CITY OF LINWOOD
FIREHOUSE
ENERGY ASSESSMENT

for

NEW JERSEY
BOARD OF PUBLIC UTILITIES

CHA PROJECT NO. 22215

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1.0 INTRODUCTION AND BACKGROUND

The Fire House is a single story, approximately 11,360 SF structure constructed in the 1950s. The building consists of the engine room, offices, rental hall, kitchen, meeting room, restrooms, and lounge. The basement houses a mechanical equipment room and storage areas. The facility operates 24 hours per day with at least one person.

New Jersey’s Clean Energy Program, funded by the New Jersey Board of Public Utilities, supports energy efficiency and sustainability for Municipal and Local Government Energy Audits. Through the support of a utility trust fund, New Jersey is able to assist state and local authorities in reducing energy consumption while increasing comfort.

2.0 EXECUTIVE SUMMARY

This report details the results of the Fire House in Linwood, New Jersey. The single story, approximately 11,360 SF structure consists of the engine room, offices, rental hall, kitchen, meeting room, restrooms, and lounge. The facility is operational 24/7 with at least one person on site. The following areas were evaluated for energy conservation measures:

- Lighting replacement
- Boiler replacement
- Infrared heater installation
- Insulation upgrades

A potential Energy Conservation Measure (ECM) was identified for the above categories. Potential annual savings of $2,400 for the recommended ECM may be realized with a payback of 6.4 years.

The ECMs identified in this report will allow for the building to reduce its energy usage and if pursued has the opportunity to qualify for the New Jersey SmartStart Buildings Program. A summary of the cost, saving, and payback for the recommended ECM follows:

ECM-5 Lighting Replacements

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
16,600	7.7	20,200	0	2,400	1.2	1,200	6.9	6.4

*Incentive shown is per the New Jersey Smart Start Program, 2011 Prescriptive Lighting Application. See section 5.0 for other incentive opportunities.

In addition, the following measures are recommended if they qualify for funding through the Direct Install Program (see section 5.2.4). Under this program, incentives can be potentially awarded for up to 60% of a project's budgetary cost with a maximum incentive of $50,000, when the work is performed by a participating Direct Install contractor.

- ECM-2 Boiler Replacement
- ECM-4 Install Infrared Heaters – Engine Room

3.0 EXISTING CONDITIONS

3.1 Building – General

The single story, approximately 11,360 SF Fire House was constructed in the 1950s. The facility is comprised of an engine room, offices, rental hall, kitchen, meeting room, restrooms and lounge. The building basement consists of a mechanical equipment room and storage areas.

The facility operates 24 hours per day with at least one person. From 8:00 AM to 4:00 PM, Monday through Friday, there are at least six people on site. The meeting room is used about two to three times per week for several hours at a time. This hall is used approximately two times per month.

The front exterior wall is constructed of 4” face brick and 8” concrete masonry unit (CMU) block. The remaining exterior walls are constructed of 8” CMU block with stucco top finish. The roof assembly is supported by steel joists, 4” concrete decking, 2” rigid insulation, and rubber membrane.

Building windows are vinyl frame with double pane glass and are in average condition. The engine room is equipped with two overhead doors in the front of the building, which are insulated and have door seals.

3.2 Utility Usage

Utilities include electricity, natural gas, and potable water. Electricity is purchased from Atlantic City Electric with supply provided from Constellation New Energy, Inc. Natural gas is purchased from South Jersey Gas, and potable water is provided by New Jersey American Water.

From October 2009 through September 2010, electric usage was approximately 36,400 kWh at a cost of about $4,300. Analyzing electricity bills during this period showed that the building was charged at a blended unit cost of $0.12 per kWh. Electricity usage was generally higher in the summer months when air conditioning equipment operates. During the same timeframe, the building heat and domestic hot water (DHW) produced by natural gas-fired equipment required about 5,100 therms. Based on the annual cost of about $6,800, the blended price for natural gas was $1.33 per therm. Natural gas consumption was highest in the winter months when the building was in heating mode. Most of the gas use in this building is for space heating, and about 15 therms per month were used as a baseline case for domestic hot water production.

Review of potable water utility bills from September 2009 through August 2010 determined the facility used a total of 74,000 gallons of water annually. At a total cost of about $600, the unit cost for water was $7.25 per kGal. It should be noted that the month of June recorded usage of 21,000 gallons of water while the remainder of the year averaged 5,000 gallons per month. The cause for the usage spike was unknown to facility staff. Utility data can be found in Appendix A.

3.3 HVAC Systems

Building heat is generated by a Crane 130 MBH input, gas-fired hot water boiler. The boiler is over 25 years’ old and is beyond its useful life. The hot water is distributed via five in-line mounted pumps. The terminal heating equipment includes hot water finned tube radiators and suspended unit heaters. There are five hot water unit heaters in the engine room that are mounted to the ceiling and blow the air down into the room.

Two wall mounted Sanyo split-system air conditioning units provide space cooling for the meeting room and Fire Marshall's office. These units are about six years' old and have an existing efficiency of about 12 EER. The meeting room has two 5 ton self contained rooftop units which are cooling only. These units are about eight years' old and have an existing efficiency of about 12 EER. The remainder of the building has two high velocity air handlers which are cooling only systems. The ducts are small 2" diameter branches and serve air outlets in various rooms. These high velocity systems are less than five years' old.

The kitchen hood has an exhaust fan located on the roof. The motor was not seen, but is estimated at 2 HP. The exhaust fan and kitchen hood are seldom used. The restrooms have a single exhaust fan which is operated with a wall switch.

3.4 Lighting/Electrical Systems

3.4.1 Interior Lighting

The building's lighting is older style T-12 lamps and magnetic ballasts. The lighting is controlled by individual switches on the walls.

3.4.2 Exterior Lighting

There are several fixtures mounted to the building, and four 75 watt incandescent lamps on timers serve the flagpole.

3.5 Control Systems

3.5.1 HVAC Controls

The HVAC controls in the building consist of wall mounted thermostats. Temperature setpoints vary throughout the main building area; on average, these are 68°F for heating and 73°F for cooling during occupied times. The thermostats are programmable and use unoccupied setpoints of 80°F for cooling and 60°F for heating in the zones that are not used.

The five unit heaters in the engine room are controlled by a manual thermostat set at about 65°F.

3.5.2 Lighting/Electrical Controls

Lighting controls within the building are manual switches located within each space. The outside lighting is controlled with a photocell sensor.

3.6 Plumbing Systems

Domestic hot water is generated by a 40 gallon, AO Smith gas-fired water heater with an input of 40 MBH and is in average condition. It has an existing efficiency of about 80%.

4.0 ENERGY CONSERVATION MEASURES

4.1 ECM-1 Insulate Roof Over Rental Hall

The roof of the rental hall is flat with a rubber membrane on the outside. The existing insulation is old and this ECM evaluated adding about 6 inches of batt insulation. This would raise the thermal resistance, or R-value, from about R-15 to R-34.

To calculate the savings associated with adding insulation, the existing thermal losses through the roof were calculated with the existing insulation, which was then compared with the thermal losses through the roof with the added insulation. The difference between the existing conditions and proposed conditions was compared with yearly temperature bin data. The calculated annual savings associated with adding additional roof insulation would be approximately 170 therms of natural gas per year and 120 kWh of power.

Insulation has a life expectancy of about 20 years according to the manufacturer, and the total energy savings over the life of the project would be about 2,400 kWh, 3,400 therms, and $4,000.

The implementation cost and savings related to this ECM are presented in Appendix B and summarized below:

ECM-1 Insulate Roof Over Rental Hall

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
4,300	0	120	170	200	0.1	NA	22	NA

* There is no incentive available through the New Jersey Smart Start program for this ECM. See section 5.0 for other incentive opportunities.

This measure is not recommended.

4.2 ECM-2 Boiler Replacement

The Firehouse is heated with a natural gas boiler with 1,100 MBH input. The boiler is over 25 years' old and operates with an estimated efficiency of 68%. Hot water is circulated throughout the building to finned tube heaters and unit heaters in the engine room. This ECM assessed replacing the existing boiler with a gas fired condensing unit, which can achieve efficiencies up to 95%.

To calculate the savings associated with replacing the boiler, historical utility data was utilized. A new condensing boiler could save approximately 1280 therms of natural gas per year.

Condensing boilers are costly which adversely affects the payback of this ECM. However, since the current boiler is very old, it is recommended that when a new boiler is required, a condensing unit should be considered.

Condensing boilers have a life expectancy of about 20 years, according to ASHRAE. The total energy savings over the life of the project is 25,600 therms and $34,000.

The implementation cost and savings associated with this ECM are represented in Appendix C and summarized below:

ECM-2 Boiler Replacement

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
56,700	0	0	1,280	1,700	(0.4)	1,200	>25	>25

* Incentive shown is per the New Jersey Smart Start Program, Gas Heating Application. Also, this measure is potentially eligible for Direct Install funding. See section 5.0 for other incentive opportunities.

This measure is not recommended.

4.3 ECM-3 Increase Wall Insulation – Engine Room

The exterior walls of the engine room are constructed 12" CMU block which has a low R-value of about 13. This ECM addressed adding rigid board insulation to the interior side of the CMU block walls in the engine room to minimize heat energy losses.

To calculate the savings, the heat losses through the exterior walls of engine room were found using the existing walls' R-value and bin weather data for Atlantic City, NJ. The values were totaled to determine the existing annual heat losses. Heat loss values were then determined with a thermal resistance which included the addition of R-16 insulation. The annual energy savings of adding insulation to the exterior block walls is expected to be about 70 therms.

Rigid board insulation has an expected life of 20 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 1,400 therms and $2,000.

The implementation cost and savings related to this ECM are presented in Appendix D and summarized below:

ECM-3 Increase Wall Insulation – Engine Room

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
4,500	0	0	70	100	(0.6)	NA	>25	>25

* There is no incentive is available through the New Jersey Smart Start 2011 program for this ECM. See section 5.0 for other incentive opportunities.

This measure is not recommended.

4.4 ECM-4 Install Infrared Heaters – Engine Room

The engine room is heated by five hot water unit heaters suspended from the ceiling. Since the unit heaters utilize hot water supplied by the boiler plant, the units generate heat at the same efficiency as the boiler. This ECM evaluated replacement of the hot water unit heaters with infrared gas fired heaters.

Infrared heaters distribute heat more effectively than traditional unit heaters, have higher burner efficiencies, and do not require an air circulation fan.

The proposed infrared heaters have a burner efficiency of 85% and will transfer heat more effectively via radiation. A block load spreadsheet was developed, and applying efficiency improvements, it was determined that the annual heating gas energy required using infrared heaters is about 1,000 therms. Electrical energy savings will also be realized by eliminating the need to operate the air circulation fans utilized by the existing unit heaters. The electrical energy saving was calculated by applying the annual heating operating hours from the bin data spreadsheet to the power requirement for the existing unit heaters and proposed infrared heaters. The total annual electrical savings for this ECM is estimated to be 3,700 kWh.

Implementation of this measure requires running natural gas piping from the service line to the proposed units. New exhaust flue stacks and electrical wiring will also be necessary. Flue stacks for the heaters can be combined per the manufacturer's installation instructions. To calculate the budgetary cost, four infrared heaters were used as outlined in the cost estimate. The quantity, size, and capacity of the heaters were used for estimating purposes only. Exact heater selection and sizing cannot be completed without generating a heating load profile for the space.

It is important to note that application of this measure will significantly reduce the load on the hot water boiler. Therefore, if this ECM was combined with replacing the boiler, a much smaller boiler would be adequate to meet the reduced building heating load, reducing the initial cost of a new boiler. If both the boiler and unit heaters were replaced, the savings for both measures taken together will need to be calculated and may be less than indicated.

Infrared heaters have an expected life of 15 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 15,000 therms and 55,500 kWh, totaling $27,000.

The implementation cost and savings related to this ECM are presented in Appendix E and summarized as below:

ECM-4 Install Infrared Heaters – Engine Room

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
20,000	0	3,700	1,000	1,800	0.4	NA	11.0	NA

* Incentive shown is per the New Jersey Smart Start Program, Gas Heating Application. Also, this measure is potentially eligible for Direct Install funding. See section 5.0 for other incentive opportunities.

This measure is not recommended.

4.5 ECM-5 Lighting Replacements

During the site visit, a comprehensive fixture survey was conducted of the entire building. Each switch and circuit was identified, as well as the number of fixtures, locations, approximate operating times, and existing wattage consumption. The existing fixtures are older technology T-12 lamps and magnetic ballasts throughout most of the facility. This measure addressed the expected energy savings by replacing the T-12 fixtures with high efficiency T-8 fluorescent lamps and electronic ballasts.

Energy savings for this measure were calculated by applying the existing and proposed fixture wattages to the estimated time of operation to determine annual electrical consumption. The difference resulted in an annual savings of about 20,200 kWh per year. Supporting calculations, including all assumptions for lighting hours and the annual energy usage for each fixture is provided in Appendix F.

Lighting has an expected life of 15 years, according to the manufacturer, and total energy savings over the life of the project are estimated at 303,000 kWh, totaling $36,000.

The implementation cost and savings related to this ECM are presented in Appendix F and summarized below:

ECM-5 Lighting Replacements

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
16,600	7.7	20,200	0	2,400	1.2	1,200	6.9	6.4

*Incentive shown is per the New Jersey Smart Start Program, 2011 Prescriptive Lighting Application. See section 5.0 for other incentive opportunities.

This measure is recommended.

5.0 PROJECT INCENTIVES

5.1 Incentives Overview

5.1.1 New Jersey Pay For Performance Program

The Firehouse building will be eligible for incentives from the New Jersey Office of Clean Energy. The most significant incentives will be from the New Jersey Pay for Performance (P4P) Program. The P4P program is designed for qualified energy conservation projects in facilities whose demand in any of the preceding 12 months exceeds 200 kW. However, the 200 kW/month average minimum has been waived for buildings owned by local governments or municipalities and non-profit organizations. Facilities that meet this criterion must also achieve a minimum performance target of 15% energy reduction by using the EPA Portfolio Manager benchmarking tool before and after implementation of the measure(s). If the participant is a municipal electric company customer, and a customer of a regulated gas New Jersey Utility, only gas measures will be eligible under the Program. American Recovery and Reinvestment Act (ARRA) funding, when available, may allow oil, propane and municipal electric customers to be eligible for the P4P Program.

Incentive #1: Energy Reduction Plan – This incentive is designed to offset the cost of services associated with the development of the Energy Reduction Plan (ERP). The standard incentive pays $0.10 per square foot, up to a maximum of $50,000, not to exceed 50% of facility annual energy cost, paid after approval of application. For building audits funded by the New Jersey Board of Public Utilities, which receive an initial 75% incentive toward performance of the energy audit, facilities are only eligible for an additional $0.05 per square foot, up to a maximum of $25,000, rather than the standard incentive noted above.

Incentive #2: Installation of Recommended Measures – This incentive is based on projected energy saving and designed to pay approximately 60% of the total performance-based incentive. Base incentives deliver $0.11/kWh and $1.10/therm not to exceed 30% of total project cost.

Incentive #3: Post-Construction Benchmarking Report – This incentive is paid after acceptance of a report proving energy savings over one year utilizing the Environmental Protection Agency (EPA) Portfolio Manager benchmarking tool. Incentive #3 base incentives deliver $0.07/kWh and $0.70/therm not to exceed 20% of total project cost.

Combining incentives #2 and #3 will provide a total of $0.18/ kWh and $1.8/therm not to exceed 50% of total project cost. Additional incentives for #2 and #3 are increased by $0.005/kWh and $0.05/therm for each percentage increase above the 15% minimum target to 20%, calculated with the EPA Portfolio Manager benchmarking tool, not to exceed 50% of total project cost.

5.1.2 New Jersey Smart Start Program

For this program, specific incentives for energy conservation measures are calculated on an individual basis utilizing the 2011 New Jersey Smart Start incentive program. This program provides incentives dependent upon mechanical and electrical equipment. If applicable, incentives from this program are reflected in the ECM summaries and attached appendices.

If the building qualifies and enters into the New Jersey Pay for Performance Program, all energy savings will be included in the total building energy reduction, and savings will be applied towards the Pay for Performance incentive. A project is not applicable for both New Jersey incentive programs.

5.1.3 Energy Efficient and Conservation Block Grant

Following is a brief summary of the Energy Efficient and Conservation Block Grant (EECBG) program. The Energy Efficiency and Conservation Block Grant Complete Program Application Package should be consulted for rules and regulations.

Additional funding is available to local government entities through the EECBG, a part of New Jersey's Clean Energy program (NJCEP). The grant is for local government entities only, and can offset the cost of energy reduction implementation to a maximum of $20,000 per building.

This program is provided in conjunction with NJCEP funding and any utility incentive programs; the total amount of the three incentives combined cannot exceed 100% of project cost. Funds shall first be provided by NJCEP, followed by the EECBG and any utility incentives available to the customer. The total amount of the incentive shall be determined TRC Solutions, a third party technical consulting firm for the NJCEP.

In order to receive EECBG incentives, local governments must not have received a Direct Block Grant from the US Department of Energy. A list of the 512 qualifying municipalities and counties is provided on the NJCEP website. Qualifying municipalities must participate in at least one eligible Commercial & Industrial component of the NJCEP, utility incentive programs, or install building shell measures recommended by the Local Government Energy Audit Program. Eligible conservation programs through NJCEP include:

- Direct Install
- Pay for Performance
- NJ SmartStart Buildings for measures recommended by a Local Government Energy Audit (LGEA) or an equivalent audit completed within the last 12 months
- Applicants may propose to independently install building shell measures recommended by a LGEA or an equivalent audit. The audit must have been completed within the past 12 months.
- Any eligible utility energy efficiency incentive program

Most facilities owned or leased by an eligible local government within the State of New Jersey are eligible for this grant. Ineligible facilities include casinos or other gambling establishments, aquariums, zoos, golf courses, swimming pools, and any building owned or leased by the United States Federal Government. New construction is also ineligible.

5.1.4 ARRA Initiative "Energy Efficiency Programs through the Clean Energy Program"

The American Recovery and Reinvestment Act (ARRA) Initiative is available to New Jersey oil, propane, cooperative and municipal electric customers who do not pay the Societal Benefits Charge. This charge can be seen on any electric bill as the line item "SBC Charge." Applicants can participate in this program in conjunction with other New Jersey Clean Energy Program initiatives including Pay for Performance, Local Government Energy Audits, and Direct Install programs.

Funding for this program is dispersed on a first come, first serve basis until all funds are exhausted. The program does not limit the municipality to a minimum or maximum incentive, and the availability of funding cannot be determined prior to application. If the municipality meets all qualifications, the application must be submitted to TRC Energy Solutions for review. TRC will then determine the amount of the incentive based on projected energy savings of the project. It is important to note that all applications for this incentive must be submitted before implementation of energy conservation measures.

Additional information is available on New Jersey's Clean Energy Program website.

5.2 Building Incentives

5.2.1 New Jersey Pay For Performance Program

Under incentive #1 of the New Jersey Pay for Performance Program, the Fire House is eligible for about $664 toward development of an Energy Reduction Plan. When calculating the total amount under Incentives #2 and #3, all energy conservation measures are applicable as the amount received is based on building wide energy improvements. Since the overall energy reduction for the building is estimated to exceed the 15% minimum, the building is eligible to receive monies based as discussed above in section 5.1.1. In total, incentives through the NJ P4P program are expected to total about $12,280, reducing the total project payback from 16.3 years to 14.3 years. See Appendix G for calculations.

5.2.2 New Jersey Smart Start Program

The City of Linwood Fire House is eligible for several incentives available under New Jersey Smart Start Programs. The total amount of all qualified incentives is about $2,400 and includes lighting and boiler replacement.

Incentives cannot be obtained under multiple NJCEP programs.

5.2.3 Energy Efficient and Conservation Block Grant

The Firehouse building is owned by local government, and is, therefore, eligible for this incentive. The incentive amount is determined by TRC Solutions and is not calculable at this time. Further information about this incentive, including the application, can be found at:
http://www.njcleanenergy.com/commercial-industrial/programs/energy-efficiency-and-conservation-block-grants

5.2.4 Direct Install Program

The building is potentially eligible to receive funding from the Direct Install Program. This money will be in conjunction with the Energy Efficiency and Conservation Block Grant. The total implementation cost for all ECMs potentially eligible for Direct Install funding is about $92,700 and includes lighting upgrades, new boiler, and infrared heater. This program would pay 60%, or about $55,600 of these initial costs. This funding has the potential to significantly affect the payback periods of ECMs. For the Fire House, the Direct Install Program brings the simple payback from about 16.0 years, to approximately 7.4 years.

6.0 ALTERNATIVE ENERGY SCREENING EVALUATION

6.1 Geothermal

Geothermal heat pumps (GHP) transfer heat between the constant temperature of the earth and the building to maintain the building's interior space conditions. Below the surface of the earth throughout New Jersey the temperature remains in the low 50°F range throughout the year. This stable temperature provides a source for heat in the winter and a means to reject excess heat in the summer. With GHP systems, water is circulated between the building and the piping buried in the ground. The ground heat exchanger in a GHP system is made up of a closed or open loop pipe system. Most common is the closed loop in which high density polyethylene pipe is buried horizontally at 4-6 feet deep or vertically at 100 to 400 feet deep. These pipes are filled with an environmentally friendly antifreeze/water solution that acts as a heat exchanger. In the summer, the water picks up heat from the building and moves it to the ground. In the winter the system reverses and fluid picks up heat from the ground and moves it to the building. Heat pumps make collection and transfer of this heat to and from the building possible.

The building uses a gas-fired, hot water boiler and split system AHUs with DX cooling to meet the HVAC requirements. Since the existing heating and air conditioning systems would need to be removed and replaced, the high cost associated with this would make this option unfavorable. This measure is not recommended.

6.2 Solar

6.2.1 Photovoltaic Rooftop Solar Power Generation

The facility was evaluated for the potential to install rooftop photovoltaic (PV) solar panels for power generation. Present technology incorporates the use of solar cell arrays that produce direct current (DC) electricity. This DC current is converted to alternating current (AC) with the use of an electrical device known as an inverter. The building's roof appears to have sufficient room to install a 10 kW solar cell array. A structural analysis would be required to determine if the roof framing could support a cell array.

The PVWATTS solar power generation model was utilized to calculate PV power generation. The New Jersey Clean Power Estimator provided by the New Jersey Clean Energy Program is presently being updated; therefore, the site recommended use of the PVWATT solar grid analyzer version 1. The closest city available in the model is Atlantic City, New Jersey and a fixed tilt array type was utilized to calculate energy production. The PVWATT solar power generation model is provided in Appendix H.

The State of New Jersey incentives for non-residential PV applications is $0.75/watt up to 50 kW of installed PV array. Federal tax credits are also available for renewable energy projects up to 30% of installation cost. Municipalities do not pay federal taxes; therefore, would not be able to utilize the federal tax credit incentive.

Installation of (PV) arrays in the state New Jersey will allow the owner to participate in the New Jersey solar renewable energy certificates program (SREC). This is a program that has been set up to allow entities with large amounts of environmentally unfriendly emissions to purchase credits from zero emission (PV) solar-producers. An alternative compliance penalty (ACP) is paid for by the high emission producers and is set each year on a declining scale of 3% per year. One SREC credit is equivalent to 1000 kilowatt hours of PV electrical production; these credits can be traded for period of 15 years from the date of installation. There is no definitive way to calculate an exact price that will be received by the

PV producer per SREC over the next 15 years. Renewable Energy Consultants estimated an average of $487/ SERC per year and this number was utilized in the cash flow for this report.

The implementation cost and savings related to this ECM are presented in Appendix H and summarized as follows:

Photovoltaic (PV) Rooftop Solar Power Generation – 10 kW System

Budgetary Cost	Annual Utility Savings				Total Savings	New Jersey Renewable Energy Incentive*	New Jersey Renewable SREC**	Payback (without incentive)	Payback (with incentives)
	Electricity		Natural Gas	Total					
$	kW	kWh	Therms	$	$	$	$	Years	Years
70,000	0	12,500	0	1,500	1,500	15,000	6,100	>25	7.2

*Incentive based on New Jersey Renewable Energy Program for non-residential applications of $0.75 per Watt of installed capacity
** Estimated Solar Renewable Energy Certificate Program (SREC) for 15 years at $487/1000 kWh

While the payback period is within the parameters for recommended measures, further investigation of possible installation locations, required system maintenance, and local installation costs are suggested prior to consideration for implementation.

6.2.2 Solar Thermal Hot Water Plant

Active solar thermal systems use solar collectors to gather the sun's energy to heat water, another fluid, or air. An absorber in the collector converts the sun's energy into heat. The heat is then transferred by circulating water, antifreeze, or sometimes air to another location for immediate use or storage for later utilization. Applications for active solar thermal energy include providing hot water, heating swimming pools, space heating, and preheating air in residential and commercial buildings.

A standard solar hot water system is typically composed of solar collectors, heat storage vessel, piping, circulators, and controls. Systems are typically integrated to work alongside a conventional heating system that provides heat when solar resources are not sufficient. The solar collectors are usually placed on the roof of the building, oriented south, and tilted around the site's latitude, to maximize the amount of radiation collected on a yearly basis.

Several options exist for using active solar thermal systems for space heating. The most common method involves using glazed collectors to heat a liquid held in a storage tank (similar to an active solar hot water system). The most practical system would transfer the heat from the panels to thermal storage tanks and transfer solar produced thermal energy to use for domestic hot water production. DHW is presently produced by a gas fired water heater and, therefore, this measure would offer natural gas savings.

Currently, an incentive is not available for installation of thermal solar systems. A Federal tax credit of 30% of installation cost for the thermal applications is available; however, the City of Linwood does not pay Federal taxes and, therefore, would not benefit from this program.

The implementation cost and savings related to this ECM are presented in Appendix I and summarized as follows:

Solar Thermal Domestic Hot Water Plant

Budgetary Cost	Annual Utility Savings				Total Savings	New Jersey Renewable Energy Incentive	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$	$	$	Years	Years
27,100	0	0	170	200	200	NA	>25	NA

* No incentive is available in New Jersey at this time.

This measure is not recommended.

6.3 Wind

Small wind turbines use a horizontal axis propeller, or rotor, to capture the kinetic energy of the wind and convert it into rotary motion to drive a generator which usually is designed specifically for the wind turbine. The rotor consists of two or three blades, usually made from wood or fiberglass. These materials give the turbine the needed strength and flexibility, and have the added advantage of not interfering with television signals. The structural backbone of the wind turbine is the mainframe, and includes the slip-rings that connect the wind turbine, which rotates as it points into changing wind directions, and the fixed tower wiring. The tail aligns the rotor into the wind.

To avoid turbulence and capture greater wind energy, turbines are mounted on towers. Turbines should be mounted at least 30 feet above any structure or natural feature within 300 feet of the installation. Smaller turbines can utilize shorter towers. For example, a 250-watt turbine may be mounted on a 30-50 foot tower, while a 10 kW turbine will usually need a tower of 80-120 feet. Tower designs include tubular or latticed, guyed or self-supporting. Wind turbine manufacturers also provide towers.

The New Jersey Clean Energy Program for small wind installations has designated numerous pre-approved wind turbines for installation in the State of New Jersey. Incentives for wind turbine installations are based on kilowatt hours saved in the first year. Systems sized under 16,000 kWh per year of production will receive a $3.20 per kWh incentive. Systems producing over 16,000 kWh will receive $51,200 for the first 16,000 kWh of production with an additional $0.50 per kWh up to a maximum cap of 750,000 kWh per year. Federal tax credits are also available for renewable energy projects up to 30% of installation cost for systems less than 100 kW. However, as noted previously, municipalities do not pay federal taxes and is, therefore, not eligible for the tax credit incentive.

The most important part of any small wind generation project is the mean annual wind speed at the height of which the turbine will be installed. A wind speed map is included in Appendix J. The firehouse is located in a residential neighborhood with limited ground clearance so this measure is not recommended.

6.4 Combined Heat and Power Generation (CHP)

Combined heat and power, cogeneration, is self-production of electricity on-site with beneficial recovery of the heat byproduct from the electrical generator. Common CHP equipment includes reciprocating engine-driven, micro turbines, steam turbines, and fuel cells. Typical CHP customers include industrial, commercial, institutional, educational institutions, and multifamily residential facilities. CHP systems that are commercially viable at the present time are sized approximately 50 kW and above, with numerous options in blocks grouped around 300 kW, 800 kW, 1,200 kW and larger. Typically, CHP systems are used to produce a portion of the electricity needed by a facility some or all of the time, with the balance of electric needs satisfied by purchase from the grid.

Any proposed CHP project will need to consider many factors, such as existing system load, use of thermal energy produced, system size, natural gas fuel availability, and proposed plant location. The Firehouse has some need for electrical generation and the ability to use some of the thermal byproduct during the winter, but the thermal usage during the summer months is low. Thermal energy produced by the CHP plant in the warmer months will be wasted and will not be utilized.

This measure is not recommended.

6.5 Biomass Power Generation

Biomass power generation is a process in which waste organic materials are used to produce electricity or thermal energy. These materials would otherwise be sent to the landfill or expelled to the atmosphere. To participate in NJCEP's Customer On-Site Renewable Energy program, participants must install an on-site sustainable biomass or fuel cell energy generation system. Incentives for bio-power installations are available to support up to 1MW-dc of rated capacity.

*Class I organic residues are eligible for funding through the NJCEP CORE program. Class I wastes include the following renewable supply of organic material:

- Wood wastes not adulterated with chemicals, glues or adhesives
- Agricultural residues (corn stover, rice hulls or nut shells, manures, poultry litter, horse manure, etc) and/or methane gases from landfills
- Food wastes
- Municipal tree trimming and grass clipping wastes
- Paper and cardboard wastes
- Non adulterated construction wood wastes, pallets

The NJDEP evaluates biomass resources not identified in the RPS.

Examples of eligible facilities for a CORE incentive include:

- Digestion of sewage sludge
- Landfill gas facilities
- Combustion of wood wastes to steam turbine
- Gasification of wood wastes to reciprocating engine
- Gasification or pyrolysis of bio-solid wastes to generation equipment

* from NJOCE Website

This measure is not recommended due to of noise issues and because the building does not have a steady waste stream to fuel the power generation system.

6.6 Demand Response Curtailment

Presently, electricity is delivered by Atlantic City Electric, which receives the electricity from regional power grid RFC. PJM is the regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of 13 states and the District of Columbia including the State of New Jersey.

Utility Curtailment is an agreement with the regional transmission organization and an approved Curtailment Service Provider (CSP) to shed electrical load by either turning major equipment off or energizing all or part of a facility utilizing an emergency generator; therefore, reducing the electrical demand on the utility grid. This program is to benefit the utility company during high demand periods and PJM offers incentives to the CSP to participate in this program. Enrolling in the program will require program participants to drop electrical load or turn on emergency generators during high electrical demand conditions or during emergencies. Part of the program also will require that program participants reduce their required load or run emergency generators with notice to test the system.

A pre-approved CSP will require a minimum of 100 kW of load reduction to participate in any curtailment program and this measure is not recommended because the facility does not have adequate load to meet the required minimum load reduction.

7.0 EPA PORTFOLIO MANAGER

The United States Environmental Protection Agency (EPA) is a federal agency in charge of regulating environment waste and policy in the United States. The EPA has released the EPA Portfolio Manager for public use. The program is designed to allow property owners and managers to share, compare and improve upon their facility's energy consumption. Inputting such parameters as electricity, heating fuel, building characteristics and location into the website based program generates a naturalized energy rating score out of 100. Once an account is registered, monthly utility data can be entered to track the savings progress and retrieve an updated energy rating score on a monthly basis.

The EPA Portfolio Manager did not generate an energy rating score for this building because the building type (Fire Station/Police Station) is not eligible for an energy star rating. However, the Site Energy Usage Index (EUI) was calculated to be 84 kBTU/ft^2/year. The EUI can be improved by addressing the ECMs listed in this report. By implementing the measures discussed in this report, it is expected that the EUI can be reduced to approximately 42 kBTU/ft^2/year.

A full EPA Energy Star Portfolio Manager Report is located in Appendix K.

The user name and password for the building's EPA Portfolio Manager Account has been provided to Hank Kolakowski.

8.0 CONCLUSIONS & RECOMMENDATIONS

The energy audit conducted by CHA at the Fire House in Linwood, New Jersey identified a potential ECM for lighting replacements. Potential annual savings of $2,400 may be realized for the recommended ECMs, with a summary of the costs, savings, and paybacks as follows:

ECM-5 Lighting Replacements

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
16,600	7.7	20,200	0	2,400	1.2	1,200	6.9	6.4

*Incentive shown is per the New Jersey Smart Start Program, 2011 Prescriptive Lighting Application. See section 5.0 for other incentive opportunities.

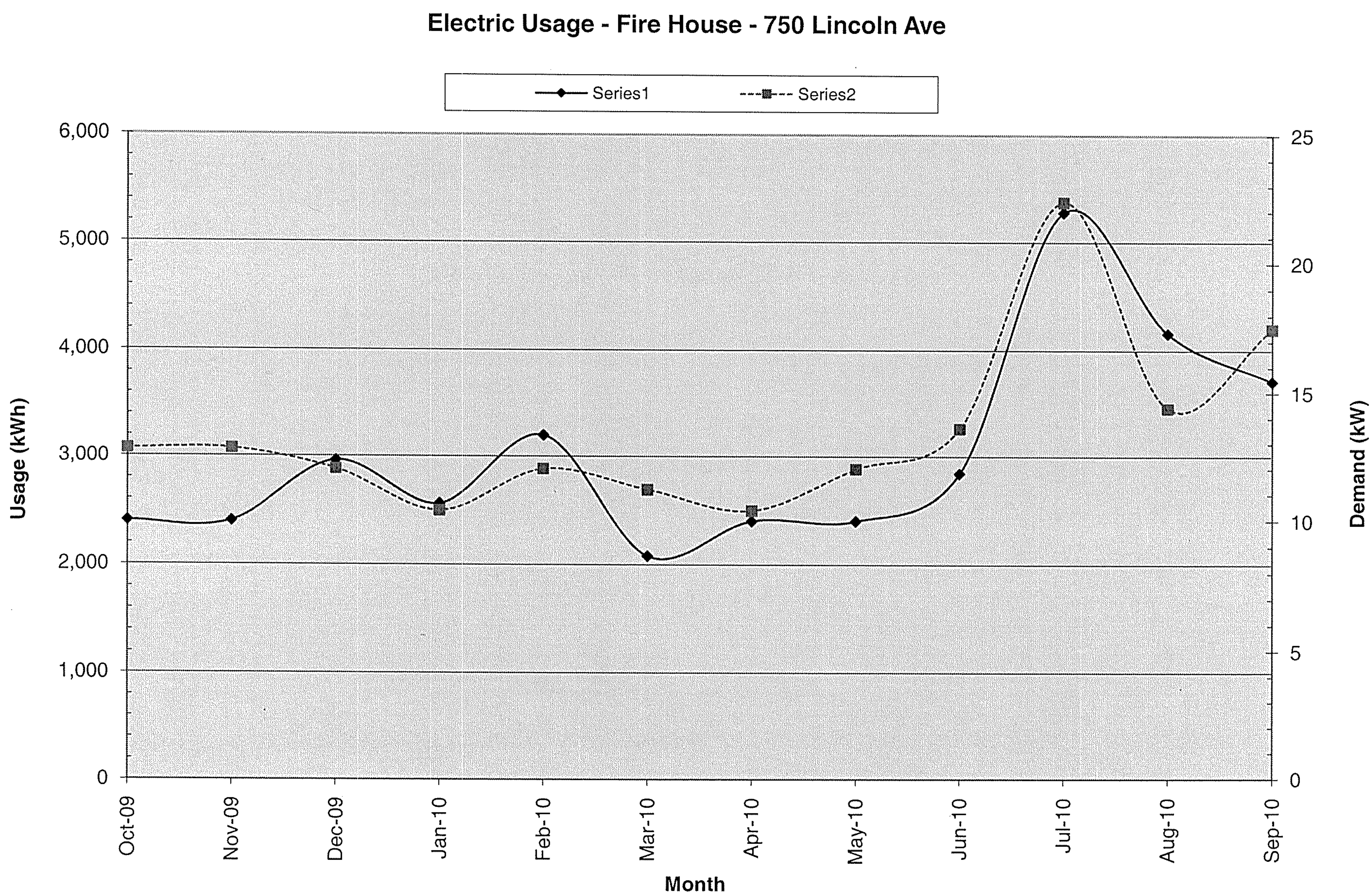
APPENDIX A

Utility Usage Analysis

City of Linwood
CHA Project Number: 22215
Firehouse

750 Lincoln Ave
Account Number: **0099 4699 9999**
Meter Number: **4198080806**

			Charges					Unit Costs		
Month	Consumption (kWh)	Demand (kW)	Total ($)	Supply ($)	Delivery ($)	Demand ($)	Consumption ($)	Blended Rate ($/kWh)	Consumption ($/kWh)	Demand ($/kW)
October-09	2,400	12.8	$409.77	$258.04	$151.73	$0.00	$409.77	0.1707	0.1707	-
November-09	2,400	12.8	$409.77	$258.04	$151.73	$0.00	$409.77	0.1707	0.1707	-
December-09	2,960	12.0	$506.98	$352.52	$154.46	$0.00	$506.98	0.1713	0.1713	-
January-10	2,560	10.4	$418.07	$295.97	$122.10	$0.00	$418.07	0.1633	0.1633	-
February-10	3,200	12.0	$535.83	$375.71	$160.12	$0.00	$535.83	0.1674	0.1674	-
March-10	2,080	11.2	$363.76	$249.85	$113.91	$0.00	$363.76	0.1749	0.1749	-
April-10	2,400	10.4	$405.76	$282.41	$123.35	$0.00	$405.76	0.1691	0.1691	-
May-10	2,400	12.0	$301.61	$259.97	$41.64	$0.00	$301.61	0.1257	0.1257	-
June-10	2,840	13.6	$212.65	$0.00	$212.65	$0.00	$212.65	0.0749	0.0749	-
July-10	5,280	22.4	$314.93	$0.00	$314.93	$0.00	$314.93	0.0596	0.0596	-
August-10	4,160	14.4	$236.77	$0.00	$236.77	$0.00	$236.77	0.0569	0.0569	-
September-10	3,710	17.5	$222.56	$0.00	$222.56	$0.00	$222.56	0.0600	0.0600	-
Total	36,390	22.4	$4,338.46	$2,332.51	$2,005.95	$0.00	$3,928.69	0.1192	0.1080	-
Most Recent Yr	36,390	22.4	$4,338.46	$2,332.51	$2,005.95	$0.00	$3,928.69	0.1192	0.1080	-



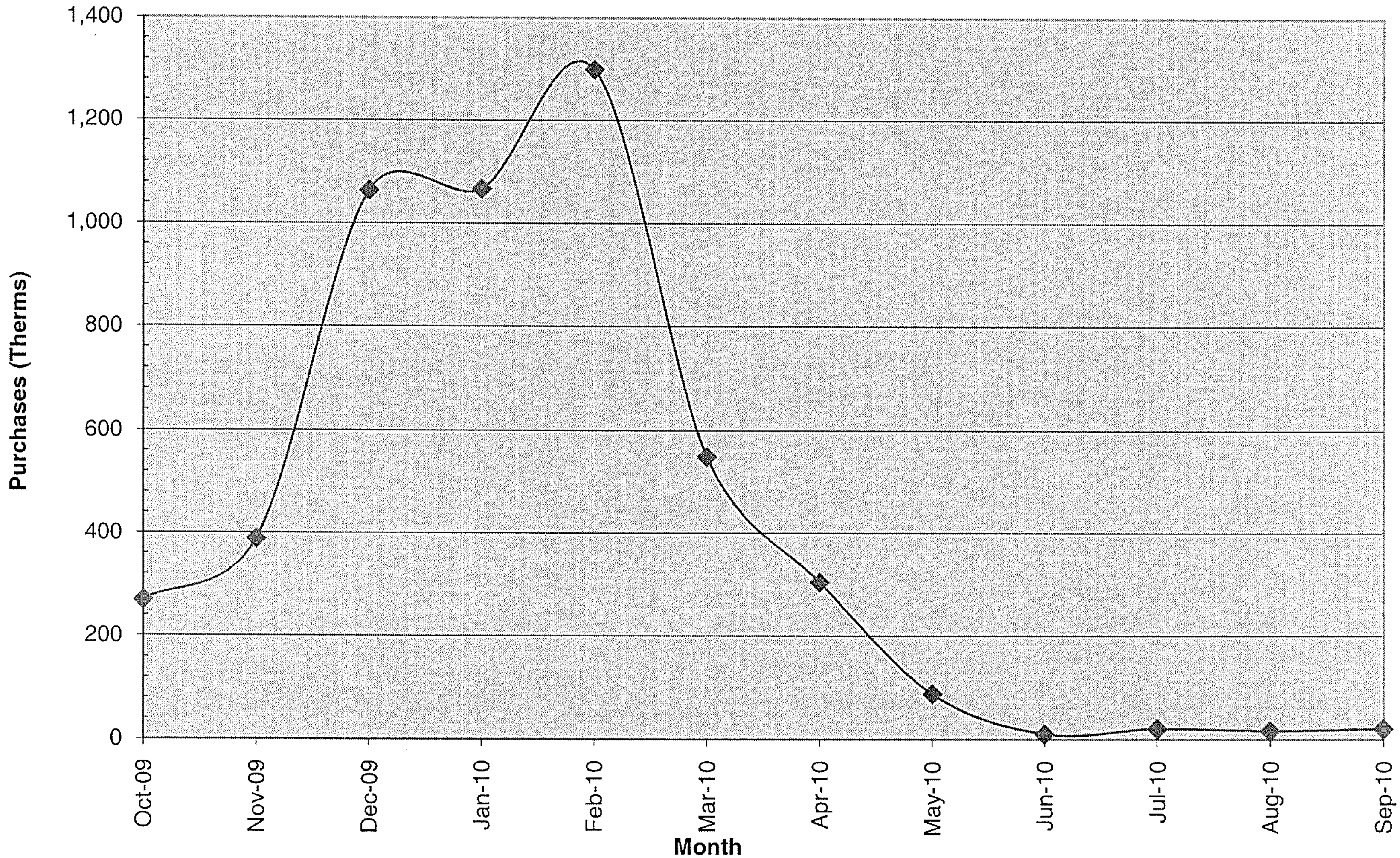
Electric Utility Data - Rev1
Fire House-Electricity Chart

City of Linwood
CHA Project Number: 22215
Fire House

Account Number: **1 16 37 0038 0 4**
Meter Number: **0336946**

Month	Therms		Total Charges		($/therm)
September-09	16	$	34.00	$	2.08
October-09	269	$	277.72	$	1.03
November-09	388	$	425.11	$	1.10
December-09	1064	$	1,423.23	$	1.34
January-10	1067	$	1,443.97	$	1.35
February-10	1299	$	1,748.68	$	1.35
March-10	549	$	747.81	$	1.36
April-10	304	$	423.52	$	1.39
May-10	87	$	130.78	$	1.50
June-10	10	$	45.36	$	4.54
July-10	20	$	28.73	$	1.44
August-10	16	$	25.58	$	1.60
September-10	20	$	28.73	$	1.44
Most Recent Yr	5,093	$	6,749	$	1.33

Natural Gas Usage - Fire House



Gas Utility Data - Rev1
FireHouse Gas Chart

City of Linwood
CHA Project Number: 22215
Fire House
New Jersey American Water

Account Number: **18-11977376-7**
Meter Number: **85393430**

Month	Gallons	Total Charges	($/kGal.)
August-09	3000	$ 26.35	$ 8.78
September-09	5000	$ 37.95	$ 7.59
October-09	3000	$ 26.37	$ 8.79
November-09	5000	$ 37.95	$ 7.59
December-09	5000	$ 37.95	$ 7.59
January-10	5000	$ 37.95	$ 7.59
February-10	5000	$ 37.95	$ 7.59
March-10	4000	$ 32.16	$ 8.04
April-10	5000	$ 37.95	$ 7.59
May-10	6000	$ 43.75	$ 7.29
June-10	21000	$ 130.59	$ 6.22
July-10	5000	$ 37.96	$ 7.59
August-10	5000	$ 37.93	$ 7.59
Total	77,000	$ 563	$ 7.31
Most Recent Yr	74,000	$ 536	$ 7.25

ELECTRIC MARKETERS LIST

The following is a listing of marketers/suppliers/brokers that have been licensed by the NJ Board of Public Utilities to sell electricity to residential, small commercial and industrial customers served by the Public Service Electric and Gas Company distribution system. **This listing is provided for informational purposes only and PSE&G makes no representations or warranties as to the competencies of the entities listed herein or to the completeness of this listing.**

American Powernet Management
867 Berkshire Blvd, Suite 101
Wyomissing, PA 19610
www.americanpowernet.com

BOC Energy Services
575 Mountain Avenue
Murray Hill, NJ 07974
www.boc-gases.com

Commerce Energy Inc.
535 Route 38, Suite 138
Cherry Hill, NJ 08002
(888) 817-8572 or
(858) 910-8099
www.commerceenergy.com

ConEdison Solutions
701 Westchester Avenue
Suite 201 West
White Plains, NY 10604
(800) 316-8011
www.ConEdSolutions.com

Constellation NewEnergy, Inc.
1199 Route 22 East
Mountainside, NJ 07092
908 228-5100
www.newenergy.com

Credit Suisse (USA), Inc.
700 College Road East
Princeton, NJ 08450
www.creditsuisse.com

Direct Energy Services, LLC
One Gateway Center, Suite 2600
Newark, NJ 07102
(973) 799-8568
www.directenergy.com

FirstEnergy Solutions
395 Ghent Road Suite 407
Akron, OH 44333
(800) 977-0500
www.fes.com

Gerdau Ameristeel Energy Co.
North Crossman Road
Sayreville, NJ 08872

Gexa Energy LLC New Jersey
20 Greenway Plaza, Suite 600
Houston, TX 77046
(866) 304-GEXA
Beth.miller@gexaenergy.com

Glacial Energy of New Jersey
2602 McKinney Avenue, Suite 220
Dallas, TX 75204
www.glacialenergy.com

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095
www.hess.com

Integrys Energy Services, Inc
99 Wood Avenue, Suite 802
Iselin, NJ 08830
www.integrysenergy.com

Liberty Power Delaware, LLC
1901 W Cypress Road, Suite 600
Fort Lauderdale, FL 33309
(866) Power-99
(866) 769-3799
www.libertypowercorp.com

Liberty Power Holdings, LLC
1901 W Cypress Creek Road, Suite 600
Fort Lauderdale, FL 33309
(866) Power-99
(866) 769-3799
www.libertypowercorp.com

Pepco Energy Services, Inc.
d/b/a Power Choice
23 S. Kinderkamack Rd Ste D
Montvale, NJ 07645
(800) 363-7499
www.pepco-services.com

PPL EnergyPlus, LLC
Energy Marketing Center
Two North Ninth Street
Allentown, PA 18101
1-866-505-8825
http://www.pplenergyplus.com/

Sempra Energy Solutions
The Mac-Cali Building
581 Main Street, 8th Floor
Woodbridge, NJ 07095
(877) 273-6772
www.SempraSolutions.com

South Jersey Energy Company
1 South Jersey Plaza, Route 54
Folsom, NJ 08037
(800) 756-3749
www.sjindustries.com

Strategic Energy, LLC
6 East Main Street, Suite 6E
Ramsey, NJ 07446
(888) 925-9115
www.sel.com

Suez Energy Resources NA
333 Thornall Street FL6
Edison, NJ 08818
866.999.8374(toll free)
www.suezenergyresources.com

UGI Energy Services, Inc.
d/b/a POWERMARK
1 Meridian Blvd. Suite 2C01
Wyomissing, PA 19610
(800) 427-8545
www.ugienergyservices.com

GAS MARKETERS LIST

The following is a listing of marketers/suppliers/brokers that have been licensed by the NJ Board of Public Utilities to sell natural gas to residential, small commercial and industrial customers served by the Public Service Electric and Gas Company distribution system. **This listing is provided for informational purposes only and PSE&G makes no representations or warranties as to the competencies of the entities listed herein or to the completeness of this listing.**

Gateway Energy Services
44 Whispering Pines Lane
Lakewood, NJ 08701
(800) 805-8586
www.gesc.com

Great Eastern Energy
3044 Coney Island Ave. PH
Brooklyn, NY 11235
888-651-4121
www.greateasterngas.com

Hess Corporation
1 Hess Plaza
Woodbridge, NJ 07095
(800) 437-7872
www.hess.com

Hudson Energy Services, LLC
545 Route 17 South
Ridgewood, NJ 07450
(201) 251-2400
www.hudsonenergyservices.com

Intelligent Energy
7001 SW 24th Avenue
Gainesville, FL 32607
Sales: 1 877 I've Got Gas
(1 877 483-4684)
Customer Service:
1 800 927-9794
www.intelligentenergy.org

Systrum Energy
877-SYSTRUM
(877-797-8786)
www.systrumenergy.com

Macquarie Cook Energy, LLC
10100 Santa Monica Blvd, 18th Fl
Los Angeles, CA 90067

Metro Energy Group, LLC
14 Washington Place
Hackensack, NJ 07601
www.metroenergy.com

Metromedia Energy, Inc.
6 Industrial Way
Eatontown, NJ 07724
(800) 828-9427
www.metromediaenergy.com

Mitchell- Supreme Fuel
(NATGASCO)
532 Freeman Street
Orange, NJ 07050
(800) 840-4GAS
www.mitchellsupreme.com

MxEnergy Inc.
P.O. Box 177
Annapolis Junction, MD 20701
800-375-1277
www.mxenergy.com

Pepco Energy Services, Inc.
23 S Kinderkamack Rd, Suite D
Montvale, NJ 07645
(800) 363-7499
www.pepco-services.com

Plymouth Rock Energy, LLC
165 Remsen Street
Brooklyn, NJ 11201
866-539-6450
www.plymouthrockenergy.com

PPL EnergyPlus, LLC
Energy Marketing Center
Two North Ninth Street
Allentown, PA 18101
1-866-505-8825
www.pplenergyplus.com/natural+gas/

RPL Holdings, Inc
601 Carlson Pkwy
Minnetonka, MN 55305

South Jersey Energy Company
One South Jersey Plaza, Rte 54
Folsom, NJ 08037
(800) 756-3749
www.sjindustries.com/sje.htm

Sprague Energy Corp.
Two International Drive, Ste 200
Portsmouth, NH 03801
800-225-1560
www.spragueenergy.com

Stuyvesant Energy LLC
642 Southern Boulevard
Bronx, NY 10455
(718) 665-5700
www.stuyfuel.com

Tiger Natural Gas, Inc.
1422 E. 71st Street, Suite J.
Tulsa, OK 74136
1-888-875-6122
www.tigernaturalgas.com

UGI Energy Services, Inc.
d/b/a GASMARK
704 E. Main Street, Suite I
Moorestown, NJ 08057
856-273-9995
www.ugienergyservices.com

Woodruff Energy
73 Water Street
P.O. Box 777
Bridgeton, NJ 08302
(856) 455-1111
www.woodruffenergy.com

APPENDIX B

ECM-1 Increase Roof Insulation

City of Linwood, NJ
CHA #22215
Building: Linwood Fire House

ECM-1 Increase Roof Insulation

Fire hall area only

Existing Roof Area	3,000	sf
Existing U-value	0.07	Btu/hr/(sf*F)
Existing R-value	14.9	
Proposed R-value	34	Adding R-19 batt insulation.
Proposed U-value	0.03	Btu/hr/(sf*F)
Heating System Efficiency	68%	
Cooling System Efficiency	1.20	kW/ton
Heating "On" Temp	60	F

Existing Cooling

Existing Cooling Load Temp Diff.	73	F
Existing Max. Roof Cooling Load	27,879	Btu/hr

Proposed Cooling

Proposed Cooling Load	12,274	Btu/hr
Occupied Cooling Setpoint	72	F
Unoccupied Cooling Setpoint	72	F

Existing Heating

Existing Heating Load Temp Diff.	56	F
Existing Max. Roof Heating Load	21,386	Btu/hr

Proposed Heating

Proposed Heating Load	9,416	Btu/hr
Occupied Heating Setpoint	70	F
Unoccupied Heating Setpoint	60	F

Existing Heating Total	20,004,812	Btu/yr
Proposed Heating Total	8,807,649	Btu/yr
Savings	11,197,164	Btu/yr
Input	165	therms
Existing Cooling Total	217	kWh/yr
Proposed Cooling Total	96	kWh/yr
Savings	121	kWh/yr

				Occupied				Unoccupied							
Avg Outdoor Air Temp. Bins °F	Existing Equipment Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Existing Heat Gain	Proposed Heat Gain	Existing Heat Loss	Proposed Heat Loss	Existing Heat Gain	Proposed Heat Gain	Existing Heat Loss	Proposed Heat Loss	Existing Cooling Load	Existing Heating Load	Proposed Cooling Load	Proposed Heating Load
				(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(kWh/yr)	(Btu/yr)	(kWh/yr)	(Btu/yr)
102.5	0	0	0	6,131	2,699	-	-	6,131	2,699	-	-	-	-	-	-
97.5	9	0	9	5,126	2,257	-	-	5,126	2,257	-	-	5	-	2	-
92.5	69	1	68	4,121	1,814	-	-	4,121	1,814	-	-	28	-	13	-
87.5	132	2	130	3,116	1,372	-	-	3,116	1,372	-	-	41	-	18	-
82.5	344	6	338	2,111	929	-	-	2,111	929	-	-	73	-	32	-
77.5	566	10	556	1,106	487	-	-	1,106	487	-	-	63	-	28	-
72.5	755	13	742	101	44	-	-	101	44	-	-	8	-	3	-
67.5	780	14	766	-	-	-	-	-	-	-	-	-	-	-	-
62.5	889	16	873	-	-	-	-	-	-	-	-	-	-	-	-
57.5	742	13	729	-	-	2,513	1,106	-	-	503	221	-	399,488	-	175,885
52.5	627	11	616	-	-	3,518	1,549	-	-	1,508	664	-	967,707	-	426,059
47.5	725	13	712	-	-	4,523	1,991	-	-	2,513	1,106	-	1,847,585	-	813,448
42.5	795	14	781	-	-	5,528	2,434	-	-	3,518	1,549	-	2,824,947	-	1,243,758
37.5	784	14	770	-	-	6,533	2,876	-	-	4,523	1,991	-	3,573,780	-	1,573,451
32.5	682	12	670	-	-	7,538	3,319	-	-	5,528	2,434	-	3,794,234	-	1,670,512
27.5	345	6	339	-	-	8,543	3,761	-	-	6,533	2,876	-	2,266,096	-	997,709
22.5	229	4	225	-	-	9,548	4,204	-	-	7,538	3,319	-	1,734,307	-	763,575
17.5	189	3	186	-	-	10,553	4,646	-	-	8,543	3,761	-	1,621,316	-	713,827
12.5	70	1	69	-	-	11,558	5,088	-	-	9,548	4,204	-	670,838	-	295,354
7.5	20	0	20	-	-	12,563	5,531	-	-	10,553	4,646	-	211,768	-	93,236
2.5	8	0	8	-	-	13,568	5,973	-	-	11,558	5,088	-	92,747	-	40,834
-2.5	0	0	0	-	-	14,573	6,416	-	-	12,563	5,531	-	-	-	-
-7.5	0	0	0	-	-	15,578	6,858	-	-	13,568	5,973	-	-	-	-
TOTALS	8,760	156	8,604									217	20,004,812	96	8,807,649

City of Linwood, NJ
CHA #22215
Building: Linwood Fire House

ECM-1 Increase Roof Insulation

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
6" Fire Retardent Blanket Insualtion	3000	SF	$ 0.48	$ 0.55		$ 1,411	$ 1,997	$ -	$ 3,408	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 3,408	Subtotal
$ 340.77	10% Contingency
$ 562.27	Contractor 15% O&P
$ 4,311	**Total**

APPENDIX C

ECM-2 Replace Boiler

City of Linwood, NJ
CHA #22215
Building: Linwood Fire House

ECM-2 Replace Boiler

Existing Fuel Nat.Gas
Proposed Fuel Nat.Gas

Item	Value	Units	Formula/Comments
Baseline Fuel Cost	$ 1.33		
Proposed Fuel Cost	$ 1.33		
Baseline Fuel Use	4,907	Therms	Based on historical utility data
Existing Boiler Plant Efficiency	68%		Estimated
Baseline Boiler Load	333,702	Mbtu/yr	Baseline Fuel Use x Existing Efficiency x 100 Mbtu/Therms
Baseline Fuel Cost	$ 6,503		
Proposed Boiler Plant Efficiency	92%		New Boiler Efficiency
Proposed Fuel Use	3,627	Therms	Baseline Boiler Load / Proposed Efficiency / 100 Mbtu/Therms
Proposed Fuel Cost	$ 4,806		
Annual Savings	1,280	Therms	
Annual Savings	**$ 1,696**	**/yr**	

*Note to engineer: Link savings back to summary sheet in appropriate column.

City of Linwood, NJ
CHA #22215
Building: Linwood Fire House

ECM-2 Replace Boiler

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
Boiler Removal	1	EA		$ 2,000		$ -	$ 2,420	$ -	$ 2,420	
1,300 MBHGas-fired boiler	1	EA	$ 25,000	$ 4,000		$ 24,500	$ 4,840	$ -	$ 29,340	
Miscellaneous Electrical	1	LS	$ 400	$ 600		$ 392	$ 726	$ -	$ 1,118	
Miscellaneous Piping	1	LS	$ 1,000	$ 1,000		$ 980	$ 1,210	$ -	$ 2,190	
Boiler Control System	1	LS	$ 1,000	$ 1,000		$ 980	$ 1,210	$ -	$ 2,190	
Flue Piping	1	EA	$ 800	$ 800		$ 784	$ 968	$ -	$ 1,752	Connect to existing
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 39,010	Subtotal
$ 3,901	10% Contingency
$ 4,291	Contractor 10% O&P
$ 9,440	20% Engineering
$ 56,643	**Total**

APPENDIX D

ECM-3 Increase Wall Insulation

City of Linwood, NJ
CHA #22215
Building: Linwood Fire House

ECM-3 Increase Wall Insulation

truck bay wall only

Total Existing Wall Area	750	sf
Existing U-value	0.08	Btu/hr/(sf*F)
Existing R-value	13.1	
Proposed U-value	0.03	Btu/hr/(sf*F)
Proposed R-value	29.1	Adding 2" rigid insulation and (2) layers 5/8" gypsum
Heating Efficiency	68%	
Cooling Efficiency	1.20	kW/ton

Existing Cooling

Max. North Wall Cooling Load	1,716	Btu/hr
Max. East Wall Cooling Load	5,995	Btu/hr
Max. South Wall Cooling Load	2,726	Btu/hr
Max. West Wall Cooling Load	3,584	Btu/hr

Proposed Cooling

Max. North Wall Cooling Load	771.1340206	Btu/hr
Max. East Wall Cooling Load	2693.814433	Btu/hr
Max. South Wall Cooling Load	1224.742268	Btu/hr
Max. West Wall Cooling Load	1610.309278	Btu/hr
Occupied Cooling Setpoint	72	F
Unoccupied Cooling Setpoint	80	F
Existing Cooling Total	593.4357665	kWh/yr
Proposed Cooling Total	266.6382353	kWh/yr
Savings	326.7975312	kWh/yr

Existing Heating

Existing Heating Load Temp Diff.	56	F
Existing Max. Wall Heating Load	28,191	Btu/hr
Heating On Point	60	F

Proposed Heating

Proposed Max. Heating Load	12,666	Btu/hr
Occupied Heating Setpoint	70	F
Unoccupied Heating Setpoint	60	F
Existing Heating Total	8,647,514	Btu/yr
Proposed Heating Total	3,885,438	Btu/yr
Savings	4,762,076	Btu/yr
Input	70	therms

				Occupied				Unoccupied							
Avg Outdoor Air Temp. Bins °F	Existing Equipment Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Existing Heat Gain	Proposed Heat Gain	Existing Heat Loss	Proposed Heat Loss	Existing Heat Gain	Proposed Heat Gain	Existing Heat Loss	Proposed Heat Loss	Existing Cooling Load	Existing Heating Load	Proposed Cooling Load	Proposed Heating Load
				(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(kWh/yr)	(Btu/yr)	(kWh/yr)	(Btu/yr)
97.5	9	9	0	14,021	6,300	-	-	14,021	6,300	-	-	12.61927342	-	5.67	-
92.5	69	69	0	11,272	5,065	-	-	10,015	4,500	-	-	77.77761332	-	34.94647059	-
87.5	132	132	0	8,523	3,829	-	-	6,009	2,700	-	-	112.501235	-	50.54823529	-
82.5	344	344	0	5,774	2,594	-	-	2,003	900	-	-	198.6092183	-	89.23764706	-
77.5	566	566	0	3,024	1,359	-	-	-	-	-	-	171.1712338	-	76.90941176	-
72.5	755	755	0	275	124	-	-	-	-	-	-	20.75719267	-	9.326470588	-
67.5	780	780	0	-	-	-	-	-	-	-	-	0	-	0	-
62.5	889	889	0	-	-	-	-	-	-	-	-	0	-	0	-
57.5	742	742	0	-	-	717	322	-	-	143	64	0	532,027	0	239,046
52.5	627	627	0	-	-	1,004	451	-	-	430	193	0	629,398	0	282,796
47.5	725	725	0	-	-	1,291	580	-	-	717	322	0	935,707	0	420,425
42.5	795	795	0	-	-	1,577	709	-	-	1,004	451	0	1,254,063	0	563,466
37.5	784	784	0	-	-	1,864	838	-	-	1,291	580	0	1,461,568	0	656,701
32.5	682	682	0	-	-	2,151	966	-	-	1,577	709	0	1,467,017	0	659,149
27.5	345	345	0	-	-	2,438	1,095	-	-	1,864	838	0	841,061	0	377,899
22.5	229	229	0	-	-	2,725	1,224	-	-	2,151	966	0	623,948	0	280,348
17.5	189	189	0	-	-	3,011	1,353	-	-	2,438	1,095	0	569,168	0	255,735
12.5	70	70	0	-	-	3,298	1,482	-	-	2,725	1,224	0	230,880	0	103,737
7.5	20	20	0	-	-	3,585	1,611	-	-	3,011	1,353	0	71,702	0	32,216
2.5	8	8	0	-	-	3,872	1,740	-	-	3,298	1,482	0	30,975	0	13,918
-2.5	0	0	0	-	-	4,159	1,869	-	-	3,585	1,611	0	-	0	-
-7.5	0	0	0	-	-	4,446	1,997	-	-	3,872	1,740	0	-	0	-
TOTALS	8,760	8,760	0									593	8,647,514	267	3,885,438

City of Linwood, NJ
CHA #22215
Building: Linwood Fire House

ECM-3 Increase Wall Insulation

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
2" Rigid Foam Board	600	SF	$ 0.84	$ 0.36		$ 494	$ 261	$ -	$ 755	
2 layers 5/8" sheet rock	600	SF	$ 0.85	$ 1.68		$ 501	$ 1,217	$ -	$ 1,717	
15' High Metal Stud wall	40	LF	$ 17	$ 9		$ 666	$ 436	$ -	$ 1,102	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 3,574	Subtotal
$ 357.44	10% Contingency
$ 589.78	Contractor 15% O&P
	Engineering
$ 4,522	**Total**

APPENDIX E

ECM-4 Replace Unit Heaters with Infrared Heaters

City of Linwood, NJ
CHA #22215
Building: Linwood Fire House

ECM-4: Replace Unit Heaters with Infrared Heaters

Building Footprint	1,800	SF
Natural Gas Heat Content	100,000	Btu/Therm
Building Balance Temp.	60	°F
Internal Gains	6,758	btu/h
Unocc Internal Gain factor	0.03	
Ave Occ Internal Gain Factor	0.9	

Ex Occupied Htg Temp.	70	°F
Ex Unoccupied Htg Temp.	60	°F
Occupied Heating UA	288	btu/hr/°F
Unoccupied Heating UA	288	btu/hr/°F

Heating Energy Savings	1,030	**Therms/yr**
Electric Energy Savings	3,702	**kWh/yr**

Existing Burner Efficiency	68.0%	Existing unit heater burner efficiency
Existing Heat Distribution Effectiveness	85.0%	Heat Distribution Factor per ASHRAE Handbook - Fundamentals for Unit Heaters
Proposed Burner Efficiency	85.0%	Based on Reznor Infrared Tube Heaters
Proposed Heat Distribution Effectiveness	100%	Heat Distribution Factor per ASHRAE Handbook - Fundamentals for Infrared Heaters

					EXISTING LOADS						PROPOSED LOADS							
					Occupied			Unoccupied			Occupied			Unoccupied				
Avg Outdoor Air Temp. Bins °F	Avg Outdoor Air Enthalpy	Existing Equipment Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Existing Heating Energy Therms	Proposed Heating Energy Therms
A		B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	M	N
102.5	49.1	0	0	0	0	0	-6,082	0	0	-203	0	0	-6,082	0	0	-203	0	0
97.5	42.5	9	9	0	0	0	-6,082	0	0	-203	0	0	-6,082	0	0	-203	0	0
92.5	39.5	69	69	0	0	0	-6,082	0	0	-203	0	0	-6,082	0	0	-203	0	0
87.5	36.6	132	132	0	0	0	-6,082	0	0	-203	0	0	-6,082	0	0	-203	0	0
82.5	34	344	344	0	0	0	-6,082	0	0	-203	0	0	-6,082	0	0	-203	0	0
77.5	31.6	566	566	0	0	0	-6,082	0	0	-203	0	0	-6,082	0	0	-203	0	0
72.5	29.2	755	755	0	0	0	-6,082	0	0	-203	0	0	-6,082	0	0	-203	0	0
67.5	27	780	780	0	664	2,880	-6,082	0	0	-203	664	2,880	-6,082	0	0	-203	0	0
62.5	24.5	889	889	0	1,993	8,639	-6,082	0	0	-203	1,993	8,639	-6,082	0	0	-203	70	48
57.5	21.4	742	742	0	3,322	14,398	-6,082	664	2,880	-203	3,322	14,398	-6,082	664	2,880	-203	149	102
52.5	18.7	627	627	0	4,651	20,157	-6,082	1,993	8,639	-203	4,651	20,157	-6,082	1,993	8,639	-203	203	138
47.5	16.2	725	725	0	5,980	25,916	-6,082	3,322	14,398	-203	5,980	25,916	-6,082	3,322	14,398	-203	324	220
42.5	14.4	795	795	0	7,309	31,675	-6,082	4,651	20,157	-203	7,309	31,675	-6,082	4,651	20,157	-203	453	308
37.5	12.6	784	784	0	8,638	37,434	-6,082	5,980	25,916	-203	8,638	37,434	-6,082	5,980	25,916	-203	542	369
32.5	10.7	682	682	0	9,967	43,193	-6,082	7,309	31,675	-203	9,967	43,193	-6,082	7,309	31,675	-203	555	378
27.5	8.6	345	345	0	11,296	48,952	-6,082	8,638	37,434	-203	11,296	48,952	-6,082	8,638	37,434	-203	323	220
22.5	6.8	229	229	0	12,624	54,711	-6,082	9,967	43,193	-203	12,624	54,711	-6,082	9,967	43,193	-203	243	165
17.5	5.5	189	189	0	13,953	60,471	-6,082	11,296	48,952	-203	13,953	60,471	-6,082	11,296	48,952	-203	223	152
12.5	4.1	70	70	0	15,282	66,230	-6,082	12,624	54,711	-203	15,282	66,230	-6,082	12,624	54,711	-203	91	62
7.5	2.6	20	20	0	16,611	71,989	-6,082	13,953	60,471	-203	16,611	71,989	-6,082	13,953	60,471	-203	29	19
2.5	1	8	8	0	17,940	77,748	-6,082	15,282	66,230	-203	17,940	77,748	-6,082	15,282	66,230	-203	12	8
-2.5	0	0	0	0	19,269	83,507	-6,082	16,611	71,989	-203	19,269	83,507	-6,082	16,611	71,989	-203	0	0
-7.5	-1.5	0	0	0	20,598	89,266	-6,082	17,940	77,748	-203	20,598	89,266	-6,082	17,940	77,748	-203	0	0
TOTALS		8,760	8,760	0													3,219	2,189

Existing Building Ventilation & Infiltration (occ)	**1,067 cfm**
Overheat Ventilation Factor	**1.00**
Additional ventilation to offset overheat	**0 cfm**
Existing Building Ventilation & Infiltration (unocc)	**1,067 cfm**

Electrical Requirements for Heating Equipment

Existing Equipment

Unit	Htng Hrs	Amps	Volts	Phase	Power Factor	Annual kWh
UH-1	2,187	5.7	115	1	0.8	1147
UH-2	2,187	5.7	115	1	0.8	1147
UH-3	2,187	5.7	115	1	0.8	1147
UH-4	2,187	5.7	115	1	0.8	1147
Total						**4588**

Proposed Equipment

Unit	Htng Hrs	Amps	Volts	Phase	Power Factor	Annual kWh
Infrared Htr	2,187	1.1	115	1	0.8	221
Infrared Htr	2,187	1.1	115	1	0.8	221
Infrared Htr	2,187	1.1	115	1	0.8	221
Infrared Htr	2,187	1.1	115	1	0.8	221
Total						**885**

*Electrical data based on Reznor VR Series Infrared Heaters

Avg. OA Temp °F	Heating Hrs	Assumed % Time of Operation	hrs of Operation
102.5	0	0%	0
97.5	0	0%	0
92.5	0	0%	0
87.5	0	0%	0
82.5	0	0%	0
77.5	0	0%	0
72.5	0	0%	0
67.5	0	0%	0
62.5	889	8%	68
57.5	742	15%	114
52.5	627	23%	145
47.5	725	31%	223
42.5	795	38%	306
37.5	784	46%	362
32.5	682	54%	367
27.5	345	62%	212
22.5	229	69%	159
17.5	189	77%	145
12.5	70	85%	59
7.5	20	92%	18
2.5	8	100%	8
-2.5	0	100%	0
-7.5	0	100%	0
	6,105	36%	2187

City of Linwood, NJ
CHA #22215
Building: Linwood Fire House

ECM-4: Replace Unit Heaters with Infrared Heaters

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
						$ -	$ -	$ -	$ -	
Unit Heater Removal	4	EA		$ 450		$ -	$ 2,178	$ -	$ 2,178	
30' NG Infrared Tube Heater 125 MBH	4	EA	$ 1,500	$ 400		$ 5,880	$ 1,936	$ -	$ 7,816	Includes Controls
Miscellaneous Gas Piping, Valves, etc.	4	EA	$ 200	$ 250		$ 784	$ 1,210	$ -	$ 1,994	
4" Class B Vent Piping	100	LF	$ 6.70	$ 10		$ 657	$ 1,210	$ -	$ 1,867	Use Common Vents
4" Chimney Cap	4	EA	$ 11	$ 10		$ 43	$ 48	$ -	$ 92	Use Common Vents
Roof Flashing	4	EA	$ 28	$ 10		$ 110	$ 48	$ -	$ 158	Use Common Vents
Miscellaneous electrical	1	LS		$ 500		$ -	$ 605	$ -	$ 605	
						$ -	$ -	$ -	$ -	

Note: Unit selections and budgetary pricing are per Reznor VR series infrared tube heaters.

$14,709	Subtotal
$2,206	15% Contingency
$2,537	15% Contractor O&P
$0	0% Engineering
$19,453	**Total**

APPENDIX F

ECM-5 Lighting Replacements

City of Linwood, NJ
CHA #22215
Building: Linwood Fire House

ECM-5 Lighting Replacements

Building Schedule:

Instructions and notes:
Input existing fixtures and retrofit fixtures. Use light table

Supply Electric Rate $ 0.119 /kWh
Demand Rate /kW

	EXISTING CONDITIONS										RETROFIT CONDITIONS								COST ANALYSIS				
Area Description	Number of Fixtures	Fixture Code	Watts per Fixture	Number of Non-Operational Fixtures	Watts per Non-Operational Fixtures	kW/Space	Exist Control	Daily Hours	Annual Hours	Annual kWh	Number of Fixtures	Fixture Code	Watts per Fixture	kW/Space	Retrofit Control	Daily Hours	Annual Hours	Annual kWh	kW Saved	Annual kWh Saved	Annual $ Saved	Retrofit Cost
Lounge	4	F44EIS	164	0		0.656	switch	6	2,190	1,437	4	F44ILL-R	102	0.408	switch	6	2,190	894	0.25	543	$ 65	$ 502
Rec Room	17	F44EIS	164	0		2.788	switch	6	2,190	6,106	17	F44ILL-R	102	1.734	switch	6	2,190	3,797	1.05	2,308	$ 275	$ 2,133
CD Room	4	F82EE	158	0		0.632	switch	3	1,095	692	4	F82ILL	109	0.436	switch	3	1,095	477	0.20	215	$ 26	$ 502
Main Truck Bay	30	F82EE	158	0		4.74	switch	6	2,190	10,381	30	F82ILL	109	3.27	switch	6	2,190	7,161	1.47	3,219	$ 384	$ 3,764
Kitchen	4	F44EIS	164	0		0.656	switch	8	2,920	1,916	4	F44ILL-R	102	0.408	switch	8	2,920	1,191	0.25	724	$ 86	$ 502
Main Kitchen	7	F44EIS	164	0		1.148	switch	8	2,920	3,352	7	F44ILL-R	102	0.714	switch	8	2,920	2,085	0.43	1,267	$ 151	$ 878
Main Hall	55	F44EIS	164	0		9.02	switch	8	2,920	26,338	55	F44ILL-R	102	5.61	switch	8	2,920	16,381	3.41	9,957	$ 1,187	$ 6,901
Meeting Room	8	F44EIS	164	0		1.312	switch	4	1,460	1,916	8	F44ILL-R	102	0.816	switch	4	1,460	1,191	0.50	724	$ 86	$ 1,004
Main Office	2	F44EIS	164	0		0.328	switch	24	8,760	2,873	2	F44ILL-R	102	0.204	switch	24	8,760	1,787	0.12	1,086	$ 130	$ 251
Stairs	1	F82EE	158	0		0.158	switch	8	2,920	461	1	F82ILL	109	0.109	switch	8	2,920	318	0.05	143	$ 17	$ 125
TOTALS -	132			0		21.4				55,471	132			13.7				35,284	7.7	20,187	$ 2,407	$ 16,563

APPENDIX G

New Jersey Pay For Performance Incentive Program

City of Linwood,NJ
CHA #22215
Firehouse

New Jersey Pay For Performance Incentive Program

Note: The following calculation is based on the New Jersey Pay For Performance Incentive Program.
Building must have a minimum average electric demand of 200 kW. This minimum is waived for buildings owned by local governements or non-profit organizations.
The incentive values represented below are estimated.

Total Building Area (Square Feet)	13,285
Is this audit funded by the NJ BPU (Y/N)	Yes

Bureau of Public Utilites (BPU)

Incentive #1		
Audit not funded by NJ BPU	$0.10	$/sqft
Audit is funded by NJ BPU	$0.05	$/sqft

	Annual Utilities	
	kWh	Therms
Existing Cost (from utility)	$4,338	$6,749
Existing Usage (from utility)	36,390	5,093
Proposed Savings	23,890	2,545
Existing Total MMBtus	634	
Proposed Savings MMBtus	336	
% Energy Reduction	53.0%	
Proposed Annual Savings	$6,235	

	Min (Savings = 15%)		Increase (Savings > 15%)		Max Incentive		Achieved Incentive	
	$/kWh	$/therm	$/kWh	$/therm	$/kWh	$/therm	$/kWh	$/therm
Incentive #2	$0.11	$1.10	$0.005	$0.05	$0.13	$1.45	$0.13	$1.45
Incentive #3	$0.07	$0.70	$0.005	$0.05	$0.09	$1.05	$0.09	$1.05

	Incentives $		
	Elec	Gas	Total
Incentive #1	$0	$0	$664
Incentive #2	$3,106	$3,690	$6,796
Incentive #3	$2,150	$2,672	$4,822
Total All Incentives	$5,256	$6,362	$12,282

Total Project Cost	$101,491

		Allowable Incentive
% Incentives #1 of Utility Cost*	6.0%	$664
% Incentives #2 of Project Cost**	6.7%	$6,796
% Incentives #3 of Project Cost**	4.8%	$4,822
Total Eligible Incentives***	$12,282	
Project Cost w/ Incentives	$89,209	

Project Payback (years)	
w/o Incentives	w/ Incentives
16.3	14.3

* Maximum allowable incentive is 50% of annual utility cost if not funded by NJ BPU, and %25 if it is.
** Maximum allowable amount of Incentive #2 is 30% of total project cost.
Maximum allowable amount of Incentive #3 is 20% of total project cost.
*** Maximum allowable amount of Incentive #1 is $50,000 if not funded by NJ BPU, and $25,000 if it is.
Maximum allowable amount of Incentive #2 & #3 is $1 million per gas account and $1 million per electric account

APPENDIX H

Photovoltaic (PV) Rooftop Solar Power Generation

City of Linwood
Fire House

Cost of Electricity $0.120 $/kWh

Photovoltaic (PV) Rooftop Solar Power Generation-10kW System

Budgetary Cost	Annual Utility Savings				Estimated Maintenance Savings	Total Savings	New Jersey Renewable * Energy Incentive	New Jersey Renewable ** SREC	Payback (without incentive)	Payback (with incentive)
$	kW	kWh	therms	$	$	$	$	$	Years	Years
$70,000	**0.0**	**12,500**	**0**	**$1,500**	**0**	**$1,500**	**$15,000**	**$6,100**	**46.7**	**7.2**

*Incentive based on New Jersey renewable energy program for non-residential applications(PV)= $0.75/W of installed PV system
** Estimated Solar Renewable Energy Certificate Program (SREC) SREC for 15 Years= $487/1000kwh

PVWatts *** AC Energy & Cost Savings

Cautions for Interpreting the Results

Firehouse -10 kW

Station Identification	
City:	Atlantic_City
State:	New_Jersey
Latitude:	39.45° N
Longitude:	74.57° W
Elevation:	20 m
PV System Specifications	
DC Rating:	10.0 kW
DC to AC Derate Factor:	0.770
AC Rating:	7.7 kW
Array Type:	Fixed Tilt
Array Tilt:	39.5°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	12.0 ¢/kWh

Results

Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	3.61	895	107.40
2	4.20	932	111.84
3	4.78	1124	134.88
4	5.23	1155	138.60
5	5.44	1211	145.32
6	5.48	1133	135.96
7	5.55	1171	140.52
8	5.41	1155	138.60
9	5.23	1106	132.72
10	4.60	1034	124.08
11	3.59	821	98.52
12	3.17	766	91.92
Year	4.69	12503	1500.36

Output Hourly Performance Data

Output Results as Text

About the Hourly Performance Data

Saving Text from a Browser

Run PVWATTS v.1 for another US location or an International location
Run PVWATTS v.2 (US only)

Please send questions and comments regarding PVWATTS to Webmaster

RReDC Return to RReDC home page (*http://rredc.nrel.gov*)

Cautions for Interpreting the Results

The monthly and yearly energy production are modeled using the PV system parameters you selected and weather data that are typical or representative of long-term averages. For reference, or comparison with local information, the solar radiation values modeled for the PV array are included in the performance results.

Because weather patterns vary from year-to-year, the values in the tables are better indicators of long-term performance than performance for a particular month or year. PV performance is largely proportional to the amount of solar radiation received, which may vary from the long-term average by ± 30% for monthly values and ± 10% for yearly values. How the solar radiation might vary for your location may be evaluated by examining the tables in the *Solar Radiation Data Manual for Flat-Plate and Concentrating Collectors* (*http://rredc.nrel.gov/solar/old_data/nsrdb/redbook/*).

For these variations and the uncertainties associated with the weather data and the model used to model the PV performance, future months and years may be encountered where the actual PV performance is less than or greater than the values shown in the table. The variations may be as much as 40% for individual months and up to 20% for individual years. Compared to long-term performance over many years, the values in the table are accurate to within 10% to 12%.

If the default overall DC to AC derate factor is used, the energy values in the table will overestimate the actual energy production if nearby buildings, objects, or other PV modules and array structure shade the PV modules; if tracking mechanisms for one- and two-axis tracking systems do not keep the PV arrays at the optimum orientation with respect to the sun's position; if soiling or snow cover related losses exceed 5%; or if the system performance has degraded from new. (PV performance typically degrades 1% per year.) If any of these situations exist, an overall DC to AC derate factor should be used with PVWATTS that was calculated using system specific component derate factors for *shading*, *sun-tracking*, *soiling*, and *age*.

The PV system size is the nameplate DC power rating. The energy production values in the table are valid only for crystalline silicon PV systems.

The cost savings are determined as the product of the number of kilowatt hours (kWh) and the cost of electricity per kWh. These cost savings occur if the owner uses all the electricity produced by the PV system, or if the owner has a net-metering agreement with the utility. With net-metering, the utility bills the owner for the net electricity consumed. When electricity flows from the utility to the owner, the meter spins forward. When electricity flows from the PV system to the utility, the meter spins backwards.

If net-metering isn't available and the PV system sends surplus electricity to the utility grid, the utility generally buys the electricity from the owner at a lower price than the owner pays the utility for electricity. In this case, the cost savings shown in the table should be reduced.

Besides the cost savings shown in the table, other benefits of PV systems include greater energy independence and a reduction in fossil fuel usage and air pollution. For commercial customers, additional cost savings may come from reducing demand charges. Homeowners can often include the cost of the PV system in their home mortgage as a way of accommodating the PV system's initial cost.

To accelerate the use of PV systems, many state and local governments offer financial incentives and programs. Go to http://www.nrel.gov/stateandlocal for more information.

APPENDIX I

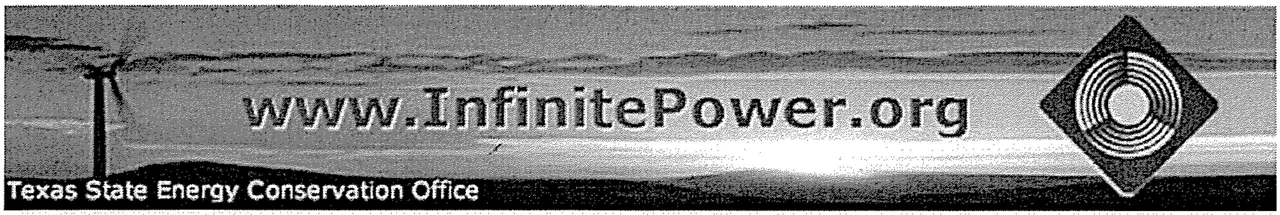
Solar Thermal Domestic Hot Water Plant

NJBPU Energy Audits
CHA #22215
City of Linwood- Firehouse

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
Synergy Solar Thermal System	2	ea			$ 3,600	$ -	$ -	$ 7,848	$ 7,848	
Piping modifications	1	ls	$ 2,000	$ 3,500		$ 1,960	$ 4,235	$ -	$ 6,195	
Electrical modifications	1	ls	$ 1,000	$ 1,000		$ 980	$ 1,210	$ -	$ 2,190	
65 GallonStorage Tanks	2	ea	$ 200	$ 250		$ 400	$ 500	$ -	$ 900	
10 Gallon Drip Tank	2	ea	$ 100	$ 78		$ 200	$ 156	$ -	$ 356	
						$ -	$ -	$ -	$ -	

$17,489	Subtotal
$ 2,623	15% Contingency
$ 2,623	15% Contractor O&P
$ 4,372	25% Engineering
$27,108	**Total**



RENEWABLE ENERGY
THE INFINITE POWER OF TEXAS

Interactive Energy Calculators

Our calculators help you understand energy production and consumption in a whole new way. Use them to develop a personal profile of your own energy use.

Carbon Pollution Calculator
Electric Power Pollution Calculator
PV System Economics
Solar Water Heating
What's a Watt?

Solar Water Heating Calculator

Water heating is a major energy consumer. Although the energy consumed daily is often less than for air conditioning or heating, it is required year round, making it a good application of solar energy. Use this calculator to explore the energy usage of your water heater, and to estimate whether a solar water heater could save you money.

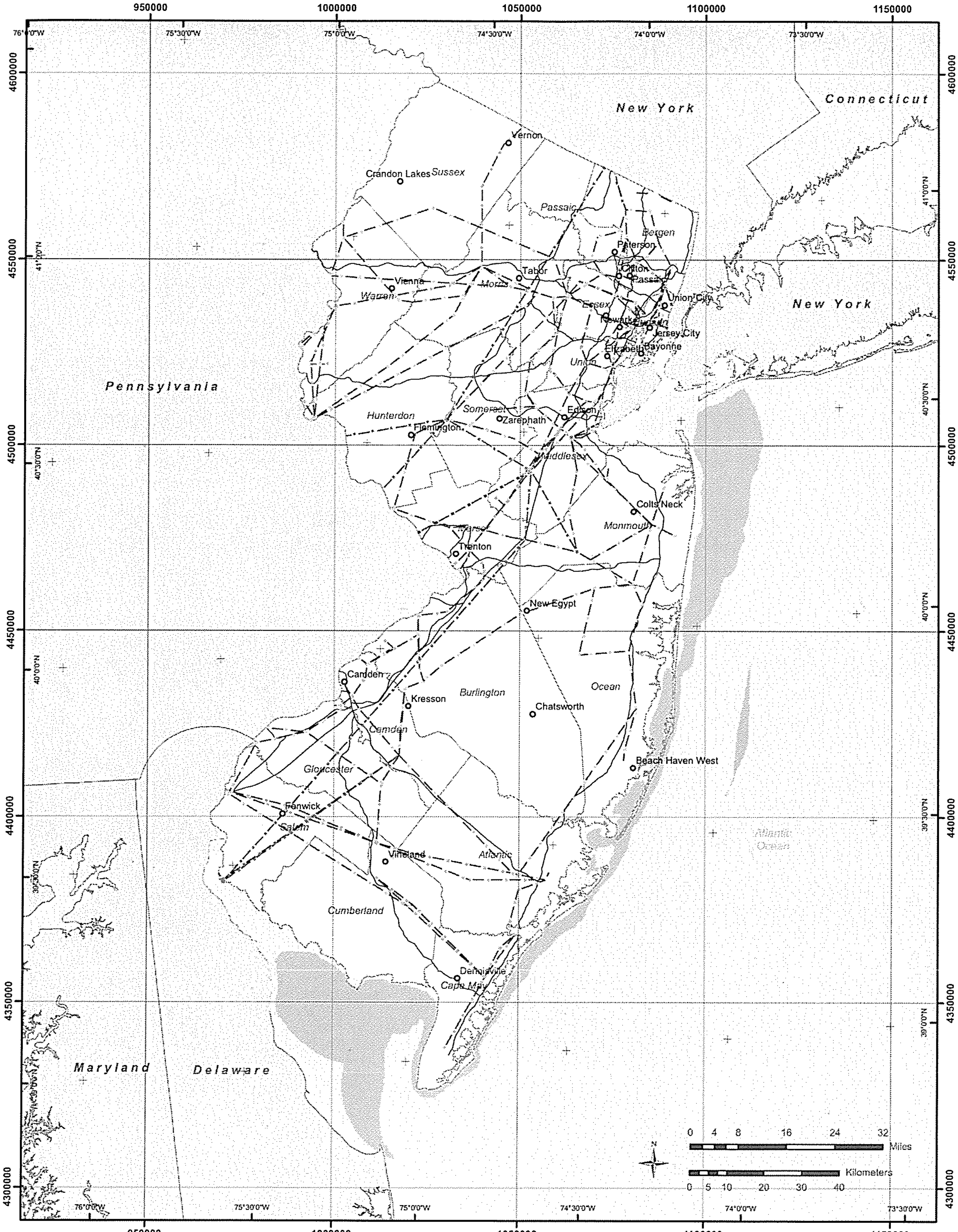
Water Heater Characteristics			
Physical		**Thermal**	
? Diameter (feet)	1.5	? Water Inlet Temperature (Degrees F)	58
? Capacity (gallons)	50	? Ambient Temperature (Degrees F)	70
? Surface Area (calculated - sq ft)	21.36	? Hot Water Temperature (Degrees F)	135
? Effective R-value	NaN	? Hot Water Usage (Gallons per Day)	64.3
Energy Use			
1694		? Heat Delivered in Hot Water (BTU/hr)	
0		? Heat loss through insulation (BTU/hr)	

Gas vs. Electric Water Heating		
Gas		**Electric**
0.8	? Overall Efficiency	.98
NaN	? Conversion Efficiency	0.98
2118 BTU/hr	? Power Into Water Heater	1729 BTU/hr
Cost		
$ 1.33 /Therm	? Utility Rates	$ 0.12 /kWh
$ 246.763	? Yearly Water Heating Cost	$ 532.307
How Does Solar Compare?		
? Solar Water Heater Cost: $ 27100		? Percentage Solar: 70
156.887 years for gas	? Payback Time for Solar System	72.7291 years for electric

More information on solar water heating:

APPENDIX J

Wind



Wind Resource of New Jersey

Mean Annual Wind Speed at 30 Meters

Features

- City
- Interstate Highway
- County Boundary
- Water Body

Generalized Transmission Line

Category

- Under 100 kV
- 100 kV-161 kV
- 230 kV-287 kV
- 345 kV
- 500 kV
- 735 kV +
- Step-Up
- DC Line

Mean Speed at 30 m

mph	m/s
< 10.1	< 4.5
10.1 - 11.2	4.5 - 5.0
11.2 - 12.3	5.0 - 5.5
12.3 - 13.4	5.5 - 6.0
13.4 - 14.5	6.0 - 6.5
14.5 - 15.7	6.5 - 7.0
15.7 - 16.8	7.0 - 7.5
16.8 - 17.9	7.5 - 8.0
17.9 - 19.0	8.0 - 8.5
> 19.0	> 8.5

AWS Truewind

Projection: Tranverse Mercator, UTM Zone 17 WGS84
Spatial Resolution of Wind Resource Data: 200m
This map was created by AWS Truewind using the MesoMap system and historical weather data. Although it is believed to represent an accurate overall picture of the wind energy resource, estimates at any location should be confirmed by measurement.

The transmission line information was obtained by AWS Truewind from the Global Energy Decisions Velocity Suite. AWS does not warrant the accuracy of the transmission line information.

AWS Truewind, LCC

APPENDIX K

EPA Portfolio Manager

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Fire House

Building ID: 2536656
For 12-month Period Ending: August 31, 2010[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: January 10, 2011

Facility
Fire House
401 Poplar Ave
Linwood, NJ 08221

Facility Owner
City of Linwood
400 Poplar Avenue
Linwood, NJ 08221

Primary Contact for this Facility
Hank Kolakowski
400 Poplar Avenue
Linwood, NJ 08221

Year Built: 1960
Gross Floor Area (ft^2): 11,365

Energy Performance Rating[2] (1-100) N/A

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	121,490
Natural Gas (kBtu)[4]	552,730
Total Energy (kBtu)	674,220
Energy Intensity[5]	
Site ($kBtu/ft^2/yr$)	59
Source ($kBtu/ft^2/yr$)	87
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	48
Electric Distribution Utility	
Pepco - Atlantic City Electric Co	
National Average Comparison	
National Average Site EUI	78
National Average Source EUI	157
% Difference from National Average Source EUI	-45%
Building Type	Fire Station/Police Station

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Meets Industry Standards[6] **for Indoor Environmental Conditions:**

Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Certifying Professional
Hank Kolakowski
400 Poplar Avenue
Linwood, NJ 08221

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

ENERGY STAR® Data Checklist for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) or a Registered Architect (RA) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE or RA in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Fire House	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Fire Station/Police Station	Is this an accurate description of the space in question?		☐
Location	401 Poplar Ave, Linwood, NJ 08221	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐

Main Building (Other)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	11,365 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Number of PCs	1(Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	168Hours(Optional)	Is this the total number of hours per week that the space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	5(Optional)	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100.		☐

Energy Consumption

Power Generation Plant or Distribution Utility: Pepco - Atlantic City Electric Co

Fuel Type: Electricity

Meter: Main electric (kWh (thousand Watt-hours))
Space(s): Entire Facility
Generation Method: Grid Purchase

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
08/01/2010	08/31/2010	4,160.00
07/01/2010	07/31/2010	5,280.00
06/01/2010	06/30/2010	2,840.00
05/01/2010	05/31/2010	2,400.00
04/01/2010	04/30/2010	2,400.00
03/01/2010	03/31/2010	2,080.00
02/01/2010	02/28/2010	3,200.00
01/01/2010	01/31/2010	2,560.00
12/01/2009	12/31/2009	2,960.00
11/01/2009	11/30/2009	2,400.00
10/01/2009	10/31/2009	2,400.00
Main electric Consumption (kWh (thousand Watt-hours))		**32,680.00**
Main electric Consumption (kBtu (thousand Btu))		**111,504.16**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**111,504.16**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Natural Gas

Meter: Natural Gas (therms)
Space(s): Entire Facility

Start Date	End Date	Energy Use (therms)
08/01/2010	08/31/2010	16.00
07/01/2010	07/31/2010	20.00
06/01/2010	06/30/2010	10.00
05/01/2010	05/31/2010	87.00
04/01/2010	04/30/2010	304.00
03/01/2010	03/31/2010	549.00
02/01/2010	02/28/2010	1,299.00
01/01/2010	01/31/2010	1,067.00
12/01/2009	12/31/2009	1,064.00
11/01/2009	11/30/2009	388.00
10/01/2009	10/31/2009	269.00

Natural Gas Consumption (therms)	**5,073.00**
Natural Gas Consumption (kBtu (thousand Btu))	**507,300.00**
Total Natural Gas Consumption (kBtu (thousand Btu))	**507,300.00**
Is this the total Natural Gas consumption at this building including all Natural Gas meters?	☐

Additional Fuels	
Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same PE or RA that signed and stamped the SEP.)

Name: ______________________________ Date: __________

Signature: ______________________________

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Fire House
401 Poplar Ave
Linwood, NJ 08221

Facility Owner
City of Linwood
400 Poplar Avenue
Linwood, NJ 08221

Primary Contact for this Facility
Hank Kolakowski
400 Poplar Avenue
Linwood, NJ 08221

General Information

Fire House	
Gross Floor Area Excluding Parking: (ft²)	11,365
Year Built	1960
For 12-month Evaluation Period Ending Date:	August 31, 2010

Facility Space Use Summary

Main Building	
Space Type	Other - Fire Station/Police Station
Gross Floor Area(ft2)	11,365
Number of PCs°	1
Weekly operating hours°	168
Workers on Main Shift°	5

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 08/31/2010)	**Baseline** (Ending Date 09/30/2010)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft2)	59	56	0	N/A	78
Source (kBtu/ft2)	87	83	0	N/A	157
Energy Cost					
$/year	N/A	N/A	N/A	N/A	N/A
$/ft2/year	N/A	N/A	N/A	N/A	N/A
Greenhouse Gas Emissions					
$MtCO_2e$/year	48	46	0	N/A	63
$kgCO_2e/ft2$/year	4	4	0	N/A	5

More than 50% of your building is defined as Fire Station/Police Station. This building is currently ineligible for a rating. Please note the National Average column represents the CBECS national average data for Fire Station/Police Station. This building uses X% less energy per square foot than the CBECS national average for Fire Station/Police Station.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.

APPENDIX L

Block Loads

HEAT GAIN/LOSS WORKSHEET

Project Name:	City of Linwood, NJ	Project No.:	CHA #22215		
Location	Linwood, NJ	Site Elevation:	17 Feet	Specific Volume	14.00 CF/#
Building Name	Linwood Fire House	Date:	12/01/10		
Engineer:	Frank Cuttita				

Building/Facility Designation: Fire House - Engine Bay Only

Outdoor Winter Design DB Temperature	14 °F	Indoor Winter Design DB Temperature	70 °F
Outdoor Summer Design DB Temperature	91 °F	Indoor Summer Design DB Temperature	72 °F
Outdoor Summer Design WB Temperature	73 °F	Indoor Summer Design WB Temperature	60 °F
Outdoor Summer Humidity Ratio	0.0121 #/#	Indoor Air (70°F) Humidity Ratio	0.0079 #/#

ENVELOPE DESCRIPTIONS (Descriptions are from Interior to Exterior)

Walls (Select One - Type X)

Select	Description	R Value	Wall Type
	Steel Siding, 4" Insulation, Steel Siding	15.2	1
	Plaster or Gypsum, frame construction, 5" Insulation, 1" stucco	18.2	1
	4" WH CMU, 1" Insulation, Finished Exterior	5.2	2
	Plaster or Gypsum, frame construction, 3" Insulation, 8" LW CMU	7.8	5
	4" Face Brick, 2" Concrete, 1" Insulation, Exterior Finish	5.1	12
	4" Face Brick, 4" Concrete, 1" Insulation, Exterior Finish	4.0	11
	Interior Finish, 2" Insulation, 8" CMU, 4" Face Brick	10.9	16
	Finished Surface, 8" LW CMU (filled), Air Space, 4" Face Brick	11.1	16
	Stucco or Gypsum, 2.5" Insul, Face Brick	14.3	10
	4" Block, 1" insulation, 8" Block	19.9	16
x	U value calculator	23.1	

Roofs (Select One)

Select	Description	R Value	Roof Type
	Tectum Deck, 3.3" Insul., BU Roof	13.0	1
	Steel Deck, 5" Insul., BU Roof	18.2	1
	Attic Roof with 6" Insul.	25.0	4
	4" HW Concrete Deck, BU Roof	2.7	2
x	Ceiling, 3" Insulation, 4" Concrete Deck, BU Roof	14.9	4
	Ceiling, 4" Concrete Deck, 3" Insulation, BU Roof	18.5	13
	Ceiling, 4" Concrete Deck, 6" Insulation, BU Roof	21.7	14
	Ceiling, Wood Deck, 6" Insulation, Felt & Membrane	22.7	10
	Wood Deck, 6" insulation, Felt & Membrane	18.0	
	U value calculator	22.1	

Windows (Select One)

Select	Description	U Value
	Aluminum Frame, 1/8" SP Glazing	1.05
	Aluminum Frame, 1/4" DP Glazing	0.60
	Aluminum Frame, 3/16" DP Glazing	0.62
	Aluminum Frame, 1/2" DP Glazing	0.50
	Skylights	0.90
x	Other	0.00

	No Storm
Flat Glass	1.05
Flat Glass (e=.6)	1.00
Flat Glass (e=0.4)	0.90
Flat Glass (e=0.2)	0.77
Double Glaze (3/16 in air)	0.63
Double Glaze (1/4 in air)	0.60
Double Glaze (1/2 in air)	0.53
Double Glaze (e=.6)	0.50
Double Glaze (e=0.4)	0.42
Double Glaze (e=0.2)	0.35
Triple Glaze (1/4 in air)	0.42
Triple Glaze (1/2 in air)	0.35

BUILDING CHARACTERISTICS

Roof Area: 1,800 SF
Occupied Area: 1,800 SF

Return Plenum? n

	Gross Wall Length	Average Wall Height	Ceiling Height	Window Area	Door Area	Net Wall Area
North Exposure	90 Ft	15.0 Ft	15.0 Ft	0 SF	900 SF	450 SF
East Exposure	0 Ft	0.0 Ft	15.0 Ft	0 SF	0 SF	0 SF
South Exposure	0 Ft	0.0 Ft	15.0 Ft	0 SF	0 SF	0 SF
West Exposure	0 Ft	0.0 Ft	15.0 Ft	0 SF	0 SF	0 SF

Occupied Forced Ventilation	0 cfm	0.0 AC/hr
Unoccupied Forced Ventilation	0 cfm	0.0 AC/hr

HEAT GAIN/LOSS WORKSHEET

Project Name:	City of Linwood, NJ	Project No.:	CHA #22215
Location	Linwood, NJ	Site Elevation:	17 Feet
Building Name	Linwood Fire House	Date:	12/01/10
Engineer:	Frank Cuttita	Specific Volume	14.00 CF/#

Building/Facility Designation: Fire House - Engine Bay Only

COOLING HEAT GAINS TO THE ROOM - SENSIBLE

SOLAR GAINS

WINDOWS	AREA (SF)	SHGF	Shade Coef	Cooling Load Factor		Solar Heat Gain	
North Exposure	0	38 btu/h/sf	0.8	0.75	Glass Type C	0 Btu/hr	
East Exposure	0	216 btu/h/sf	0.8	0.31	Glass Type C	0 Btu/hr	
South Exposure	0	109 btu/h/sf	0.8	0.58	Glass Type C	0 Btu/hr	
West Exposure	0	216 btu/h/sf	0.8	0.29	Glass Type C	0 Btu/hr	
							0 Btu/h

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain	
North Exposure	450	0.04	20 °F	1.0	390 Btu/hr	
East Exposure	0	0.04	39 °F	1.0	0 Btu/hr	
South Exposure	0	0.04	27 °F	1.0	0 Btu/hr	
West Exposure	0	0.04	22 °F	1.0	0 Btu/hr	
Roof	1,800	0.07	73 °F	1.0	8,804 Btu/hr	
Fenestration	0	0.00	19 °F		0 Btu/hr	
Doors	900	0.14	27 °F		3,394 Btu/hr	
Ceiling	1,800	0.14	0 °F		0 Btu/hr	
Partition		0.05	0 °F		0 Btu/hr	
Floor	1,800	0.04	0 °F		0 Btu/hr	
						12,587 Btu/h

INTERNAL HEAT GAINS (all loads below are based on Occupied Periods)

					Room Heat Gain	
Lights	1.00 w/sf x	1,800 Occ Area =	1.8 kW x 3.4x	1.0 RAF =	6,143 Btu/h	
Plug Load	0.10 w/sf x	1,800 Occ Area =	0.2 kW x 3.4x	1.0 RAF =	614 Btu/h	
People	0 people x	255 btu/person x	100% time in space =		0 Btu/h	
Computer Work Stations		0 Units x	120 W/Unit x	3414 =	0 Btu/h	
Equipment	0.0 kW x 3.413 =				0 Btu/h	
Misc.					0 Btu/h	
						6,758 Btu/h

VENTILATION AND INFILTRATION

		Infiltration Factor	Perimeter Ratio	Coef	Temp. Diff.	Room Heat Gain	
Walls	450 SF	0.15 CFM/SF		1.04	19 °F	1,446 Btu/h	
Doors	900 SF	0.30 CFM/LF	0.25 LF/SF	1.04	19 °F	1,427 Btu/h	
Windows	0 SF	0.20 CFM/LF	0.00 LF/SF	1.04	19 °F	0 Btu/h	
Ventilation	0 cfm			1.04	19 °F	0 Btu/h	
							2,872 Btu/h

Infiltration 134 cfm 0.0 AC/hr

COOLING HEAT GAINS TO THE RA PLENUM - SENSIBLE

4,950

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain 1	
North Exposure	0	0.04	20	1.0	0 Btu/hr	
East Exposure	0	0.04	39	1.0	0 Btu/hr	
South Exposure	0	0.04	27	1.0	0 Btu/hr	
West Exposure	0	0.04	22	1.0	0 Btu/hr	
Roof	1,800	0.07	73	0.0	0 Btu/hr	
						0 Btu/h

INTERNAL HEAT GAINS

Lights	1.00 w/sf x	1,800 Occ Area =	1.8 kW x3413x	0.00 RAF =	0 Btu/h	
Misc.					0 Btu/h	
						0 Btu/h

SENSIBLE HEAT GAINS - TEMP. DEPENDENT		SENSIBLE HEAT GAINS - TEMP. INDEPENDENT	
Solar	0	Internal Gains to Room	6,758
Conduction to Room	12,587	Internal Gains to Plenum	0
Conduction to Plenum	0		
Ventilaton and Infiltration	2,872		
Sub Total	15,460	Sub Total	6,758

HEAT GAIN/LOSS WORKSHEET

Project Name:	City of Linwood, NJ	Project No.:	CHA #22215
Location	Linwood, NJ	Site Elevation:	17 Feet
Building Name	Linwood Fire House	Date:	12/01/10
Engineer:	Frank Cuttita		

Specific Volume 14.00 CF/#

Building/Facility Designation: Fire House - Engine Bay Only

LATENT COOLING LOADS

Infiltration

			Infiltration Factor	Air Density	Humidity Ratio Dif.	Room Heat Gain
Walls	1,800 SF		0.15 CFM/SF	4,629	0.0042 #/#	5,302 Btu/h
Doors	900 SF		0.30 CFM/LF	4,629	0.0042 #/#	1,308 Btu/h
Windows	0 SF		0.20 CFM/LF	4,629	0.0042 #/#	0 Btu/h
Ventilation	0 cfm			4,629	0.0042 #/#	0 Btu/h
People	0 people		1.00 time in space		250 Btu/hr/person	0 Btu/h
						6,610 Btu/h

Cooling Load Summary

	Sensible	Latent	Total		
Temperature Dependent Gains	15,460	6,610	22,070		
Temperature Indep. Gains	6,758	0	6,758	SHR=	0.77
Total	22,217	6,610	28,828		

Building Cooling Load 2.4 Tons at 749 SF/Ton

Building Air Flow to Condition Space based on a 12°F Temp Rise is 1,774 CFM
0.99 CFM/sf

HEATING CALCULATION

CONDUCTION

	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.	Room Heat Gain
North Exposure	450	0.04	56	1,091 Btu/h
East Exposure	0	0.04	56	0 Btu/h
South Exposure	0	0.04	56	0 Btu/h
West Exposure	0	0.04	56	0 Btu/h
Fenestration	0	0.00	56	0 Btu/h
Roof	1,800	0.07	56	6,754 Btu/h
Doors	900	0.14	56	7,039 Btu/h
Ceiling	1,800	0.14	0	0 Btu/h
Partition	0	0.05	0	0 Btu/h
Floor	1,800	0.04	0	0 Btu/h

Ventilation and Infiltration

		Infiltration Factor	Coef	Temp. Difference	Air Flow	Room Heat Gain
Walls	450 SF	0.15 CFM/SF	1.04	56	68 cfm	3,946 Btu/h
Doors	900 SF	0.30 CFM/LF	1.04	56	67 cfm	3,893 Btu/h
Windows	0 SF	0.20 CFM/LF	1.04	56	0 cfm	0 Btu/h
Ventilation Load	0 cfm		1.04	56	0 cfm	0 Btu/h
Total Ventilation & Infiltration Load					134 cfm	7,839 Btu/h

Building Heating Load 22,722 btu/h
12.6 btu/sf

City of Linwood, NJ
CHA #22215
Fire House Engine Bay Only

Reconcile Thermal Model

Building Footprint	1,800 SF	Ex Occupied Clng Temp.	72 °F	Ex Occupied Htg Temp.	70 °F
Heating Efficiency	68%	Ex Unoccupied Clng Temp.	78 °F	Ex Unoccupied Htg Temp.	60 °F
Cooling Efficiency	1.20 kW/ton	Occupied Cooling UA	662 btu/hr/°F	Occupied Heating UA	266 btu/hr/°F
Internal Gains	6,758 btu/h	Unoccupied Cooling UA	662 btu/hr/°F	Unoccupied Heating UA	266 btu/hr/°F
Unoc Internal Gain factor	0.03	Cooling Occ Enthalpy Setpoint	27.5 Btu/lb		
Ave Occ Internal Gain Factor	0.7	Cooling Unocc Enthalpy Setpoint	27.5 Btu/lb		
Economizer available (Y/N)	No				

Heating and cooling energy are unrelated in this model. If the building being analyzed is not cooled, disregard cooling energy calculations

					EXISTING LOADS									
					Occupied			Unoccupied						
Avg Outdoor Air Temp. Bins °F	Avg Outdoor Air Enthalpy	Total Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Available Economizer Cooling kWh	Necessary Cooling Energy kWh	Existing Cooling Energy kWh	Existing Heating Energy therms
A		B	C	D	E	F	G	H	I	J	K	L	M	M
102.5	49.1	0	0	0	20,206	-103,664	-4,730	16,231	-103,664	-203	0	0	0	0
97.5	42.5	9	9	0	16,893	-71,989	-4,730	12,919	-71,989	-203	0	54	54	0
92.5	39.5	69	69	0	13,581	-57,591	-4,730	9,606	-57,591	-203	0	336	336	0
87.5	36.6	132	132	0	10,269	-43,673	-4,730	6,294	-43,673	-203	0	503	503	0
82.5	34.0	344	344	0	6,956	-31,195	-4,730	2,981	-31,195	-203	0	997	997	0
77.5	31.6	566	566	0	3,644	-19,677	-4,730	0	0	-203	0	1,175	1,175	0
72.5	29.2	755	755	0	331	-8,159	-4,730	0	0	-203	0	948	948	0
67.5	27.0	780	780	0	664	2,880	-4,730	0	0	-203	0	93	93	0
62.5	24.5	889	889	0	1,993	8,639	-4,730	0	0	-203	0	0	0	0
57.5	21.4	742	742	0	3,322	14,398	-4,730	664	2,880	-203	0	0	0	77
52.5	18.7	627	627	0	4,651	20,157	-4,730	1,993	8,639	-203	0	0	0	142
47.5	16.2	725	725	0	5,980	25,916	-4,730	3,322	14,398	-203	0	0	0	185
42.5	14.4	795	795	0	7,309	31,675	-4,730	4,651	20,157	-203	0	0	0	290
37.5	12.6	784	784	0	8,638	37,434	-4,730	5,980	25,916	-203	0	0	0	400
32.5	10.7	682	682	0	9,967	43,193	-4,730	7,309	31,675	-203	0	0	0	477
27.5	8.6	345	345	0	11,296	48,952	-4,730	8,638	37,434	-203	0	0	0	486
22.5	6.8	229	229	0	12,624	54,711	-4,730	9,967	43,193	-203	0	0	0	282
17.5	5.5	189	189	0	13,953	60,471	-4,730	11,296	48,952	-203	0	0	0	211
12.5	4.1	70	70	0	15,282	66,230	-4,730	12,624	54,711	-203	0	0	0	194
7.5	2.6	20	20	0	16,611	71,989	-4,730	13,953	60,471	-203	0	0	0	79
2.5	1.0	8	8	0	17,940	77,748	-4,730	15,282	66,230	-203	0	0	0	25
-2.5	0.0	0	0	0	19,269	83,507	-4,730	16,611	71,989	-203	0	0	0	11
-7.5	-1.5	0	0	0	20,598	89,266	-4,730	17,940	77,748	-203	0	0	0	0
TOTALS		8,760	8,760	0								4,106	4,106	2,857

Existing Building Ventilation & Infiltration (occ)	**1,067 cfm**
Overheat Ventilation Factor	**1.00**
Additional ventilation to offset overheat	**0 cfm**
Existing Building Ventilation & Infiltration (unocc)	**1,067 cfm**
Economizer Ventilation (from AHU's)	**cfm**

Energy Use Indices (calculated)

	Base Case
Heating	2,857
Target ->	

APPENDIX M

Equipment Inventory

Description	QTY	Manufacturer Name	Model No.	Serial No.	Equipment Type / Utility	Capacity/Size	Location	Areas Served	Date Installed	Remaining Useful Life (years)	Other Info.
HW Boiler	1	Crane			Heating / Natural Gas	1,100MBH input	Boiler Room	Entire Facility	1970	0	
HW Pump - 1	5	B&G			Pump motor / Electric	1/8 HP	Boiler Rm	Heating Zone 1-5	1995	3	
Unit Heater	4						Engine room	Engine Room			
AC	1	Weather King	WKKA-A060JK13E			5 TON		RENTAL HALL		10	
AC	1	SANYO	C2472			5 TON		RENTAL HALL		10	
AC	1	CARRIER	M-1000E12411			3 TON		FIRE MARSHALL		10	
EXHAUST FAN	1	GREENHECK	CBX-18-5					HOOD		12	
AC	1	CARRIER	38CKC024			3 TON		OFFICES		10	
AC	1	SANYO	C2473			2 TON		LOUNGE		12	
Water Heater	1	GE			Natural Gas	50 gallon				8	