy Savings Calculations:**

Cooling Energy Savings:

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

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

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

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

| ENERGY SAVINGS CALCULATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|
| **ECM INPUTS** | **EXISTING COOLING CAPACITY, BTU/Hr** | **ANNUAL COOLING HOURS** | **EXISTING UNIT SEER** | **NEW UNIT SEER** | **# OF UNITS** | **ENERGY SAVINGS kWh** | **DEMAND SAVINGS kW** |
| **RTU** | 36,000 | 1,100 | 8.5 | 14 | 1 | 1,830 | 1.7 |
| **Total** | | | | | 1 | 1,830 | 1.7 |

**Project Cost, Incentives and Maintenance Savings**

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

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

| AC UNITS REBATE SUMMARY | | | | |
|---|---|---|---|---|
| **UNIT DESCRIPTION** | **UNIT EFFICIENCY** | **REBATE $/TON** | **PROPOSED CAPACITY TONS** | **TOTAL REBATE $** |
| 5.4 tons or less Unitary AC and Split System | ≥14 SEER | $92 | 3.0 | $276 |
| **TOTAL** | | | **3** | **$276** |

Summary of cost, savings and payback for this ECM is below.

| COST & SAVINGS SUMMARY | | | | | | | |
|---|---|---|---|---|---|---|---|
| **ECM INPUTS** | **INSTALLED COST** | **# OF UNITS** | **TOTAL COST** | **REBATES** | **NET COST** | **ENERGY SAVINGS** | **PAY BACK YEARS** |
| **RTU** | $9,000 | 1 | $9,000 | $276 | $8,724 | $236 | 37.0 |
| **Total** | $9,000 | 1 | $9,000 | $276 | $8,724 | $236 | 37.0 |

**Energy Savings Summary:**

| ECM #6 - ENERGY SAVINGS SUMMARY | |
|---|---|
| **Installation Cost ($):** | $9,000 |
| **NJ Smart Start Equipment Incentive ($):** | $276 |
| **Net Installation Cost ($):** | $8,724 |
| **Maintenance Savings ($/Yr):** | $0 |
| **Energy Savings ($/Yr):** | $236 |
| **Total Yearly Savings ($/Yr):** | $236 |
| **Estimated ECM Lifetime (Yr):** | 15 |
| **Simple Payback** | 37.0 |
| **Simple Lifetime ROI** | -59.4% |
| **Simple Lifetime Maintenance Savings** | 0 |
| **Simple Lifetime Savings** | $3,540 |
| **Internal Rate of Return (IRR)** | -10% |
| **Net Present Value (NPV)** | ($5,906.65) |

## ECM #7: Water Conservation

**Description:**

The BOE Building utilizes standard plumbing fixtures. The typical sink aerator consumption is 2.2 gallons per minute. New fixtures and aerators are available that use less water that can add up to significant water reduction over a long period.

This ECM includes the replacement of the existing restroom sinks with new low flow sinks rated at 0.5 gallons per minute and fitted with time based automatic shut off. The existing quantity of sink estimated is based off observed quantity in the field.

Equipment Basis of Design

- Moen Model 8886 (Chrome)

**Energy Savings Calculations:**

Energy savings calculations are based on NJ BPU Protocols to Measure Resource Savings. Hot water savings are based on a 50% mix of hot water to cold water. Savings for installation of automatic shut off based on a 10% reduction of use per day.

Faucets:

$$\text{Water Use (Gallons)} = \text{Fixture Qty} \times \frac{\text{Hours}}{\text{Day}} \times \frac{\text{Days}}{\text{Year}} \times \text{Flow Rate} \left(\frac{\text{Gal}}{\text{Min}}\right) \times 60 \frac{\text{Min}}{\text{hr}}$$

$$\text{Water Heating Usage (kWh)} = \frac{\text{Gallons}}{\text{year}} \times 8.33 \frac{\text{Btu}}{\text{gal}} \times \Delta\text{T (50°F)} \times \frac{1}{\text{Heater Eff (95\%)}} \times \frac{\text{kW}}{3412\ \text{Btu}}$$

$$\text{Water Heating Usage (therm)} = \frac{\text{Gallons}}{\text{year}} \times 8.33 \frac{\text{Btu}}{\text{gal}} \times \Delta\text{T (50°F)} \times \frac{1}{\text{Heater Eff (80\%)}} \times \frac{\text{therm}}{100{,}000\ \text{Btu}}$$

| LOW FLOW WATER SAVING DEVICES | | | |
|---|---|---|---|
| **ECM INPUTS** | **EXISTING** | **PROPOSED** | **SAVINGS** |
| Quantity of Sinks | 6 | 6 | |
| Flow Rate (GPM) | 2.2 | 0.5 | 1.7 |
| Device Usage (min per day) | 30 | 27 | |
| Facility Operation (days / year) | 250 | 250 | |
| Heat Content of Water (Btu/gal/°F) | 8.33 | 8.33 | |
| Temperature Rise (°F) | 50.0 | 50.0 | |
| Water Heater Type | Electric | Electric | |
| Efficiency of Heating System (%) | 95% | 95% | |
| Conversion Factor for Electric | 3,412 | 3,412 | |
| Conversion Factor for Gas | 100,000 | 100,000 | |
| Electric Rate ($/kWh) | $0.129 | $0.129 | |
| Natural Gas Rate ($/therm) | $0.970 | $0.970 | |
| Water/Sewer Rate ($/1000gal) | $8.000 | $8.000 | |
| **ENERGY SAVINGS CALCULATIONS** | | | |
| Electric Usage (kWh) | 6,360 | 1,301 | 5,059 |
| Natural Gas Usage (Therm) | 0 | 0 | 0 |
| Water Usage (gallons) | 99,000 | 20,250 | 78,750 |
| Energy Cost ($) | $1,612 | $330 | $1,283 |
| **COMMENTS:** | Heating Savings based on 50% Hot Cold Mix. Assume a 10% reduction based on timed faucet controls | | |

**Energy Savings Summary:**

| ECM #7 - ENERGY SAVINGS SUMMARY | |
|---|---|
| **Installation Cost ($):** | $6,480 |
| **NJ Smart Start Equipment Incentive ($):** | $0 |
| **Net Installation Cost ($):** | $6,480 |
| **Maintenance Savings ($/Yr):** | $0 |
| **Energy Savings ($/Yr):** | $1,283 |
| **Total Yearly Savings ($/Yr):** | $1,283 |
| **Estimated ECM Lifetime (Yr):** | 15 |
| **Simple Payback** | 5.1 |
| **Simple Lifetime ROI** | 197.0% |
| **Simple Lifetime Maintenance Savings** | $0 |
| **Simple Lifetime Savings** | $19,245 |
| **Internal Rate of Return (IRR)** | 18% |
| **Net Present Value (NPV)** | $8,836.37 |

## REM #1: 5.76 kW Solar System

**Description:**

The East Hanover Board of Education Office has available roof space that could accommodate solar arrays. Based on the available area a 5.76 kilowatt solar array could be installed. The array will produce approximately 6,656 kilowatt-hours annually that will reduce the overall electric usage of the facility by 17.67%. The owner should consult a structural engineer prior to installing any solar array to insure the roof can accommodate the additional weight.

**Energy Savings Calculations:**

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

**Energy Savings Summary:**

| REM #1 - ENERGY SAVINGS SUMMARY | |
|---|---|
| **System Size ($KW_{DC}$):** | 5.76 |
| **Electric Generation (KWH/Yr):** | 6,656 |
| **Installation Cost ($):** | $28,895 |
| **SREC Revenue ($/Yr):** | $1,272 |
| **Energy Savings ($/Yr):** | $859 |
| **Total Yearly Savings ($/Yr):** | $2,130 |
| **ECM Analysis Period (Yr):** | 15 |
| **Simple Payback (Yrs):** | 13.6 |
| **Analysis Period Electric Savings ($):** | $15,969 |
| **Analysis Period SREC Revenue ($):** | $18,424 |
| **Net Present Value (NPV)** | ($7,315.41) |

## V. ADDITIONAL RECOMMENDATIONS

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

A. The School District should investigate improvement to the 1930 section of the BOE building including upgrading the windows and adding thermal insulation to the exterior walls.

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

C. Maintain all weather stripping on windows and doors.

D. Clean all light fixtures to maximize light output.

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

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

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

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

# APPENDIX A

# ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING GROUP

**East Hanover Township School District - Board Office**

| ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ECM NO. | DESCRIPTION | INSTALLATION COST | | | | YEARLY SAVINGS | | | ECM LIFETIME | LIFETIME ENERGY SAVINGS | LIFETIME MAINTENANCE SAVINGS | LIFETIME ROI | SIMPLE PAYBACK | INTERNAL RATE OF RETURN (IRR) | NET PRESENT VALUE (NPV) |
| | | MATERIAL | LABOR | REBATES, INCENTIVES | NET INSTALLATION COST | ENERGY | MAINT. / SREC | TOTAL | | (Yearly Saving * ECM Lifetime) | (Yearly Maint Svaing * ECM Lifetime) | (Lifetime Savings - Net Cost) / (Net Cost) | (Net cost / Yearly Savings) | $\sum_{n=0}^{N} \frac{C_n}{(1+IRR)^n}$ | $\sum_{n=0}^{N} \frac{C_n}{(1+DR)^n}$ |
| | | ($) | ($) | ($) | ($) | ($/Yr) | ($/Yr) | ($/Yr) | (Yr) | ($) | ($) | (%) | (Yr) | ($) | ($) |
| ECM #1 | Lighting Upgrade - General | $5,165 | $6,280 | $0 | $11,445 | $612 | $0 | $612 | 15 | $9,180 | $0 | -19.8% | 18.7 | -2.64% | ($4,138.98) |
| ECM #2 | Lighting Controls Upgrade | $1,250 | $350 | $125 | $1,475 | $101 | $0 | $101 | 15 | $1,515 | $0 | 2.7% | 14.6 | 0.34% | ($269.27) |
| ECM #3 | Boiler OA Reset Controls | $3,239 | $3,073 | $0 | $6,312 | $825 | $0 | $825 | 15 | $12,375 | $0 | 96.0% | 7.7 | 9.90% | $3,536.50 |
| ECM #4 | Boiler Replacement | $18,342 | $25,004 | $700 | $42,646 | $1,189 | $0 | $1,189 | 25 | $29,725 | $0 | -30.3% | 35.9 | -2.60% | ($21,941.93) |
| ECM #5 | Programmable Thermostats | $960 | $1,288 | $0 | $2,248 | $414 | $0 | $414 | 15 | $6,210 | $0 | 176.2% | 5.4 | 16.57% | $2,694.31 |
| ECM #6 | Split System Replacement | $4,000 | $5,000 | $276 | $8,724 | $236 | $0 | $236 | 15 | $3,540 | $0 | -59.4% | 37.0 | -9.61% | ($5,906.65) |
| ECM #7 | Water Conservation | $2,700 | $3,780 | $0 | $6,480 | $1,283 | $0 | $1,283 | 15 | $19,245 | $0 | 197.0% | 5.1 | 18.18% | $8,836.37 |
| REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY | | | | | | | | | | | | | | | |
| REM #1 | 5.76 kW PV System | $28,895 | $0 | $0 | $28,895 | $859 | $1,272 | $2,130 | 15 | $31,957 | $19,078 | 10.6% | 13.6 | 1.29% | ($3,461.17) |

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

# APPENDIX B

# Concord Engineering Group, Inc.

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

## SmartStart Building Incentives

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

### Electric Chillers

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

Energy Efficiency must comply with ASHRAE 90.1-2007

### Gas Cooling

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

### Desiccant Systems

| |
|---|
| $1.00 per cfm – gas or electric |

### Electric Unitary HVAC

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

Energy Efficiency must comply with ASHRAE 90.1-2007

### Gas Heating

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

## Ground Source Heat Pumps

| | |
|---|---|
| Closed Loop | $450 per ton, EER ≥ 16<br>$600 per ton, EER ≥ 18<br>$750 per ton, EER ≥ 20 |

Energy Efficiency must comply with ASHRAE 90.1-2007

## Variable Frequency Drives

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

## Natural Gas Water Heating

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

## Prescriptive Lighting

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

## Prescriptive Lighting - LED

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

## Lighting Controls – Occupancy Sensors

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

## Refrigeration Doors/Covers

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

## Refrigeration Controls

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

## Other Equipment Incentives

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

# APPENDIX C

# ENERGY STAR® Statement of Energy Performance

## East Hanover Board Office

**46**

**ENERGY STAR® Score**[1]

**Primary Property Function:** Office
**Gross Floor Area (ft²):** 7,083
**Built:** 1930

**For Year Ending:** November 30, 2013
**Date Generated:** April 16, 2014

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

## Property & Contact Information

| Property Address | Property Owner | Primary Contact |
|---|---|---|
| East Hanover Board Office<br>20 School Avenue<br>East Hanover, New Jersey 07936 | East Hanover Township School District<br>20 School Avenue<br>East Hanover, NJ 07936<br>(____)____-_____ | Deborah Muscara<br>20 School Avenue<br>East Hanover, NJ 07936<br>973-887-2112<br>dmuscara@easthanoverschools.org |

**Property ID**: 4037207

## Energy Consumption and Energy Use Intensity (EUI)

**Site EUI**
110.5 kBtu/ft²

**Source EUI**
154 kBtu/ft²

| Annual Energy by Fuel | |
|---|---|
| Natural Gas (kBtu) | 654,357 (84%) |
| Electric - Grid (kBtu) | 128,544 (16%) |

| National Median Comparison | |
|---|---|
| National Median Site EUI (kBtu/ft²) | 105.9 |
| National Median Source EUI (kBtu/ft²) | 147.6 |
| % Diff from National Median Source EUI | 4% |
| **Annual Emissions** | |
| Greenhouse Gas Emissions (MtCO2e/year) | 51 |

## Signature & Stamp of Verifying Professional

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

Signature: _____Date: _____

**Licensed Professional**

Michael Fischette
520 South Burnt Mill Road
Voorhees, NJ 0843
856-427-0200
mfischette@concord-engineering.com

**Professional Engineer Stamp**
**(if applicable)**

# APPENDIX D

# MAJOR EQUIPMENT LIST

**Concord Engineering Group**

**BOE OFFICE**

## Rooftop Units

| Tag | RTU-1 | RTU-2 | RTU-3 | RTU-4 |
|---|---|---|---|---|
| **Unit Type** | Packaged | Packaged | Packaged | Gas/Electric Packaged |
| **Qty** | 1 | 1 | 1 | 1 |
| **Location** | Roof | Roof | Roof | Roof |
| **Area Served** | Superintendent's Offices | Secretaries Offices | Conference Room | Special Services Offices |
| **Manufacturer** | York | York | WeatherKing | Luxaire |
| **Model #** | DCHB-T036AB | D4CE036A06ECA | 13AJA60A01 | ZS-03N11AFAAA1A |
| **Serial #** | NKEM066399 | NFMM066556 | 7282N390602796 | N1A2532734 |
| **Cooling Type** | DX Coil | DX Coil | DX Coil | DX Coil |
| **Cooling Capacity (Tons)** | 3 | 3 | 5 | 3 |
| **Cooling Efficiency (SEER/EER)** | SEER=8.5 | SEER=12.1 | SEER=13.0 | SEER=13.0 |
| **Heating Type** | N/A | N/A | N/A | Heat Exchanger |
| **Heating Input (MBH)** | N/A | N/A | N/A | 100 |
| **Efficiency** | N/A | N/A | N/A | 81% AFUE |
| **Fuel** | N/A | N/A | N/A | Natural Gas |
| **Approx Age** | 18 | 10 | 7 | 2 |
| **ASHRAE Service Life** | 15 | 15 | 15 | 15 |
| **Remaining Life** | (3) | 5 | 8 | 13 |
| **Comments** | Very Poor Condition | | | |

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

# MAJOR EQUIPMENT LIST

## Concord Engineering Group

### BOE OFFICE

## Domestic Water Heaters

| Tag | DHW-1 | DHW-2 thru 4 | |
|---|---|---|---|
| **Unit Type** | Electric Water Heater | Electric Water Heater | |
| **Qty** | 1 | 2 | |
| **Location** | Custodian Closet | Mechanical Room | |
| **Area Served** | Sink and Rest Room | Various Rest Rooms | |
| **Manufacturer** | Vanguard | Rheem | |
| **Model #** | 6E731 | 81VP68 | |
| **Serial #** | VG 0599310693 | RH 0304217828 | |
| **Size (Gallons)** | 15 | 6 | |
| **Input Capacity (MBH/KW)** | 2000 Watts | 2000 Watts | |
| **Recovery (Gal/Hr)** | N/A | N/A | |
| **Efficiency %** | 95% | 95% | |
| **Fuel** | Electric | Electric | |
| **Approx Age** | 15 | 10 | |
| **ASHRAE Service Life** | 15 | 15 | |
| **Remaining Life** | 0 | 5 | |
| **Comments** | | | |

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

# MAJOR EQUIPMENT LIST

## Concord Engineering Group

### BOE OFFICE

## Boilers

| Tag | B-1 | |
|---|---|---|
| **Unit Type** | Cast Iron Sectional | |
| **Qty** | 1 | |
| **Location** | Boiler Room | |
| **Area Served** | Entire Facility | |
| **Manufacturer** | Weil-McLain | |
| **Model #** | HG-9 | |
| **Serial #** | N/A | |
| **Rated Input Capacity (Btu/Hr)** | 445,200 BTUH | |
| **Rated Output Capacity (Btu/Hr)** | 356,000 BTUH (New) | |
| **Approx. Efficiency %** | 70% (Present Age, Condition) | |
| **Fuel** | Natural Gas | |
| **Approx Age** | 43 | |
| **ASHRAE Service Life** | 35 | |
| **Remaining Life** | (8) | |
| **Comments** | Electronic Barber Coleman controls are outdated | |

**Note:**

"N/A" = Not Applicable.

"-" = Info Not Available

# MAJOR EQUIPMENT LIST

## Concord Engineering Group

### BOE OFFICE

## Pumps

| Tag | P-1 & P-2 | P-3 & P-4 |
|---|---|---|
| **Unit Type** | In-Line Pump | In-Line Pump |
| **Qty** | 2 | 2 |
| **Location** | Boiler Room | Boiler Room |
| **Area Served** | 1971 Addition | Original building |
| **Manufacturer** | Bell & Gossett | Bell & Gossett |
| **Model #** | "-" | "-" |
| **Serial #** | "-" | "-" |
| **Horse Power** | 3/4 | 1/2 |
| **Flow** | "-" | "-" |
| **Motor Info** | Marathon | Bell & Gossett |
| **Electrical Power** | 208-230/460 Three Phase | 208-230/460 Three Phase |
| **RPM** | 1725 | 1750 |
| **Motor Efficiency %** | N/A | N/A |
| **Approx Age** | 10 | 10 |
| **ASHRAE Service Life** | 20 | 20 |
| **Remaining Life** | 10 | 10 |
| **Comments** | | |

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

# APPENDIX E

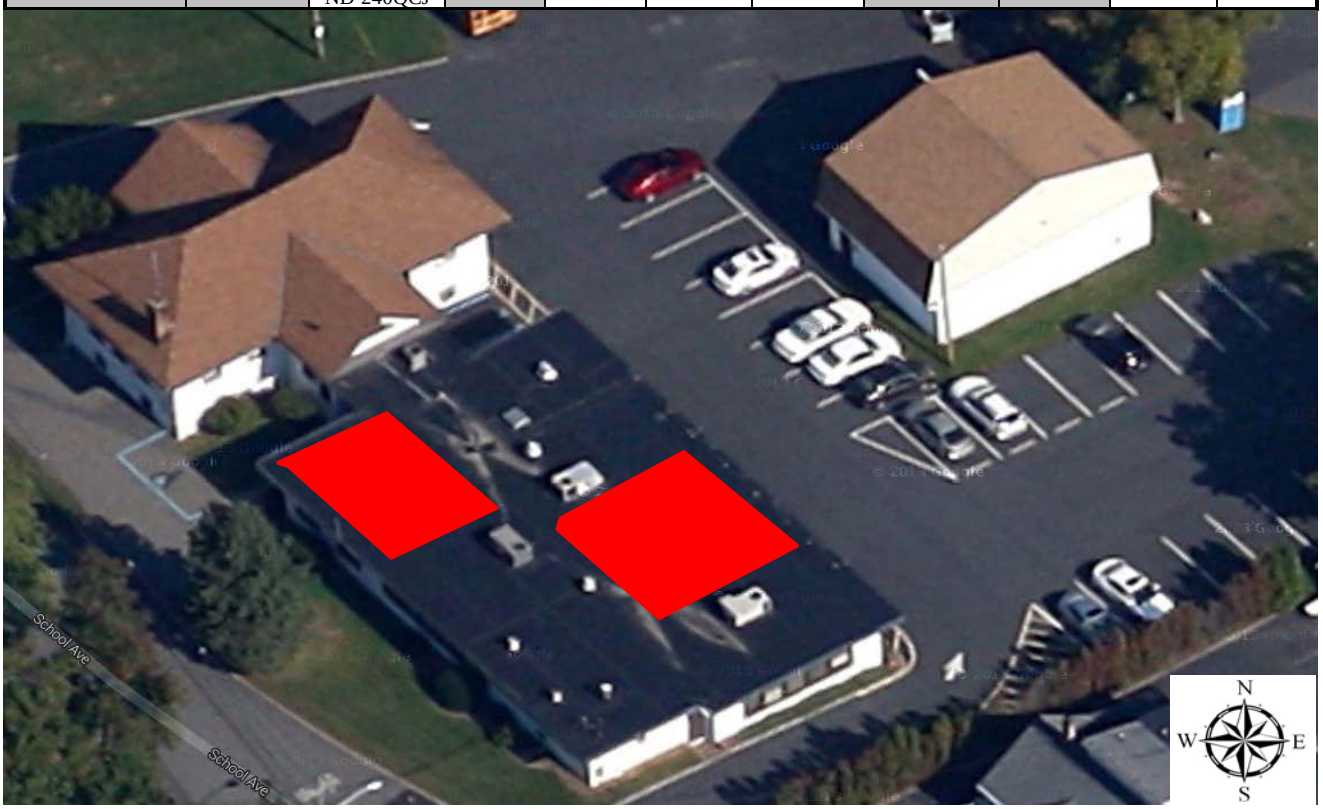
**CEG Project #:** 1C13496
**Facility Name:** Board Office
**Address:** 20 School Avenue
**City, State, Zip** East Hanover, NJ 07936

| | | | EXISTING FIXTURES | | | | | | PROPOSED FIXTURE RETROFIT | | | | | | | RETROFIT ENERGY SAVINGS | | | PROPOSED LIGHTING CONTROLS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fixture Reference # | Location | Average Burn Hours | Description | Lamps per Fixture | Watts per Fixture | Qty of Fixtures | Total kW | Usage kWh/Yr | Work Description | Equipment Description | Lamps per Fixture | Watts per Fixture | Qty of Fixtures | Total kW | Usage kWh/Yr | Energy Savings, kW | Energy Savings, kWh | Energy Savings, $ | Control Ref # | Controls Description | Qty of Controls | Hour Reduction % | Energy Savings, kWh | Energy Savings, $ |
| 100 | Main Hallway & Entrance Vestibule | 3120 | 2x2, 2 Lamp, 17w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 33 | 11 | 0.36 | 1,133 | Bypass Ballast, Relamp | 2' LED 11w; Retrofit | 2 | 22 | 11 | 0.24 | 755 | 0.12 | 378 | $49 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 2.21 | Secretaries | 3120 | 2x4 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 58 | 14 | 0.81 | 2,533 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 14 | 0.50 | 1,572 | 0.31 | 961 | $124 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 2.21 | Business Admin Office | 3120 | 2x4 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 58 | 3 | 0.17 | 543 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 3 | 0.11 | 337 | 0.07 | 206 | $27 | 5 | Dual Technology Occupancy Sensor - Remote Mnt. | 1 | 20.0% | 67 | $9 |
| 101 | Business Admin Restroom | 400 | 2x2, 1 Lamp, 17w T8, Elect. Ballast, Surface Mnt., Prismatic Lens | 1 | 18 | 2 | 0.04 | 14 | Bypass Ballast, Relamp | 2' LED 11w; Retrofit | 1 | 11 | 2 | 0.02 | 9 | 0.01 | 6 | $1 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 4.21 | Lunch Room | 3120 | 2x4 4 Lamp, 32w T8, Elect. Ballast, Recessed, Prismatic | 4 | 109 | 2 | 0.22 | 680 | Bypass Ballast, Relamp | 4' 18w LED Tube | 4 | 72 | 2 | 0.14 | 449 | 0.07 | 231 | $30 | 5 | Dual Technology Occupancy Sensor - Remote Mnt. | 1 | 20.0% | 90 | $12 |
| 10 | Boiler Room | 400 | 1x4 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., No Lens | 1 | 28 | 2 | 0.06 | 22 | Bypass Ballast, Relamp | 4' 18w LED Tube | 1 | 18 | 2 | 0.04 | 14 | 0.02 | 8 | $1 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 2.21 | Special Services | 3120 | 2x4 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 58 | 3 | 0.17 | 543 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 3 | 0.11 | 337 | 0.07 | 206 | $27 | 5 | Dual Technology Occupancy Sensor - Remote Mnt. | 0.5 | 20.0% | 67 | $9 |
| 100 | | 3120 | 2x2, 2 Lamp, 17w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 33 | 5 | 0.17 | 515 | Bypass Ballast, Relamp | 2' LED 11w; Retrofit | 2 | 22 | 5 | 0.11 | 343 | 0.06 | 172 | $22 | 5 | Dual Technology Occupancy Sensor - Remote Mnt. | 0.5 | 20.0% | 69 | $9 |
| 1.11 | Record Storage | 200 | 1x4 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic | 2 | 58 | 1 | 0.06 | 12 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 1 | 0.04 | 7 | 0.02 | 4 | $1 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 2.21 | Conference Room | 1200 | 2x4 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 58 | 8 | 0.46 | 557 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 8 | 0.29 | 346 | 0.18 | 211 | $27 | 5 | Dual Technology Occupancy Sensor - Remote Mnt. | 1 | 20.0% | 69 | $9 |
| 102 | Exit Signs | 8760 | (2) 7w CFL Exit Sign | 2 | 16 | 3 | 0.05 | 420 | Replace Fixture | LED Exit Sign | 1 | 2 | 3 | 0.01 | 53 | 0.04 | 368 | $47 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 2.21 | Board Secretary | 1200 | 2x4 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 58 | 2 | 0.12 | 139 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 2 | 0.07 | 86 | 0.04 | 53 | $7 | 5 | Dual Technology Occupancy Sensor - Remote Mnt. | 1 | 20.0% | 17 | $2 |
| 103 | Work Room | 3120 | 2x4 4 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens | 4 | 109 | 1 | 0.11 | 340 | Bypass Ballast, Relamp | 4' 18w LED Tube | 4 | 72 | 1 | 0.07 | 225 | 0.04 | 115 | $15 | 6 | Dual Technology Occupancy Sensor - Switch Mnt. | 1 | 20.0% | 45 | $6 |
| 101 | Custodial Closet | 400 | 2x2, 1 Lamp, 17w T8, Elect. Ballast, Surface Mnt., Prismatic Lens | 1 | 18 | 1 | 0.02 | 7 | Bypass Ballast, Relamp | 2' LED 11w; Retrofit | 1 | 11 | 1 | 0.01 | 4 | 0.01 | 3 | $0 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 104 | Mens Restroom | 3120 | 1x4 2 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic | 2 | 58 | 2 | 0.12 | 362 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 2 | 0.07 | 225 | 0.04 | 137 | $18 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 104 | Womens Restroom | 3120 | 1x4 2 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic | 2 | 58 | 2 | 0.12 | 362 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 2 | 0.07 | 225 | 0.04 | 137 | $18 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 105 | Maintenance Shops | 1200 | 1x4 2 Lamp, 32w T8, Elect. Ballast, Industrial, No Lens | 2 | 58 | 10 | 0.58 | 696 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 10 | 0.36 | 432 | 0.22 | 264 | $34 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 106 | | 1200 | 1x4 2 Lamp, 32w T8, Elect. Ballast, Surface Mnt., No Lens | 2 | 58 | 4 | 0.23 | 278 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 4 | 0.14 | 173 | 0.09 | 106 | $14 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 6.11 | | 1200 | 6"x4 1 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic | 1 | 28 | 3 | 0.08 | 101 | Bypass Ballast, Relamp | 4' 18w LED Tube | 1 | 18 | 3 | 0.05 | 65 | 0.03 | 36 | $5 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 2.21 | Superintendent's Office | 3120 | 2x4 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 58 | 16 | 0.93 | 2,895 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 16 | 0.58 | 1,797 | 0.35 | 1,098 | $142 | 5 | Dual Technology Occupancy Sensor - Remote Mnt. | 1 | 20.0% | 359 | $46 |

| | | | EXISTING FIXTURES | | | | | | PROPOSED FIXTURE RETROFIT | | | | | | | RETROFIT ENERGY SAVINGS | | | PROPOSED LIGHTING CONTROLS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fixture Reference # | Location | Average Burn Hours | Description | Lamps per Fixture | Watts per Fixture | Qty of Fixtures | Total kW | Usage kWh/Yr | Work Description | Equipment Description | Lamps per Fixture | Watts per Fixture | Qty of Fixtures | Total kW | Usage kWh/Yr | Energy Savings, kW | Energy Savings, kWh | Energy Savings, $ | Control Ref # | Controls Description | Qty of Controls | Hour Reduction % | Energy Savings, kWh | Energy Savings, $ |
| 2.21 | Restroom | 400 | 2x4 2 Lamp, 32w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 58 | 1 | 0.06 | 23 | Bypass Ballast, Relamp | 4' 18w LED Tube | 2 | 36 | 1 | 0.04 | 14 | 0.02 | 9 | $1 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| 100 | Top of Stairway | 3120 | 2x2, 2 Lamp, 17w T8, Elect. Ballast, Recessed Mnt., Prismatic Lens | 2 | 33 | 1 | 0.03 | 103 | Bypass Ballast, Relamp | 2' LED 11w; Retrofit | 2 | 22 | 1 | 0.02 | 69 | 0.01 | 34 | $4 | 0 | No New Controls | 0 | 0.0% | 0 | $0 |
| | **TOTAL** | | | | | **97** | **5** | **12,279** | | | | | **97** | **3** | **7,537** | **1.86** | **4,742** | **$612** | | | **7** | **2** | **784** | **$101** |

# APPENDIX F

| Location Description | Area (Sq FT) | Panel | Qty | Panel Sq Ft | Panel Total Sq Ft | Total $KW_{DC}$ | Total Annual kWh | Total $KW_{AC}$ | Panel Weight (41.9 lbs) | W/SQFT |
|---|---|---|---|---|---|---|---|---|---|---|
| Board Office | 600 | SHARP ND-240QCJ | 24 | 17.5 | 421 | 5.76 | 6,656 | 4.7 | 1,006 | 13.68 |




= Proposed PV Roof Layout

Notes:

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

**Project Name:** LGEA Solar PV Project - Board Office
**Location:**
**Description:** Photovoltaic System 100% Financing - 15 year

**Simple Payback Analysis**

| | Photovoltaic System 100% Financing - 15 year |
|---|---|
| Total Construction Cost | $28,895 |
| Annual kWh Production | 6,656 |
| Annual Energy Cost Reduction | $859 |
| Average Annual SREC Revenue | $1,272 |

Simple Payback: **13.56** Years

**Life Cycle Cost Analysis**

| | | | |
|---|---|---|---|
| Analysis Period (years): | 15 | Financing %: | 100% |
| Discount Rate: | 3% | Maintenance Escalation Rate: | 3.0% |
| Average Energy Cost ($/kWh) | **$0.129** | Energy Cost Escalation Rate: | 3.0% |
| Financing Rate: | 6.00% | Average SREC Value ($/kWh) | $0.191 |

| Period | Additional Cash Outlay | Energy kWh Production | Energy Cost Savings | Additional Maint Costs | SREC Revenue | Interest Expense | Loan Principal | Net Cash Flow | Cumulative Cash Flow |
|---|---|---|---|---|---|---|---|---|---|
| 0 | $0 | 0 | 0 | 0 | $0 | 0 | 0 | 0 | 0 |
| 1 | $0 | 6,656 | $859 | $0 | $1,664 | $1,700 | $1,226 | ($403) | ($403) |
| 2 | $0 | 6,623 | $884 | $0 | $1,656 | $1,625 | $1,301 | ($386) | ($789) |
| 3 | $0 | 6,590 | $911 | $0 | $1,647 | $1,544 | $1,381 | ($368) | ($1,157) |
| 4 | $0 | 6,557 | $938 | $0 | $1,639 | $1,459 | $1,467 | ($349) | ($1,505) |
| 5 | $0 | 6,524 | $966 | $67 | $1,631 | $1,369 | $1,557 | ($396) | ($1,901) |
| 6 | $0 | 6,491 | $995 | $67 | $1,298 | $1,273 | $1,653 | ($699) | ($2,600) |
| 7 | $0 | 6,459 | $1,025 | $67 | $1,292 | $1,171 | $1,755 | ($675) | ($3,276) |
| 8 | $0 | 6,427 | $1,056 | $66 | $1,285 | $1,063 | $1,863 | ($651) | ($3,927) |
| 9 | $0 | 6,394 | $1,088 | $66 | $1,279 | $948 | $1,978 | ($625) | ($4,552) |
| 10 | $0 | 6,362 | $1,120 | $66 | $954 | $826 | $2,100 | ($917) | ($5,469) |
| 11 | $0 | 6,331 | $1,154 | $65 | $950 | $696 | $2,230 | ($888) | ($6,357) |
| 12 | $0 | 6,299 | $1,189 | $65 | $945 | $559 | $2,367 | ($857) | ($7,214) |
| 13 | $0 | 6,267 | $1,224 | $65 | $940 | $413 | $2,513 | ($826) | ($8,040) |
| 14 | $0 | 6,236 | $1,261 | $64 | $624 | $258 | $2,668 | ($1,106) | ($9,146) |
| 15 | $0 | 6,205 | $1,299 | $64 | $620 | $93 | $2,833 | ($1,071) | ($10,217) |
| | **Totals:** | 96,420 | $15,969 | $721 | $18,424 | $14,995 | $28,895 | ($10,217) | ($66,553) |

**Net Present Value (NPV)** **($7,315)**