FAIR HAVEN
FIRE STATION

ENERGY ASSESSMENT

for

NEW JERSEY
BOARD OF PUBLIC UTILITIES

CHA PROJECT NO. 21968

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APPENDICES

1.0 INTRODUCTION

This report summarizes the energy audit for the Fire Station of the Borough of Fair Haven, located at 645 River Road. The 9,540 square foot complex was originally constructed in 1952, and has undergone a large addition for the Fair Haven Rescue Squad. Two separate buildings were also added to the property since the original construction and include a concession stand used for the annual Fair Haven Fire Station carnival and another, larger building used for storage and vehicle garage space. The facility has no full time staff; some of the approximately 250 volunteer members occupy the main building at various times daily. Multiple monthly meetings as well as several annual events are held in the main building.

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 energy audit for the 9,540 square foot Fire Station of the Borough of Fair Haven. The Fire Station was constructed in 1952, and has undergone a large addition for the Fair Haven Rescue Squad. Two separate buildings were also added, including a concession stand and larger building used for storage and vehicle garage space. The facility has no full time staff. The following areas were evaluated for energy conservation measures:

- Lighting replacement
- Boiler replacement and hot water reset
- Exit sign replacement

Various potential Energy Conservation Measures (ECMs) were identified for the above categories. Potential annual savings of $3,200 for the recommended ECMs may be realized with a payback of 6.8 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 costs, savings, and paybacks for the recommended ECMs follows:

ECM-1 Boiler Replacement with Hot Water Temperature Reset

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
15,500	0	0	1,500	0	2,300	0	2,300	1.2	600	6.7	6.5

*Incentive shown is per the New Jersey Smart Start Program, 2010 Gas Heating Application. This measure is also potentially eligible for Direct Install funding. See section 5.0 for other incentive opportunities.

ECM-2 Lighting Replacements

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
7,300	3.3	3,400	0	0	700	0	700	0.5	800	10.4	9.3

*Incentive shown is per the New Jersey Smart Start Program, 2010 Prescriptive Lighting Application.

ECM-3 Exit Sign Replacement

Budgetary Cost	Annual Utility Savings				Estimated Maintenance Savings	Total Savings	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total					
$	kW	kWh	Therms	$	$	$	$	Years	Years
500	0.1	780	0	200	0	200	NA	2.5	NA

*Incentive shown is per the New Jersey Smart Start Program, Prescriptive Lighting Application.

3.0 EXISTING CONDITIONS

3.1 Building – General

The Fire Station facility is a two-story brick and masonry building with space to house two large vehicles and apparatus. There are four overhead doors on the south (front side) and one on the north side. The building contains some offices and meeting rooms; some on the first floor but mostly on the second floor. Also part of this building is the Fair Haven Rescue Squad. Located on the western end of the building, two overhead doors on the front face of the building are used for housing their apparatus. The Rescue Squad area also contains a meeting room, office, and residential style kitchen.

Also located on this property is a concession stand used during the Fire Station's annual carnival. The Fire Station has a large industrial style kitchen on the second floor. Storage and two walk-in coolers as well as an ice making machine are located in the basement.

A separate storage building located on the northwest end of the property houses an antique fire truck as well as materials for the carnival. A small office and bathroom are only used during the carnival and a single window air conditioning unit is used for cooling during this time. A forced air heating system is used for heat when needed.

3.2 Utility Usage

Utility service includes electricity from Jersey Central Power and Light (JCP&L) and natural gas from South Jersey Energy (SJE). The Fire Station utilizes a separate meter for electricity and natural gas consumption. The entire building is heated with unit heaters and natural gas forced hot air, and cooled by electric air conditioning.

From December 2008 through December 2009, electric usage was approximately 106,480 kWh at a cost of $22,000. Analyzing electricity bills during this period showed that the Fire Station was charged at a blended rate of $0.206/kWh. Electrical consumption was generally constant year round, except for August when the annual carnival spiked consumption considerably. Electricity consumption data and a graph of the previous year are provided in Appendix A.

From January 2009 through December 2009, natural gas consumption was approximately 10,210 therms at a cost of $15,400. Analyzing natural gas bills during this period showed that the blended rate was $1.50/therm. Natural gas consumption was higher during the winter heating months as well as in August due to higher demand for cooking appliances during the annual carnival. Natural gas data and graph are included in Appendix A.

Electricity and natural gas commodity supply and delivery is presently purchased from JCP&L. The delivery component will always be the responsibility of the utility that connects the facility to the power grid or gas line; however, the supply can be purchased from a third party. The electricity or natural gas commodity supply entity will require submission of one to three years of past energy bills. Contract terms can vary among suppliers. A list of approved electrical and natural gas energy commodity suppliers can be found in Appendix B. According to the U.S. Energy Information Administration, the average commercial unit costs of electricity and natural gas in New Jersey during July 2010 was $0.152 per kWh and $1.09 per therm. Based on the fact that the building is currently paying above the state average for electricity and natural gas, it is recommended that a third party supplier be pursued for both utilities.

3.3 HVAC Systems

Building heat is generated by two Weil-McLain 305MBH input, 247MBH output, natural gas-fired heating hot water (HHW) boilers. Four HHW loops are utilized for individual zone heating. Each zone is fed from a single hot water loop that circulates HHW between the two boilers. A single outside air temperature sensor enables the boilers during the winter months and manual zone thermostats control loop water temperatures. Only one boiler is required to heat the building.

Heating in the Fire Station is done with fin tube radiation along the walls or ceiling mounted unit heaters in the truck bays.

Cooling is provided to select areas by individual zone air conditioning systems. The three AC split system units currently in use are Fujitsu model AUO3OC1. Cooled spaces include the recreational room, upstairs meeting area, and Rescue Squad's meeting room.

Exhaust fans are utilized throughout the building for kitchen and restroom exhaust; each is served by a dedicated fractional horsepower rooftop exhaust fan.

3.4 Lighting/Electrical Systems

The lighting system consists of 8 ft. and 4 ft., T-12 fixtures and some high and medium wattage incandescent bulbs. Most of the lighting is manually controlled by wall switches. Surrounding outdoor lights are controlled by timers, except the lighting on the south side that is controlled by switches during fire and emergency calls. The older exit signs use incandescent bulbs.

3.5 Control Systems

All of the controls for reheat and perimeter radiation are standard style thermostats. The hot water hydronic system is zoned with four individual zone pumps. The manual space thermostats are usually maintained at 68°F during occupied periods and 60°F during vacant timeframes.

Cooling setpoints for the split systems are 72°F during occupied times; the units are turned off manually when not being used.

3.6 Building – Special Systems

The facility has a gas fired emergency generator. There are also two compressors and a refrigerated air dryer used for refilling the Scott Air Packs used by the firemen for self-contained breathing equipment.

3.7 Plumbing Systems

Domestic hot water is produced by a standard gas fired A.O. Smith, 75 gallon water heater located in the basement. A small 20 gallon electric hot water heater is also utilized for one of the restrooms.

An equipment inventory is provided in Appendix K.

4.0 ENERGY CONSERVATION MEASURES

4.1 ECM-1 Boiler Replacement with Hot Water Temperature Reset

Heating hot water is provided by two Weil-McLain Model PFG – 6 - PIN gas-fired, hot water boilers. The boilers are rated at 305,000 Btuh input, 247,000 Btuh output, with a rated efficiency of 81%. This ECM evaluated replacing one of the original boilers with a high efficiency, condensing boiler with a hot water (HW) temperature reset control system. By installing a HW reset system, heat losses from the building's HHW piping system can be greatly reduced. Additionally, combining the control system with a condensing boiler can improve firing efficiency up to 93%, or higher.

Applying HW temperature reset was evaluated by generating a spreadsheet comparing the existing piping system losses to those of the proposed system. Building drawings were not available; therefore, total linear footage and required line sizes could not be definitively determined, and some assumptions were made based on the scaled CAD drawings.

These boilers were recently installed; however, the energy savings resulting from replacement of one of the boilers with a higher efficiency unit may justify the conversion. Calculations determined that the boilers consume about 9,600 therms annually. Applying an operational boiler efficiency of 79% to its annual natural gas usage established a baseline boiler load of approximately 758,400 MBH per year. With the improved efficiency determined in the HW reset calculation, the proposed condensing boiler will require 8,160 therms to meet this load, resulting in a savings of about 1,460 therms of natural gas per year. The proposed boiler efficiency rating is based on the use of an Aerco MLX Series boiler for the calculation. Exact boiler selection and sizing cannot be completed without a more detailed analysis of the building's hydronic heating system and generation of a load profile.

For implementation of this measure, a single new gas-fired, condensing, hot water boiler would be installed, along with a HW temperature reset control system. One of the existing Weil-McLain boilers would stay in operation as a backup and for cold weather use. Minimal supply and return piping would be required to reconnect the new boiler. The existing hot water piping arrangement has already been optimized for the boiler installation. A new exhaust flue system will also be required.

Condensing boilers and hot water reset control system have an expected life of 25 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 36,500 therms and $57,500.

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

ECM-1 Boiler Replacement with Hot Water Temperature Reset

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
15,500	0	0	1,500	0	2,300	0	2,300	1.2	600	6.7	6.5

*Incentive shown is per the New Jersey Smart Start Program, 2010 Gas Heating Application. This measure is also potentially eligible for Direct Install funding. See section 5.0 for other incentive opportunities.

This measure is recommended.

4.2 ECM-2 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 Fire Station utilizes a variety of lighting fixtures. The fire engine bays are lit with (12) 8', two lamp T-12 fixtures with magnetic ballasts to illuminate the space, which is inefficient by current standards. The second floor meeting area is lit with (22) 2 x 4, four lamp T-12 fixtures; the Rescue Squad uses (15) 2 x 2, U-tube T-12 fixtures. Additional inefficient lighting includes (29) 60 W incandescent flood lamps.

This measure addressed energy savings from replacing the T-12 fixtures with high output T-8 fluorescent lamps and replacing the 60 W incandescent flood lamps with 13 W compact fluorescent flood lamps.

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 3,400 kWh per year. Supporting calculations, including all assumptions for lighting hours and the annual energy usage for each fixture is provided in Appendix C.

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 5,100 kWh and $10,500.

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

ECM-2 Lighting Replacements

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
7,300	3.3	3,400	0	0	700	0	700	0.5	800	10.4	9.3

*Incentive shown is per the New Jersey Smart Start Program, 2010 Prescriptive Lighting Application.

This measure is recommended.

4.3 ECM-3 Exit Sign Replacement

A building walkthrough noted four old style exit signs, which utilize two, 8 watt bulbs and have an overall consumption of 24 watts each; the existing exit signs are considered outdated and inefficient. Replacing the fixtures with new, energy efficient LED signs will reduce the electrical usage to approximately 1.7 watts/fixture.

The combined wattage of the existing exit signs were applied to the hours in a year. The computation determined the annual electrical consumption for these signs to be about 840 kWh. Reapplying the calculation to the combined wattage for the proposed exit signs yielded an annual consumption of 60 kWh, resulting in a savings of approximately 780 kWh.

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 11,700 kWh and $3,000.

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

ECM-3 Exit Sign Replacement

Budgetary Cost	Annual Utility Savings				Estimated Maintenance Savings	Total Savings	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total					
$	kW	kWh	Therms	$	$	$	$	Years	Years
500	0.1	780	0	200	0	200	NA	2.5	NA

*Incentive shown is per the New Jersey Smart Start Program, Prescriptive Lighting Application.

This measure is recommended.

5.0 PROJECT INCENTIVES

5.1 Incentives Overview

5.1.1 New Jersey Pay For Performance Program

The 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. Available incentives are as follows:

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 2010 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.

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.

5.1.5 Direct Install Program

The Direct Install Program targets small and medium sized facilities where the peak electrical demand does not exceed 200 kW in any of the previous 12 months. Buildings must be located in New Jersey and served by one of the state's public, regulated electric or natural gas utility companies. On a case-by-case basis, the program manager may accept a project for a customer that is within 10% of the 200 kW peak demand threshold.

The 200 kW peak demand threshold has been waived for local government entities that receive and utilize their Energy Efficiency and Conservation Block Grant as discussed in section 5.1.3 in conjunction with Direct Install.

Direct Install is funded through New Jersey's Clean Energy Program and is designed to provide capital for building energy upgrade projects to fast track implementation. The program will pay up to 60% of the costs for lighting, HVAC, motors, natural gas, refrigeration, and other equipment upgrades with higher efficiency alternatives. If a building is eligible for this funding, the Direct Install Program can significantly reduce the implementation cost of energy conservation projects.

The program pays a maximum amount of $50,000 per building, and up to $250,000 per customer per year. Installations must be completed by a Direct Install participating contractor, a list of which can be found on the New Jersey Clean Energy Website at http://www.njcleanenergy.com. Contractors will coordinate with the applicant to arrange installation of recommended measures identified in a previous energy assessment, such as this document.

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 9,540 square foot building is eligible for about $480 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 $ 477, reducing the total project payback from 6.9 years to 6.8 years. See Appendix E for calculations.

5.2.2 New Jersey Smart Start Program

The Fair Haven Fire Station is eligible for several incentives available under New Jersey Smart Start Programs. The total amount of all qualified incentives is about $1,400 and includes installing a high efficiency gas-fired boiler and upgrades to the lighting system.

5.2.3 Energy Efficient and Conservation Block Grant

The Fair Haven Fire Station is leased by the borough which makes it 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 Fire Station will be 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 in Fire Station is about $23,300. This program would pay 60%, or about $14,000 of these initial costs. This funding has the potential to significantly affect the payback periods of Energy Conservation Measures. For the Fire Station, the Direct Install Program brings the simple payback from about 6.9 years, to approximately 2.7 years.

In order to apply for this program the borough must contact the Direct Install contractor for Monmouth County, Hutchinson Mechanical Services. Contact information is available on the New Jersey Clean Energy Website.

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's°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 boiler and split air conditioning systems to meet its HVAC needs. None of which are not compatible with a geothermal energy source. Therefore, to take advantage of a GHP system, the existing mechanical equipment would have to be removed or overhauled; and either a low temperature closed loop water source heat pump system or a water to water heat pump system would have to be installed to realize the benefit of the consistent temperature of the ground.

This measure is not recommended due to the extent of HVAC system renovation needed for implementation. Additionally, the building's minimal heating requirements do not justify such an extensive renovation and the project would not payback within the useful life of the equipment.

6.2 Solar

6.2.1 Photovoltaic Rooftop Solar Power Generation

The Fire Station as 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 has sufficient room to install a solar cell array above the second floor meeting room but it would need to be angled south for maximum efficiency. 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 Newark, New Jersey and a fixed tilt array type was utilized to calculate energy production. The PVWATT solar power generation model is provided in Appendix F.

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

Installation of (PV) arrays in the state of 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 periods of 15 years from the date of installation. The cost of the ACP penalty for 2009 was $700; this is the amount that must be paid per SERC by the high emission producers. The expected dollar amount that will be paid to the PV producer for 2010 is expected to be $600/SREC credit. Payments that will be received from the PV producer will change from year to year dependent upon supply and demand. Renewable Energy Consultants is a third party SREC broker that has been approved by the New Jersey Clean Energy Program. As stated above 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.

There was no kW usage data available for determining the size of the PV solar array, so a 10 kW was used for the calculations. Incentives for a 10 kW PV solar array were used in the payback calculation.

The system costs for PV installations were derived from the most recent Solar Center, of New Jersey, estimates of total cost of system installation (see Appendix F). It should be noted that the cost of installation is approximately $6.33 per watt or $6,330 per kW of installed system. This has decreased in the past few years due to the rise in national demand for PV power generator systems. Other cost considerations will also need to be considered. PV panels have an approximate 20 year life span; however, the inverter device that converts DC electricity to AC has a life span of 10 to 12 years and will need to be replaced multiple times during the useful life of the PV system.

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

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
63,300	0	11,830	0	2,400	2,400	7,500	5,800	26.4	6.8

*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

The Fair Haven Fire Station has a very attractive south facing roof for photovoltaics. The roof is pitched and does not have many nearby structures to cast shadows over the solar cells.

The payback on this ECM is within the parameters for recommended measures.

6.2.2 Solar Thermal Hot Water Plant

Active solar thermal systems use solar collectors to gather the sun's energy to heat water, other fluids, 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, a 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 a solar DHW system would save site gas usage.

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, Fair Haven 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 G 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		600	900	900	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 are 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. In the Fair Haven Borough area, the map shown in the appendices indicates a mean annual wind speed of about 11.9 miles per hour. For the building, there are site restrictions, such as parking lots, trees and surrounding structures that would greatly affect a tower location.

A wind speed map is included in Appendix H.

If a site could be identified near the building with limited obstructions, a meteorological tower could be installed to gain a more accurate representation of wind speed for the area.

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, 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 building does not have an excessively large electricity demand, and it does not have a heating load to use the thermal byproduct in the summer. An absorption chiller could be installed to utilize the heat to produce chilled water; however, there is no chilled water distribution system in the building. The most viable selection for a CHP plant at this location would be a reciprocating engine natural gas-fired unit. Purchasing this system and performing modifications to the existing HVAC and electrical systems would greatly outweigh the savings over the life of the equipment.

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 the extent of HVAC system renovation needed for implementation. Additionally, the building's minimal heating requirements do not justify such an extensive renovation and the project would not payback within the useful life of the equipment.

6.6 Demand Response Curtailment

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 incentives are offered 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 emergencies. Part of the program also will require that participants reduce their required load or run emergency generators with notice to test the system.

JCP&L does not currently have a Demand Response Curtailment, or load shedding program for its customers so this is not an option for the Fire Station.

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 Fire Station is considered a below average energy consumer per the Portfolio Manager with a Site Energy Usage Index (EUI) of 134 kBTU/ft^2/year. The EUI can be improved by addressing wasted energy from inefficient heating equipment and inefficient lighting systems. By implementing the measures discussed in this report, it is expected that the EUI can be reduced to approximately 115 kBTU/ft^2/year; the national average for this building type is 157 kBTU/ft^2/year. 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.

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

The user name and password for the building's EPA Portfolio Manager Account will be provided to the supervisor of the Borough of Fair Haven.

8.0 CONCLUSIONS & RECOMMENDATIONS

The energy audit conducted by CHA at the Fire Station of the Borough of Fair Haven in Fair Haven, New Jersey identified potential ECMs for lighting replacement, boiler replacement and hot water reset, and exit sign replacement. Potential annual savings of $3,200 may be realized for the recommended ECMs, with a summary of the costs, savings, and paybacks as follows:

ECM-1 Boiler Replacement with Hot Water Temperature Reset

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
15,500	0	0	1,500	0	2,300	0	2,300	1.2	600	6.7	6.5

*Incentive shown is per the New Jersey Smart Start Program, 2010 Gas Heating Application. This measure is also potentially eligible for Direct Install funding. See section 5.0 for other incentive opportunities.

ECM-2 Lighting Replacements

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
7,300	3.3	3,400	0	0	700	0	700	0.5	800	10.4	9.3

*Incentive shown is per the New Jersey Smart Start Program, 2010 Prescriptive Lighting Application.

ECM-3 Exit Sign Replacement

Budgetary Cost	Annual Utility Savings				Estimated Maintenance Savings	Total Savings	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total					
$	kW	kWh	Therms	$	$	$	$	Years	Years
500	0.1	780	0	200	0	200	NA	2.5	NA

*Incentive shown is per the New Jersey Smart Start Program, Prescriptive Lighting Application.

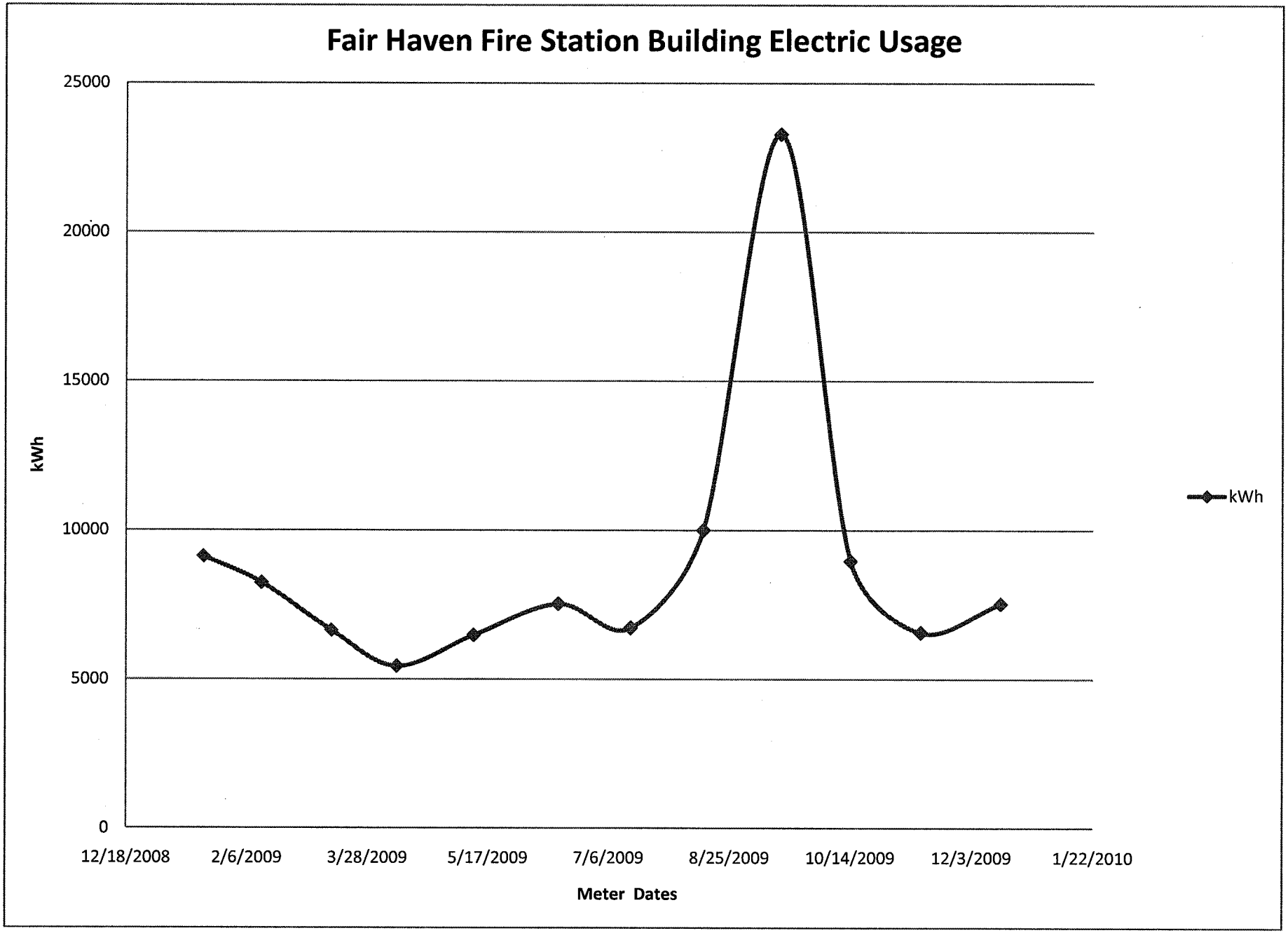
APPENDIX A

Utility Usage Analysis

Account Number 10 00 55 8880 0 0
Meter number
Address River Road

Meter Date	Billing kWH	Charge
1/10/2008	6960	$1,401.28
2/8/2008	6000	$1,268.77
3/10/2008	6480	$1,316.72
4/9/2008	6240	$1,253.77
5/9/2008	5520	$1,162.95
6/11/2008	6880	$1,509.15
7/11/2008	7120	$1,611.40
8/12/2008	10800	$2,200.68
9/10/2008	22560	$4,551.43
10/9/2008	8000	$1,568.48
11/11/2008	8880	$1,693.52
12/11/2008	7120	$1,474.76
1/19/2009	9120	$1,799.69
2/12/2009	8240	$1,677.89
3/13/2009	6640	$1,433.74
4/9/2009	5440	$1,250.18
5/11/2009	6480	$1,397.32
6/15/2009	7520	$1,678.96
7/15/2009	6720	$1,541.45
8/14/2009	10000	$2,056.71
9/15/2009	23280	$4,545.40
10/14/2009	8960	$1,721.56
11/12/2009	6560	$1,383.75
12/15/2009	7520	$1,538.98

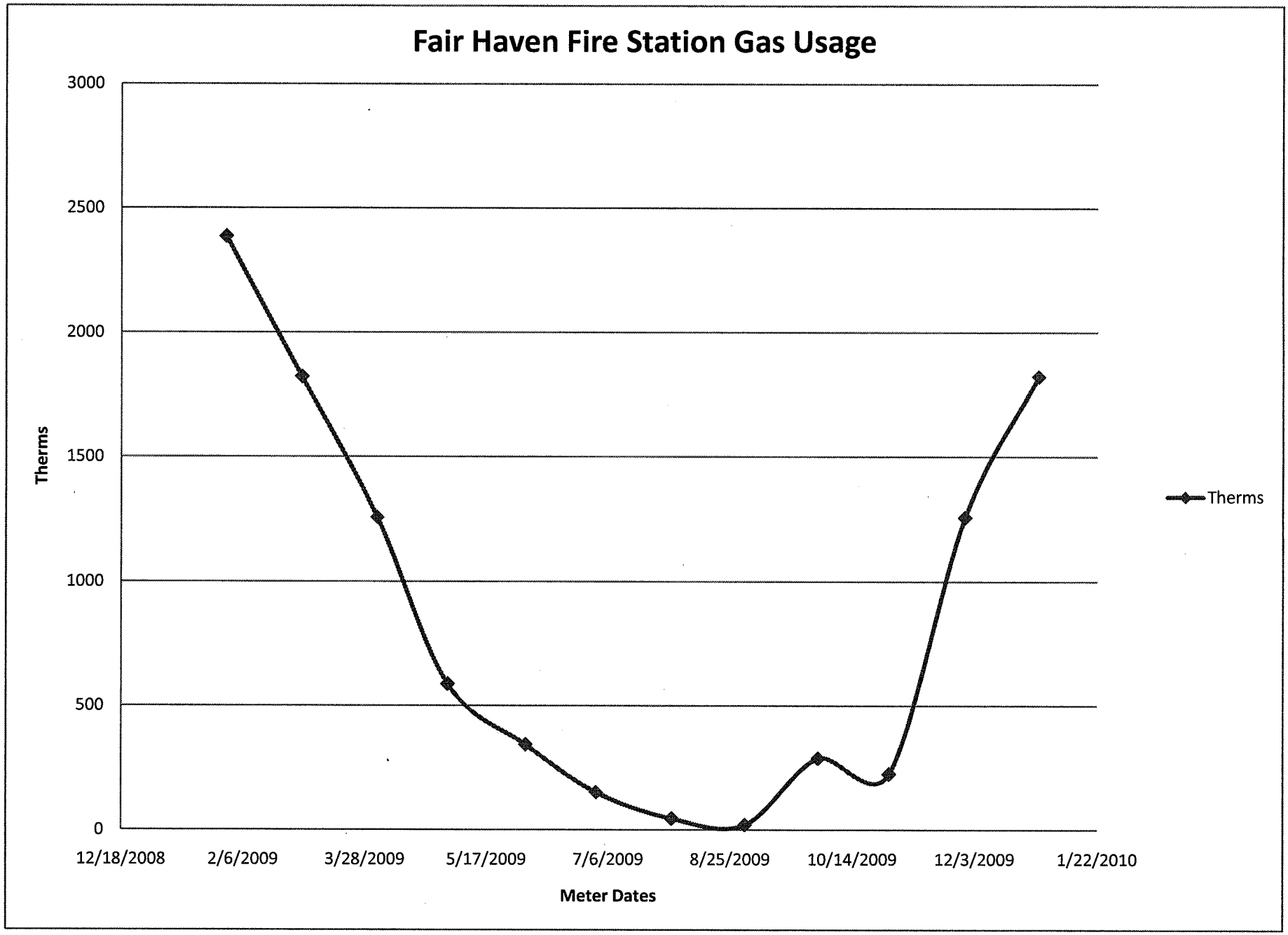
Total	209040	$43,038.54


Fair Haven Fire Station Building Electric Usage
25000
20000
15000
10000
5000
0
kWh
12/18/2008
2/6/2009
3/28/2009
5/17/2009
7/6/2009
8/25/2009
10/14/2009
12/3/2009
1/22/2010
Meter Dates
kWh

Fair Haven Fire Station
Natural Gas Bills
Fari Haven, NJ

Meter Date	Billing Therms	Charge
1/30/2009	2386	$3,327.90
3/2/2009	1821.5	$2,568.86
4/2/2009	1257	$1,809.82
5/1/2009	587	$941.05
6/2/2009	344	$625.85
7/1/2009	152	$376.82
8/1/2009	46	$93.29
8/31/2009	21	$206.90
9/30/2009	289	$554.57
10/29/2009	226	$473.33
11/29/2009	1257	$1,809.82
12/29/2009	1821.5	$2,568.86

Total	10,208	$15,357.07


Fair Haven Fire Station Gas Usage
3000
2500
2000
1500
1000
500
0
Therms
12/18/2008
2/6/2009
3/28/2009
5/17/2009
7/6/2009
8/25/2009
10/14/2009
12/3/2009
1/22/2010
Meter Dates
Therms

APPENDIX B

Approved Electrical and Natural Gas Energy Commodity Suppliers

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

Jan 14, 2009

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 C

ECM-1 Boiler Replacement with Hot Water Temperature Reset

Fair Haven
CHA #21968
Building: Fire Station

ECM-1 Boiler Replacement

Existing Fuel	Nat.Gas
Proposed Fuel	Nat.Gas

Item	Value	Units	Formula/Comments
Baseline Fuel Cost	$ 1.50		
Proposed Fuel Cost	$ 1.50		
Baseline Fuel Use	9,600	Therms	Based on historical utility data
Existing Boiler Plant Efficiency	79%		Estimated or Measured
Baseline Boiler Load	758,400	Mbtu/yr	Baseline Fuel Use x Existing Efficiency x 100 Mbtu/Therms
Baseline Fuel Cost	$ 14,400		
Proposed Boiler Plant Efficiency	93%		New Boiler Efficiency
Proposed Fuel Use	8,155	Therms	Baseline Boiler Load / Proposed Efficiency / 100 Mbtu/Therms
Proposed Fuel Cost	$ 12,232		
Annual Savings	1,445	Therms	
Annual Savings	$ 2,168	/yr	

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

Savings Summary:

Unit Cost	**$ 1.50**	**$/Therm**
Boiler Replacement Annual Cost Savings	**$ 2,168**	**$/yr**
Hot Water Temperature Annual Savings	**$ 120**	**$/yr**
Total Annual Savings	**$ 2,288**	**$/yr**
Boiler Installation Cost	**$ 15,459**	
Simple Payback	**6.8**	

Fair Haven
CHA #21968
Building: Fire Station

ECM-1 Boiler Replacement with Hot Water Temperature Reset

Description
Existing heating hot water (HHW) supply setpoint is 180°F.
Proposed:
Vary heating hot water supply temperature as building heating load decreases in relation to outside air temperature.

A	B	C	D	E	F	G	H	I	J
					Proposed Usage			Utility Usage	
Amb. Bin Temp °F	Avg. DB Bin Temp °F	Bin Hours	Heating Bin HOURS	Existing Heat Loss In Piping MBH	Avg. HHW Temp @ OA Temp °F	Proposed Heat Loss In Piping MBH	Proposed Boiler Efficiency	Existing Utility Use Therms/Yr	Proposed Utility Use Therms/Yr
100-104	102.0	0	0	0	0	0	0.0%	0	0
95-99	97.0	3	0	0	0	0	0.0%	0	0
90-94	92.0	34	0	0	0	0	0.0%	0	0
85-89	87.0	131	0	0	0	0	0.0%	0	0
80-84	82.0	500	0	0	0	0	0.0%	0	0
75-79	77.0	620	0	0	0	0	0.0%	0	0
70-74	72.0	664	0	0	0	0	0.0%	0	0
65-69	67.0	854	0	0	0	0	0.0%	0	0
60-64	62.0	927	927	2,492	80	1,339	96.0%	26	14
55-59	57.0	600	600	1,613	88	867	95.0%	17	9
50-54	52.0	610	610	1,640	95	881	94.0%	17	9
45-49	47.0	611	611	1,642	103	883	93.4%	18	9
40-44	42.0	656	656	1,763	110	948	92.0%	19	10
35-39	37.0	1,023	1,023	2,750	118	1,478	90.6%	30	16
30-34	32.0	734	734	1,973	125	1,060	89.8%	22	12
25-29	27.0	334	334	898	133	483	89.0%	10	5
20-24	22.0	252	252	677	140	364	88.5%	8	4
15-19	17.0	125	125	336	148	181	88.0%	4	2
10-14	12.0	47	47	126	155	68	87.6%	1	1
5-9	7.0	22	22	59	163	32	87.2%	1	0
0-4	2.0	13	13	35	170	19	86.8%	0	0
-5- -1	-3.0	0	0	0	170	0	86.8%	0	0
-10- -6	-8.0	0	0	0	170	0	86.8%	0	0
Totals		**8,760**	**5,954**	**16,004**		**8,602**		**174**	**93**

Annual Energy Savings	**80**	**Therms/yr**
Annual Cost Savings	**$ 120**	**/yr**

Existing Boiler Efficiency	79%	
Avg. Proposed Boiler Efficiency	92%	

Building HHW Piping System		
Heating On Temperature	65	°F
Total Length of Pipe	560	LF
Existing HHW Setpoint High	180	°F
Existing HHW Setpoint Low	160	°F
Avg HHW Temp	170	°F
Avg Pipe Size	1 1/2	Inches
Avg Insul Thickness	1	Inches
Existing Heat Loss	16.0	Btu/Hr/LF
Percent in Uncond. Space	30%	
Existing System Heat Loss	2,688	Btu/Hr
Proposed Min HHW Return*	70	°F
Avg Prop HHW Supply Temp	108	°F
Proposed Heat Loss	8.6	Btu/Hr/LF
Proposed System Heat Loss	1,445	Btu/Hr

*Refer to proposed boiler capabilities

Size (in)	Length (ft)
1/2	0
3/4	60
1	160
1 1/4	0
1 1/2	300
2	40
2 1/2	0
3	0
1 1/2	**Average**

Comments:

A-C	Newark, NJ weather bins
D	Based on building balance points and bin data.
E	Existing heat loss in piping system based on current average HHW temperature.
F	Estimated Average HHW temperature with HW reset based on OA temperature.
G	Proposed heat loss in piping system based on estimated average HW temperature. Return HHW temp min 70 deg F
H	Proposed boiler efficiency based return water temperature and boiler efficiency curve.
I-J	Utility usage to overcome heat loss in HHW piping system based on boiler efficiency.

Fair Haven
CHA #21968
Building: Fire Station

ECM-1 Boiler Replacement

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.		
						$ -	$ -	$ -	$ -	
New high efficiency boiler	1	ea.	$ 9,000			$ 8,820	$ -	$ -	$ 8,820	Based on an Aerco MLX Boiler.
Boiler removal. Disconnect water and	1	Lot		$ 500		$ -	$ 605	$ -	$ 605	
Disconnect electrical wiring.	1	Lot		$ 200		$ -	$ 242	$ -	$ 242	
Install new boiler. Reconnect the gas and hot water piping. Install new stack material. Reconnect electrical.	1	Lot	$ 700	$ 1,000		$ 686	$ 1,210	$ -	$ 1,896	
Startup	1	Lot		$ 500		$ -	$ 605	$ -	$ 605	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 12,168	Subtotal
$ 608.40	5% Contingency
$ 1,277.64	Contractor 10% O&P
$ 1,405	10% Engineering
$ 15,459	**Total**

Note: This assumes replacing one boiler with a condensing style boiler and leaving the second Weil-McLain for backup.

New Jersey Smart Start Incentive	Total MBH	UNIT	$ / UNIT	TOTAL SAVINGS	Cost W/O INCENTIVE	Cost W/ INCENTIV
(1) 350 MBH Aerco Boiler	350	EA	$1.75	$613	$15,459	$ 14,847
				$613	$15,459	$14,847

Total ECM Cost w/ Incentives	**$14,847**

APPENDIX D

ECM-2 Lighting Replacements

Fair Haven
CHA #21968
Building: Fire Station

ECM-2 Replacement of incandescent and T-12 lights

Building Schedule:
Existing conditions (master switch): 20 hrs/week
Supply Electric Rate $ 0.207 /kWh
Demand Rate $ /kW

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

	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	Simple Payback
Meeting Room - Fire Station	20	F44EE	144	0	146.88	2.88	switch		1,040	2,995	20	F44ILL	112	2.24	switch	0	1,040	2,330	1	666	$ 138	$ 2,510	18.2
Main Stairwell	2	F44EE	144	0	146.88	0.288	switch		1,040	300	2	F44ILL	112	0.224	switch	0	1,040	233	0	67	$ 14	$ 251	18.2
Recreation Room	11	I60/1	60	0	61.2	0.66	switch		1,040	686	11	CFT13/1	17	0.187	switch	0	1,040	194	0	492	$ 102	$ 439	4.3
Garage Bays	6	F82EHE	207	0	211.14	1.242	switch		1,040	1,292	6	F44ILL	112	0.672	switch	0	1,040	699	1	593	$ 123	$ 753	6.1
Fire Police Bays	2	F82EHE	207	0	211.14	0.414	switch		1,040	431	2	F44ILL	112	0.224	switch	0	1,040	233	0	198	$ 41	$ 251	6.1
Back Hall	6	I60/1	60	0	61.2	0.36	switch		1,040	374	6	CFT13/1	17	0.102	switch	0	1,040	106	0	268	$ 55	$ 239	4.3
Rescue Garage	4	F82EHE	207	0	211.14	0.828	switch		1,040	861	4	F44ILL	112	0.448	switch	0	1,040	466	0	395	$ 82	$ 502	6.1
Meeting Room - Rescue	15	FU2EE	72	0	73.44	1.08	switch		1,040	1,123	15	FU2LL	60	0.9	switch	0	1,040	936	0	187	$ 39	$ 1,882	48.6
Rescue Office	12	I60/1	60	0	61.2	0.72	switch		1,040	749	12	CFT13/1	17	0.204	switch	0	1,040	212	1	537	$ 111	$ 479	4.3
TOTALS -	**78**			**0**		**8.5**				**8,811**	**78**			**5.2**				**5,409**	**3.3**	**3,402**	**$ 704**	**$ 7,305**	**10.4**

New Jersey Smart Start Incentive	QTY	UNIT	$ / UNIT	TOTAL SAVINGS	Cost W/O INCENTIVE	Cost W/ INCENTIVE
1 & 2 Lamp T-12 Retrofit < 250 Watt	27	EA	15	$ 405.00	$ -	$ -
3 & 4 Lamp T-12 Retrofit < 250 Watt	22	EA	15	$ 330.00		$ -
Metal Halides	0	EA	25	$ -		
				$ 735	$ 7,305	$ 6,570

Total ECM Cost w/ Incentives		$ 6,570

APPENDIX E

ECM-3 Exit Sign Replacement

Fair Haven
CHA #21968
Building: Fire Station

ECM-3 Replace EXIT signs with LED type

Analysis

Referenced Data

Demand Rate	$ -	/kW
Supply Electrical Rate	$ 0.207	/kWh

Inputs

	Material	Labor
Demolition	$ -	$ 5
New Sign Install	$ 85	$ 10

Contingency	10%	of Sub-Total
Contractor O&P	12%	of Sub-Total
Engineering	0%	of Sub-Total
Replacement Power	1.7	watts/sign

Sign Type	Wattage Per Side	Sides	Quantity
A	24	1	4
B	0	1	0
C	0	1	0

Results

Utility Savings	Electrical	781 kWh
	Demand	0.1 kW
	Steam	- klbs
Savings		**$162**
Implementation Cost		**$487**
Simple Payback (Yrs)		**3.0**

Calculations

Current Power Consumption = [(24 W/side x 1 side x 4 signs) + (0 W/side x 1 side x 0 signs) + (0 W/side x 1 side x 0 sign)] x 8,760 hrs/yr

= 0.096 kW x 8,760 hrs/yr

= 841 kWh

Proposed Power Consumption = (1.7 W/sign x 4 signs) x 8,760 hrs/yr

= 0. kW x 8,760 hrs/yr

= 60 kWh

Fair Haven
CHA #21968
Building: Fire Station

ECM-3 Replace EXIT signs with LED type

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.		
						$ -	$ -	$ -	$ -	
Demolition	4	Ea	$ -	$ 5		$ -	$ 24	$ -	$ 24	
New Sign Install	4	Ea	$ 85	$ 10		$ 333	$ 48	$ -	$ 382	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 406	Subtotal
$ 41	10% Contingency
$ 41	Contractor 10% O&P
$ -	0% Engineering
$ 487	**Total**

New Jersey Smart Start Incentive	QTY	UNIT	$ / UNIT	TOTAL SAVINGS	Cost W/O INCENTIV	Cost W/ INCENTIV
LED Exit Signs	4	EA	10	40	$ 487	$ 447
				40	$ 487	$ 447

Total ECM Cost w/ Incentives	$ 447
Payback with incentive	2.77

APPENDIX F

New Jersey Pay For Performance Incentive Program

Fair Haven
CHA #21968
Fire Station

New Jersey Pay For Performance Incentive Program

Note: The following calculation is based on the New Jersey Pay For Performance Incentive Program per April, 2010. 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 applicable through December 31, 2010.

Total Building Area (Square Feet)	9,540
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)	$22,026	$15,357
Existing Usage (from utility)	106,480	10,200
Proposed Savings	4,183	1,525
Existing Total MMBtus	1,383	
Proposed Savings MMBtus	167	
% Energy Reduction	**12.1%**	
Proposed Annual Savings	$3,153	

	≥%15	
	$/kWh	$/therm
Incentive #2	$0.11	$1.10
Incentive #3	$0.07	$0.70

	Incentives $		
	Elec	Gas	Total
Incentive #1	$0	$0	$477
Incentive #2	$0	$0	$0
Incentive #3	$0	$0	$0
Total All Incentives	**$0**	**$0**	**$477**

Total Project Cost	$23,252

		Allowable Incentive
% Incentives #1 of Utility Cost*	1.3%	$477
% Incentives #2 of Project Cost**	0.0%	$0
% Incentives #3 of Project Cost**	0.0%	$0
Total Eligible Incentives***	**$477**	
Project Cost w/ Incentives	$22,775	

Project Payback (years)	
w/o Incentives	w/ Incentives
7.4	7.2

* 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 G

Photovoltaic (PV) Rooftop Solar Power Generation

Fair Haven
Fire Station

Cost of Electricity $0.207 $/kWh

Photovoltaic (PV) Rooftop Solar Power Generation-10 kW 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
$63,300	**0.0**	**11,830**	**0**	**$2,400**	**0**	**$2,400**	**$7,500**	**$5,800**	**26.4**	**6.8**

Note: Budgetary cost is based on $8,000/kW.

*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

Estimated Solar Renewable Energy Certificate Program (SREC) payments for 15 Years from RR Renewable Energy Consultants

Year	SREC
1	600
2	600
3	600
4	500
5	500
6	500
7	500
8	500
9	500
10	500
11	400
12	400
13	400
14	400
15	400
AVG	**487**

PVWatts *** AC Energy & Cost Savings

Cautions for Interpreting the Results

(Type comments here to appear on printout; maximum 1 row of 80 characters.)

Station Identification	
City:	Newark
State:	New_Jersey
Latitude:	40.70° N
Longitude:	74.17° W
Elevation:	9 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:	40.7°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	20.7 ¢/kWh

Results			
Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	3.36	828	171.40
2	4.05	894	185.06
3	4.58	1084	224.39
4	4.84	1060	219.42
5	5.30	1168	241.78
6	5.33	1101	227.91
7	5.27	1112	230.18
8	5.25	1101	227.91
9	5.06	1068	221.08
10	4.46	1005	208.03
11	3.15	718	148.63
12	2.87	692	143.24
Year	4.46	11830	2448.81

Output Hourly Performance Data

About the Hourly Performance Data

*

Output Results as Text

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

Disclaimer and copyright notice

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.

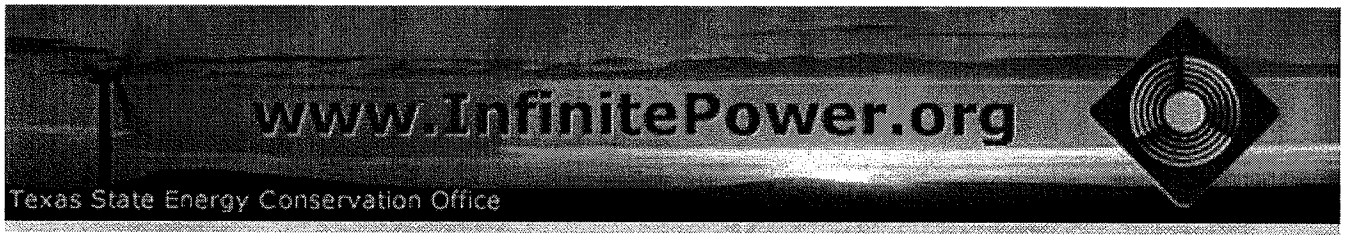
Besides the cost savings shown in the table, other benefits of PV systems include greater energy independence and a reduction in fossil fuel usage and air pollution. For commercial customers, additional cost savings may come from reducing demand charges. Homeowners can often include the cost of the PV 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.

Return to RREDC Home Page (*http://rredc.nrel.gov/*)

APPENDIX H

Solar Thermal Domestic Hot Water Plant



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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)	55
? Capacity (gallons)	75	? Ambient Temperature (Degrees F)	70
? Surface Area (calculated - sq ft)	30.27	? Hot Water Temperature (Degrees F)	120
? Effective R-value	NaN	? Hot Water Usage (Gallons per Day)	64.3
Energy Use			
1430		? Heat Delivered in Hot Water (BTU/hr)	
0		? Heat loss through insulation (BTU/hr)	

Gas vs. Electric Water Heating		
Gas		**Electric**
80	? Overall Efficiency	0.98
80	? Conversion Efficiency	0.98
17.88 BTU/hr	? Power Into Water Heater	1459 BTU/hr
Cost		
$ 1.50 /Therm	? Utility Rates	$ 0.08 /kWh
$ 600	? Yearly Water Heating Cost	$ 299.455(
How Does Solar Compare?		

? Solar Water Heater Cost: $ 27000		? Percentage Solar: 70
16417.3 years for gas	? Payback Time for Solar System	128.805 years for electric

More information on solar water heating:

Fact sheet - Solar Water Heaters
Fact sheet - Solar Water Heaters for Swimming Pools
Kids fact sheet - Heat from the Sun

Return to Top of Page

Send comments, questions, and suggestions to **website manager**.

NJBPU Energy Audits
CHA #21968
Building: Borough of Fair Haven - Fire Station

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 Gallon Storage 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**

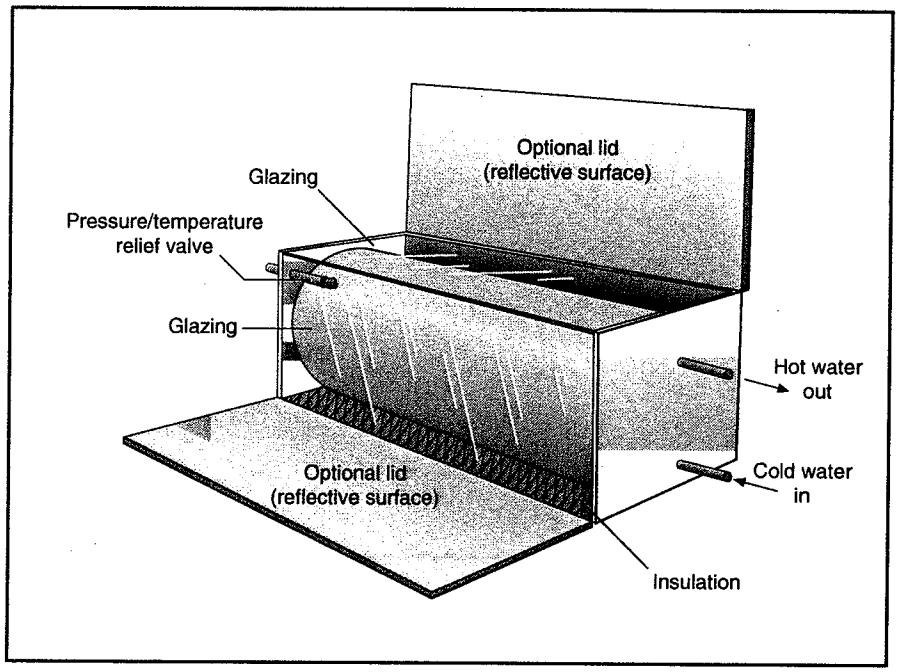
Solar Water Heaters

RENEWABLE ENERGY
THE INFINITE POWER OF TEXAS

SECO FACT SHEET **NO. 10**

HIGHLIGHTS

- **Solar water heaters can provide half or more of the hot water needs in the average home**
- **Simple or complex, solar water heater systems save money**



Breadbox or batch heater *Allows cold water to flow in from the bottom and hot water to flow out of the top.*

SUMMARY

Solar water heaters can be as simple as a garden hose left in the sun or as complex as multiple glass-plated solar collectors filled with propylene glycol. Simple or complex, solar water heaters are an economical option for home and business owners wishing to reduce their water heating costs.

TYPES OF SYSTEMS

PASSIVE SOLAR SYSTEMS

Generally speaking, a passive solar system requires no moving parts and no external energy source except the sun itself.

Passive water heating systems are not much more complex than a regular garden hose that has been left in the sun. The basic passive water heater consists of one or more 40 gallon water tanks that have been painted black and placed in a well insulated box that has glass or plastic on one side to allow the sun's rays to heat the tanks. This Integral Collector Storage (ICS) system, also known as a "bread box" or batch heater, allows cold water to flow in from the bottom and hot water to flow out of the top. The system operates using only the water pressure from the city or your well. Water from the system is then routed to a standard water heater, where your thermostat determines if the water is already hot enough for use or if additional heat is necessary.

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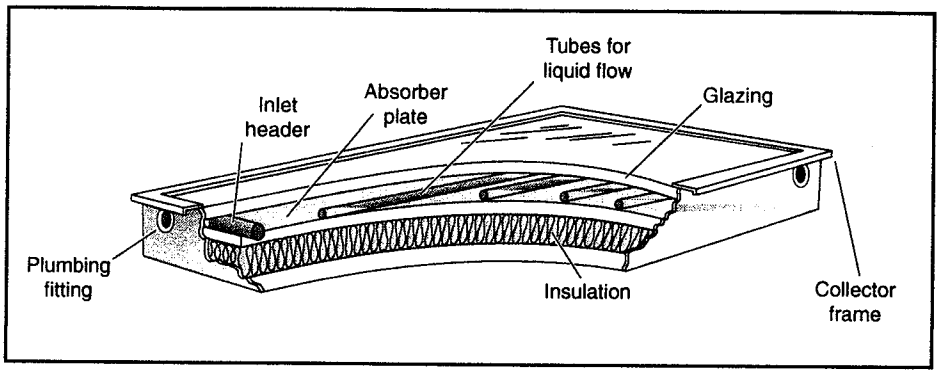


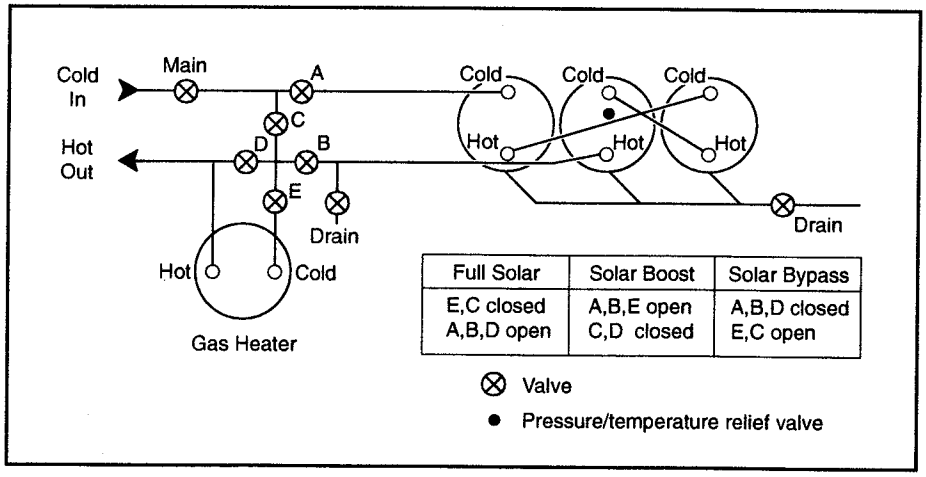
Liquid heating "flat plate" collector *It is a very simple machine.*

ACTIVE SOLAR SYSTEMS: DIRECT AND INDIRECT

Active water heaters are more efficient than their passive brethren, but they also require more equipment in the form of collectors, sensors, circulating pumps and controller mechanisms.

Active systems come in two categories: direct (sometimes known as open loop) and indirect (closed loop). Direct systems heat water in the collectors. Indirect systems do not heat the household water, but instead they employ another fluid such as freon, distilled water or propylene glycol. After the fluid is heated in the collectors, it travels through a heat exchanger, where the heat it contains is transferred to the household water.

While direct systems are more efficient than indirect ones, they require more maintenance and are prone to scaling: a build up of mineral deposits that can close the smaller pipes. In addition, the direct systems must be allowed to drain to prevent damage from freezing or overheating. This drain down design limits installation options and requires additional components.



Full solar, solar boost, and solar bypass systems *Direct systems are more efficient than indirect ones.*

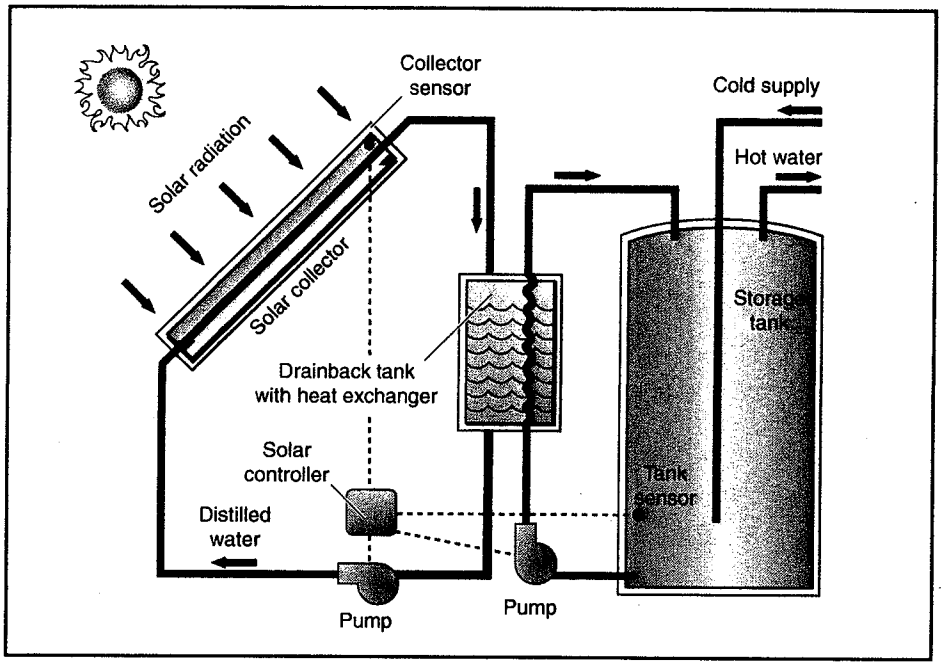
COLLECTOR SYSTEM BASICS

The flat plate solar collector is a very simple machine. An insulated rectangular box, it contains a metal plate (usually copper) that has been painted black, with headers made of 3/4 inch or 1 inch pipe at each end that are connected to small tubes called risers made from 1/4 inch pipe. Supply water flows from the header into the risers where it is heated and then returns to the storage tank. The entire box is covered with tempered glass, which is hail resistant, and then installed at an angle equal to latitude plus 10 degrees.

STORAGE TANKS

Whether the design used is direct or indirect, a large storage tank will be required. The most commonly used size is 80 gallons. Similar in shape to a water heater, solar water storage tanks must be highly insulated to preserve the heat gained by the collectors. From the storage tank, the water is usually routed to a standard water heater.

Tempering or mixing valves are recommended for residential water heating because solar systems typically heat water to 180 degrees, which can be a safety hazard especially with small children. The tempering valve can be set to 120 degrees and allows cold water to mix with the hot water before it reaches the faucet.



Drain back system *The direct systems must be allowed to drain to prevent damage.*

GETTING MORE FROM YOUR SYSTEM

Have you already installed low flow shower heads and aerators on all faucets? This is a cost effective method of not only conserving water but also reducing hot water demand as well.

The time of day when you use water can greatly affect how far you can stretch your solar heated water. For instance after normal morning water usage (when your schedule allows) wait until around noon to do laundry. This allows the solar system to heat up during the morning and to recover again in the afternoon.

DO IT YOURSELF?

Passive hot water systems, which range in price from $800 to $1,500, are among the easiest ways to incorporate solar design into the home. Because of their simplicity, many homeowners design, build and install passive hot water systems themselves for under $400. If a homeowner doesn't want to embark on a project without help, there are a myriad of instructional videos, blueprints and other materials available to the home handyman.

Of course, a competent contractor can reduce the hassle factor. If you decide to use a contractor, ask friends for recommendations and be sure to ask potential contractors about their experience with the type of system you want installed. Whether you build it yourself or purchase a passive system, all permits should be purchased and local plumbing codes followed. The installation of an active solar system, which can cost $2,000 to $3,500, is best left to a professional. The best equipment may not operate correctly or may even be ruined by a bad installation.

InfinitePower.org

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ORGANIZATIONS

American Solar Energy Society
2400 Central Ave., G-1
Boulder, CO 80301
(303) 443-3130
www.ases.org

Energy Center
University of Texas at El Paso
P. O. Box 645
El Paso, Texas 79968
(888) 879-2887
energycenter.utep.edu

Florida Solar Energy Center
1679 Clearlake Road
Cocoa, FL 32922
(407) 638-1000
www.fsec.ucf.edu

Passive Solar Industries Council
1511 K Street, Suite 600
Washington, DC 20005
(202) 628-7400
www.sbicouncil.org

Texas Solar Energy Society
P. O. Box 1447
Austin, TX 78767-1447
(512) 326-3391
e-mail: info@txses.org
www.txses.org

Texas Renewable Energy Industries Association
P. O. Box 16469
Austin, TX 78761
(512) 345-5446
www.treia.org

RESOURCES

TEXAS RENEWABLE ENERGY EDUCATION CAMPAIGN

FREE TEXAS RENEWABLE ENERGY INFORMATION

For more information on how you can put Texas' abundant renewable energy resources to use in your home or business, visit our website at **www.InifinitePower.org** or call us at 1-800-531-5441 ext 31796. Ask about our free lesson plans and videos available to teachers and home schoolers.

ON THE WORLD WIDE WEB:

Renewables, products, sustainable living. A good place to start search. **solstice.crest.org**

El Paso Solar Energy Association. Lots of good information. **www.epsea.org**

Florida Solar Energy Center. Information on solar pool heating and other information. **www.fsec.ucf.edu** You can order a manual called "Solar Water and Pool Heating Design and Installation Manual," for $25. Run by the Florida Solar Energy Center, the site contains a panoply of other documents on renewable energy. **www.fsec.ucf.edu/docsale.htm**

Fun facts on solar water heating, including this one: "Over 1.5 million Americans have invested in solar hot water systems for their homes and businesses, with over 94% of these customers considering the investment a wise decision." **www.seia.org/sf/sfsolth.htm**

City of Austin Green Builder Program's comprehensive guide covering energy, water, building materials, solid waste and other topics. A mammoth resource.
www.greenbuilder.com/sourcebook

Department of Energy offers a wealth of information on solar water heating, including tips on sizing your system, potential cost savings and other helpful info.
www.eren.doe.gov/erec/factsheets/solrwatr.html
www.eren.doe.gov/solarbuildings/hotwater.html

Software to estimate the economic benefits can be found at:
eren.doe.gov/solarbuildings/sbm.html

BOOKS:

The Passive Solar Energy Book. Edward Mazria, Rodale Press, 1979.

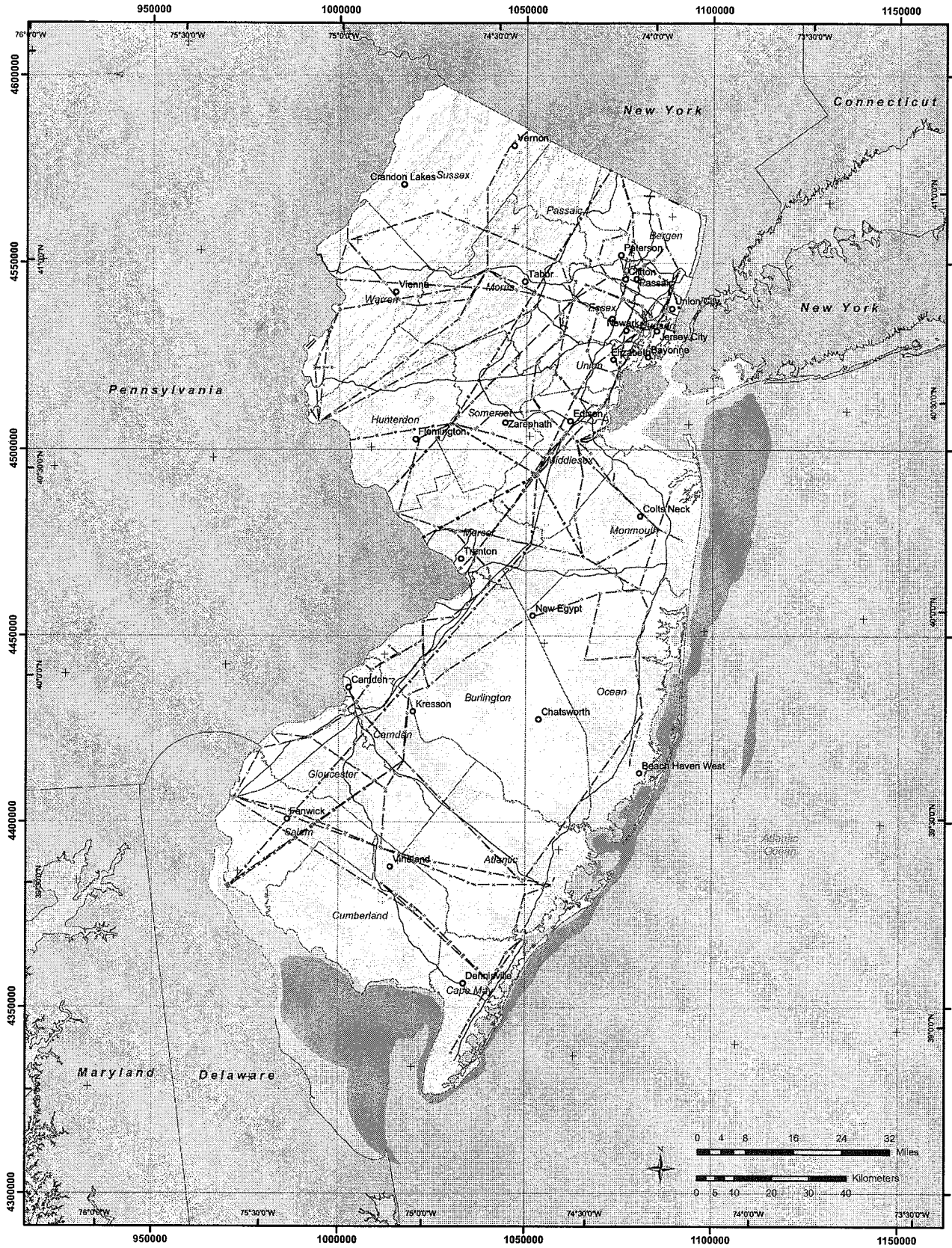
Solar Water Heating Systems, Active and Passive. US Department of Energy. (available by calling (800) 523-2929)

RENEWABLE ENERGY
THE INFINITE POWER
OF TEXAS

STATE ENERGY CONSERVATION OFFICE
111 EAST 17TH STREET, ROOM 1114
AUSTIN, TEXAS 78774
PH. 800.531.5441 ext 31796
www.InfinitePower.org

APPENDIX I

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

Mean Speed at 30 m			
mph	m/s		
< 10.1	< 4.5	13.4 - 14.5	6.0 - 6.5
10.1 - 11.2	4.5 - 5.0	14.5 - 15.7	6.5 - 7.0
11.2 - 12.3	5.0 - 5.5	15.7 - 16.8	7.0 - 7.5
12.3 - 13.4	5.5 - 6.0	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.

APPENDIX J

EPA Portfolio Manager

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Fire Station

Building ID: 2413121
For 12-month Period Ending: November 30, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: October 14, 2010

Facility
Fire Station
645 River Road
Fair haven , NJ 07704

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1952
Gross Floor Area (ft²): 9,540

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

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	360,555
Natural Gas (kBtu)[4]	920,368
Total Energy (kBtu)	1,280,923

Energy Intensity[5]

Site (kBtu/ft²/yr)	134
Source (kBtu/ft²/yr)	227

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	104

Electric Distribution Utility
FirstEnergy - Jersey Central Power & Lt 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.

Certifying Professional
N/A

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**

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 Station	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	645 River Road, Fair haven , NJ 07704	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		☐

Fire Station (Other)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	9,540 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	N/A(Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	N/A(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	N/A(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 STAR® Data Checklist for Commercial Buildings

Energy Consumption

Power Generation Plant or Distribution Utility: FirstEnergy - Jersey Central Power & Lt Co

Fuel Type: Electricity

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

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
10/15/2009	11/12/2009	6,560.00
09/16/2009	10/14/2009	8,960.00
08/15/2009	09/15/2009	23,280.00
07/16/2009	08/14/2009	10,000.00
06/16/2009	07/15/2009	6,720.00
05/12/2009	06/15/2009	7,520.00
04/10/2009	05/11/2009	6,480.00
03/14/2009	04/09/2009	5,440.00
02/13/2009	03/13/2009	6,640.00
01/20/2009	02/12/2009	8,240.00
12/12/2008	01/19/2009	9,120.00
Electricity Consumption (kWh (thousand Watt-hours))		**98,960.00**
Electricity Consumption (kBtu (thousand Btu))		**337,651.52**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**337,651.52**
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)
10/30/2009	11/29/2009	1,257.00
10/01/2009	10/29/2009	226.00
09/01/2009	09/30/2009	289.00
08/02/2009	08/31/2009	21.00
07/02/2009	08/01/2009	46.00
06/03/2009	07/01/2009	152.00
05/02/2009	06/02/2009	344.00
04/03/2009	05/01/2009	587.00
03/03/2009	04/02/2009	1,257.00
01/31/2009	03/02/2009	1,821.50
12/31/2008	01/30/2009	2,386.00

Natural Gas Consumption (therms)	**8,386.50**
Natural Gas Consumption (kBtu (thousand Btu))	**838,650.00**
Total Natural Gas Consumption (kBtu (thousand Btu))	**838,650.00**
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 Station
645 River Road
Fair haven , NJ 07704

Facility Owner
N/A

Primary Contact for this Facility
N/A

General Information

Fire Station	
Gross Floor Area Excluding Parking: (ft^2)	9,540
Year Built	1952
For 12-month Evaluation Period Ending Date:	November 30, 2009

Facility Space Use Summary

Fire Station	
Space Type	Other - Fire Station/Police Station
Gross Floor Area(ft^2)	9,540
Number of PCs°	N/A
Weekly operating hours°	N/A
Workers on Main Shift°	N/A

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 11/30/2009)	**Baseline** (Ending Date 11/30/2009)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft2)	134	134	0	N/A	78
Source (kBtu/ft2)	227	227	0	N/A	157
Energy Cost					
$/year	$ 34,940.68	$ 34,940.68	N/A	N/A	$ 20,297.71
$/ft2/year	$ 3.66	$ 3.66	N/A	N/A	$ 2.13
Greenhouse Gas Emissions					
$MtCO_2e$/year	104	104	0	N/A	60
$kgCO_2e/ft^2$/year	11	11	0	N/A	6

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 K

Equipment Inventory

New Jersey BPU Energy Audit Program
CHA #21968
Borough of Fair Haven - Borough Hall

Description	QTY	Manufacturer Name	Model No.	Serial No.	Equipment Type / Utility	Capacity/Size	Location	Areas Served	Date Installed	Remaining Useful Life (years)	Other Info.
Boiler	1	Weil-McLain	PFG-6-PIN	-	Heating & Cooling / Natural Gas & Electric	305 MBH input, 215 MBH output	Boiler Room	Entire Building		16	Good Condition
HW Pump	1	Bell & Gossett	-	-	Heating / Electric	1/8 HP	Boiler Room	Entire Building	-	-	Good Condition
HW Pump	1	Bell & Gossett	-	-	Heating / Electric	1/8 HP	Boiler Room	Entire Building	-	-	Good Condition
HW Pump	1	Bell & Gossett	-	-	Heating / Electric	1/8 HP	Boiler Room	Entire Building	-	-	Good Condition
Heat Pump AHU #1	1	Lennox	G/HC060SB	EEFS1224105	HVAC / HW & Electric	60,000 Btuh	Boiler Room	2nd Floor	-	16	Good Condition
Heat Pump AHU #2	1	Lennox	G/HC048SB	EEFS120048	HVAC / HW & Electric	48,000 Btuh	Boiler Room	1st Floor	-	16	Good Condition
Heat Pump AHU #3	1	Lennox	CB30M-65-4P	5808D30708	HVAC / HW & Electric	30,000 Btuh	Boiler Room	2nd Floor	-	16	Fair Condition
York Furnace	1	York	515B120CVHFS	EEFS1224105	HVAC / HW & Electric	-	Boiler Room	Library		10	Fair Condition
Condenser #1	1	Lennox	HS29-060-134	5807643110	Cooling / Electric	5.0 tons; 17.3 Amps	Outside	Heat Pump AHU	-	10	Fair Condition
Condenser #2	1	Lennox	HS29-060-134		Cooling / Electric	5.0 tons; 17.3 Amps	Outside	Heat Pump AHU	-	10	Fair Condition
Condenser #3	1	Lennox	HS29-513-14	5895E-63900	Cooling / Electric	5.0 tons; 15.9 Amps	Outside	Heat Pump AHU	-	10	Fair Condition
Domestic HW Heater	1	A.O. Smith			DHW / Natural Gas	75 Gal / 75,500 Btuh	Boiler Room	Entire Building	-	10	Fair Condition