

**BOROUGH OF MILFORD
FIRE HOUSE AND SUB STATION
ENERGY ASSESSMENT**

for

**NEW JERSEY
BOARD OF PUBLIC UTILITIES**

CHA PROJECT NO. 22312

February 2011

Prepared by:



6 Campus Drive
Parsippany, NJ 07054

(973) 538-2120

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1.0 INTRODUCTION & BACKGROUND

The Milford Fire House, a 6,750 square foot structure, located at 21 Water Street, includes a garage with two truck bays, large open meeting hall, restrooms, kitchen, and bar. The main portion was constructed in 1930; an addition was built in 1981. The building is open several hours during the week, usually in the mornings.

The Milford Sub Station is a 1,600 square foot building used for truck and general storage. The building is located at 530 Little York Mt. Pleasant Road. The building has very minor usage and no set occupancy.

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 Milford Fire House and Milford Sub Station. The fire house is a 6,750 square foot structure, which includes a garage with two truck bays, large open meeting hall, kitchen, and bar. The main portion was constructed in 1930; an addition was built in 1981. The sub station is a 1,600 square foot building used for truck and general storage. The building has very minor usage and no set occupancy.

Various potential Energy Conservation Measures (ECMs) were identified for the above categories. Potential annual savings of \$6,300 for the recommended ECMs may be realized with a payback of 6.0 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 and/or Direct Install Program. A summary of the costs, savings, and paybacks for the recommended ECMs follows:

Summary of Energy Conservation Measures							
Energy Conservation Measure		Approx. Costs (\$)	Approx. Annual Savings (\$)	Payback w/o Incentive	Potential Incentive* (\$)	Payback w/ Incentive	Recommended for Implementation (X)
ECM-FH1	Install Roof Insulation in Meeting Hall	5,300	600	8.8	-	-	X
ECM-FH2	Replace Furnaces with Oil Fired Condensing Furnaces	16,000	1,100	14.5	9,600	5.8	X
ECM-FH3	Install Wall Insulation on North Wall	6,600	200	>25	-	-	
ECM-FH4	Install Infrared Heaters in Garage Area	5,300	700	7.6	-	-	X
ECM-FH5	Replacement of T-12 Fixtures	16,600	1,300	12.8	10,000	5.1	X
ECM-FH6	Replace Kitchen Electric DHW Heater with On-Demand Propane	4,000	700	5.7	300	5.3	X
ECM-SS1	Install Ceiling Insulation	3,000	500	6.0	-	-	X
ECM SS-2	Replace Furnace with Oil Fired Condensing Furnace	6,300	400	15.8	3,800	6.3	
ECM SS-3	Increase Wall Insulation	3,100	400	7.8	-	-	X
ECM SS-4	Lighting Replacements	1,500	100	15.0	900	6.0	X
ECM SS-5	Replace Oil Furnace with Oil Fired Infrared Heaters	3,900	900	4.3	-	-	X

Measures were evaluated on an independent basis. Actual energy savings of the measures could be less if implemented in conjunction with other ECMs.

3.0 EXISTING CONDITIONS

3.1 Building - General

The Milford Fire House building has two sections. The original main building, built in 1930, was an automotive dealership at one time. It is a single story structure of approximately 5,300 square feet and includes two truck bays, large open meeting hall, kitchen, and some storage. The rear section was an addition in 1981 and is a two story structure that contains kitchen storage and two offices on the ground floor and a bar on the second floor. This section of the building is approximately 1,450 square feet.

The original section of the building is constructed of concrete block, and has a brick exterior finish. According to building personnel, insulation has been added to the walls except for the north side of the building. The roof is shingled and supported by metal trusses. The attic space has old fiberglass insulation between the joists which is about 6" thick; however, it no longer covers the entire attic space.

The addition's first floor is constructed of insulated concrete block. The second story has white vinyl siding and wood studs which are filled with insulation. The asphalt shingled roof is constructed of wood trusses and has insulation between the rafters. The building has three roller doors leading into the garage space; two are 17'x10' and one is 12'x10'. There are three pedestrian doors and few windows, except in the back portion of the building. The building has a diverse usage schedule; the bar is used about 20 nights per year, and the building hosts various functions as scheduled.

The sub station is constructed of corrugated sheet metal with a metal frame. The building has three bays for vehicle and general storage and three 12'x10' insulated garage doors. The walls and roof are constructed of corrugated metal and have metal support beams. There is no attic space, and the building has very little insulation. The building is rarely used and does not have a set occupancy schedule.

3.2 Utility Usage

3.2.1 Fire House

The utilities include electricity, propane, #2 fuel oil, and water. Fuel oil is used for heating, and propane primarily for cooking; both fuels are provided by Stem Brothers. Tanks located on the side of the building hold both fuels and are filled when needed. The electric utility is delivered and generated by Jersey Central Power and Light (JCP&L). Water is provided by the Borough of Milford.

The borough only had three months of electric utility bill information available; therefore, many of the months' charges were estimated. The utility company provided a chart showing the previous year's energy consumption; however, it did not contain details about charges and demand. Based on the months of bills available, (August 2010-October 2010) and the utility chart, about 23,330 kWh of electricity is utilized per year and averages 27.3 kW of demand. The borough paid \$4.52 per kW and about \$0.177 per kWh. This represented a blended rate of \$0.24/kWh.

From October 2009 through September 2010 the #2 oil tank was filled six times with 1,670 gallons at a total cost of \$4,500, or about \$2.68 per gallon. The propane tank was filled five times from April 2009 through March 2010 with 560 gallons at a cost of about \$2.74 per gallon for a total of about \$1,500. Water usage was about 44,000 gallons at a cost of \$300 equaling approximately \$7.25 per thousand gallons.

3.2.2 Sub Station

The sub station monitors and uses #2 fuel oil and electricity. Electricity is supplied by JCP&L and there is an oil storage tank which is filled when needed by Stem Brothers. Similarly to the fire house, there was only three months data available to perform the electric utility analysis. Instead, a chart located on the bills outlining the previous year's usage was used. The charges were averaged by the three months of available utility data. In the past 12 months, the sub station used a total of 1,980 kWh at a cost of \$600, at a blended rate of about \$0.30 per kWh. This cost is high, due mainly to the minimal usage.

The sub station heating oil tank was filled five times from March 2009 through February 2010 with a total of 640 gallons of #2 heating oil at a cost of \$1,600, or about \$2.49 per gallon.

According to data from the Department of Energy, the statewide average cost for #2 heating oil customers in the state of New Jersey was about \$3.17/gallon over the past year. The statewide average for propane was about \$3.62 per gallon. The commercial statewide average for electricity in the past year for the state of New Jersey was about \$0.137 per kWh. If the borough paid a rate closer to the statewide average for electricity, about \$2,700 per year could be saved. This can be achieved by opting to purchase electricity from a third party supplier. A list of suppliers is available on the JCP&L website, and in Appendix U.

3.3 HVAC Systems

3.3.1 HVAC System Fire House

The original section has two old oil fired furnaces, each about 125 MBtu, that distribute hot air to the truck bays and meeting hall. One furnace services the entire truck bay area and half of the hall; the other, the remainder of the hall. Both furnaces are Williamson, Tempomatic model. Based on their condition, they have an estimated efficiency of about 70%. The furnaces are connected to ducts in the attic space. Also located in the attic are two 5 ton Trane air conditioners which utilize the same ductwork to provide air conditioning. Automatic isolation dampers in the ductwork open and close for heating or cooling mode.

Each furnace is controlled by a programmable thermostat. Both thermostats have heating setpoint temperatures at 60°F during the unoccupied and 70°F during occupied times. Two manually controlled thermostats are connected to the air conditioners in the attic. The air conditioners are off during unoccupied times and are activated only when the meeting hall is rented out.

For the rear section addition, there is no heat in the kitchen storage area and offices. The kitchen has a small glo-warm propane heater of approximately 16,000 Btu. A Metzger oil fired furnace serves the bar on the second floor. The furnace, with an input capacity of 140 MBtu, is located in a room on the ground floor and accessed from outside the building. This unit has an estimated efficiency of about 70% based on age and condition.

The rear section of the building has heating throughout but cooling only on the second floor bar area. Two air conditioners located in the ceiling of the bar and serve the bar area only. There are two thermostats located in the bar area and control the heating and cooling. The setpoints are 70°F occupied and 60°F unoccupied for heating, and 72°F occupied and 82°F unoccupied in cooling mode.

There is no mechanical ventilation for the meeting hall or bar area except a small exhaust fan for the restrooms. There is one commercial kitchen exhaust hood which is connected to an exhaust fan located on

the roof of the main building. The exhaust hood is used only a few hours per year. The makeup for the hood is from a duct which connects the kitchen to the roof. This duct is capped and sealed so uncontrolled air does not migrate into the kitchen. The cap is manually opened in the summer when the hood is in use.

3.3.2 Sub Station HVAC

The sub station is heated by a very old #2 oil fired furnace manufactured by International Heater. Model number or capacity information was not available. However, based on building size, the furnace was estimated at about 125 MBtu input. The efficiency was estimated at 70% due to the condition of the furnace. The building has a constant heating setpoint of about 55°F, and no cooling. In addition, the sub station does not have mechanical ventilation.

3.4 Lighting/Electrical Systems

3.4.1 Fire House

The building has 4-lamp T12 lights, including the main truck bay, stairwell, and CD room off the bar. All lighting has magnetic ballasts and is controlled by individual switches at the entrance to the rooms. Lights are manually turned off when not in use. The exterior sign has a T-12 light fixture; there are two building spotlights, 100 watts each. The spotlights are controlled by a motion sensor and the sign is illuminated from dusk to about midnight via a timer.

3.4.2 Sub Station

The sub station is lit by (12) 2-lamp T12 fixtures with magnetic ballasts on switches. There is no exterior lighting.

3.5 Plumbing Systems

3.5.1 Fire House

Domestic hot water for the dishwasher and bar area is generated by an 80 gallon Bradford White electric tank heater with an input of 4.5 kW. A 5 gallon, 1.5 kW input Rheem electric heater serves a small hand sink in the meeting hall area. This heater is usually off and only turned on when the hall is in use. A third domestic hot water heater serves three kitchen and two restroom sinks. The heater, manufactured by Bradford White, has a capacity of 50 gallons, and electric rating of 4.5 kW. This heater is turned off for the majority of the year.

There are two restrooms located at the main entrance and the fixtures are standard flow. These fixtures were evaluated for replacement with low-flow; however, usage does not justify the cost.

3.5.2 Sub Station

The sub station has one restroom with standard flow fixtures. There is a small point of use electric heater for the sink.

4.0 ENERGY CONSERVATION MEASURES

4.1 Fire House

4.1.1 ECM-FH1 Install Roof Insulation in Meeting Hall

The fire house original building is about 5,300 square feet and has a shingled roof constructed with wooden trusses. The wooden trusses create an attic area where there is about 3-5" batt insulation between the ceiling joists. The insulation is deteriorated, and in some areas the insulation has been moved around and is bare. This ECM evaluated installing an additional 6" of blown in insulation.

To calculate the energy savings, the existing thermal resistance (R-value) of all roof components was compared to the proposed thermal resistance with added insulation. The existing roof was calculated to have an R-value of about 15.2, and the new roof will have an R-value of about 35.2. Factoring in the temperature setpoints of the space, furnace and air conditioning efficiency, and reconciling to outdoor temperature data from Newark, NJ (the closest city available), a saving was calculated.

By installing additional insulation in the attic space the fire house could save about 210 gallons of #2 heating oil and about 30 kWh annually.

Insulation has a life expectancy of about 24 years according to ASHRAE. The savings over the life of the project would be about 5,040 gallons #2 fuel oil, 720 kWh, and \$14,400.

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

ECM-FH1 Install Roof Insulation in Meeting Hall

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Fuel Oil #2	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
5,300	0	30	210	600	1.7	NA	8.8	NA

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

This measure was evaluated independently of all other ECMs. Actual energy savings may be less if implemented in conjunction with other measures due to interactive effects.

This measure is recommended.

4.1.2 ECM-FH2 Replace Furnaces with Oil Fired Condensing Furnaces

The building is heated by three #2 oil fired furnaces. Two furnaces serve the engine bay and main hall area, and a third oil furnace heats the second floor of the back part of the building. The two Williamson furnaces for the front section of the building are estimated to be about 125 MBtu and, the furnace in the rear section has an input capacity of 140 MBtu. The precise efficiency of the furnaces was not available on the nameplate data; based on age and condition, the efficiency was conservatively estimated to be about 70%. Condensing furnaces can reach efficiencies of up to 97% but generally range closer to 92%

in typical operation. Replacing the three furnaces with condensing models would save #2 fuel oil for heating.

To calculate the savings of installing new condensing furnaces, the existing heating load requirement of the building was established from the utility bills. The furnace efficiency was changed from 70% to 92% and the resulting heating load was calculated. With the existing efficiency, the building uses about 1,670 gallons of #2 fuel oil. With new furnaces the building would use about 1,270 gallons of fuel oil. This represents a savings of about 400 gallons of fuel oil per year. At a cost of \$2.68 per gallon, this would save about \$1,100 per year.

Furnaces have a life expectancy of about 18 years according to ASHRAE. The savings over the life of the project would be about 7,200 gallons of #2 fuel oil and \$19,800.

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

ECM-FH2 Replace Furnaces with Oil Fired Condensing Furnaces

ECM #112 Replace Furnaces with Oil Fired Condensing Furnaces								
Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Fuel Oil #2	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
16,000	0	0	400	1,100	0.2	9,600	14.5	5.8

*This Incentive is shown per the 2011 Direct Install Program. For other incentives, see section 5.

This measure was evaluated independently of all other ECMs. Actual energy savings may be less if implemented in conjunction with other measures due to interactive effects.

This measure is recommended.

4.1.3 ECM-FH3 Install Wall Insulation on North Wall

The front part of the building walls is constructed with filled concrete block. The inside of the meeting hall is covered in gypsum board and paint. Building personnel noted that most of the hall has had additional insulation installed. All walls have been insulated except the northern wall. This ECM evaluated installing wall insulation on the northern section of wall.

To calculate the savings for this ECM, the existing thermal resistance of the wall was compared to the proposed thermal resistance with additional insulation. The existing wall section has an R-Value of about 7.0. By framing the inside of the wall, adding 3.5" of craft faced fiberglass insulation, and then covering it with gypsum board, the R-Value would increase to about 16.0. Comparing the heat transfer through the walls in both conditions with outdoor temperature bin data from Newark, NJ provided heating and cooling load requirements. The energy savings result from an increased thermal resistance.

By installing insulation on the northern section of wall, the building would save about 90 gallons of #2 fuel oil, and 10 kWh of cooling per year.

Insulation has a life expectancy of about 24 years according to ASHRAE. The savings over the life of the project would be about 2,160 gallons #2 fuel oil, 240 kWh, and \$4,800.

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

ECM-FH3 Install Wall Insulation on North Wall

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 fuel Oil				
\$	kW	kWh	Gallons	\$	\$	Years	Years
6,600	0	10	90	200	(0.3)	NA	>25

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

This measure was evaluated independently of all other ECMs. Actual energy savings may be less if implemented in conjunction with other measures due to interactive effects.

This measure is not recommended.

4.1.4 ECM-FH4 Install Infrared Heaters in Garage Area

The garage is heated by one of the Williamson furnaces that also handles part of the open meeting hall. As previously mentioned, the unit is approximately 125 MBtu and 70% efficient. This ECM analyzed eliminating this furnace and adding #2 fuel oil fired infrared heaters in the garage area. Natural gas heaters were not considered for this ECM because it is not available to the building.

To determine the savings associated with installing infrared heaters, a block load of the space was created to determine the amount of heat energy required to maintain setpoint temperature in the winter. The block load takes into account parameters such as roof and wall insulation levels, ventilation and infiltration loads, building occupancy and usage, and temperature setpoints. The block load was then compared to temperature bin data for Newark, NJ to create an accurate representation of heating needs.

To calculate the savings associated with implementing infrared heaters, the efficiencies of the existing furnace was compared with the proposed efficiencies of the IR heaters at 87%. Additionally, the heating effectiveness between the two types of heaters was also used to determine savings. Heating effectiveness is a ratio between the amount of heat being produced compared to the amount of heat that actually reaches the floor space. IR heaters have an effectiveness ratio close to 100% because they use infrared wavelengths to distribute heat. Furnaces must rely on a circulating fan to distribute heat which can cause certain areas of the space to be overheated or under heated. The effectiveness of the building's furnace is about 85%.

The higher efficiencies and better effectiveness of the infrared heaters will save about 170 gallons of fuel oil per year and a fan savings of about 1,110 kWh per year.

The implementation costs were based on one Omega 100MBH low intensity 40 foot infrared heater; however, exact sizing requirements for the building should be assessed before this ECM is implemented. Additional modifications are required to bring oil piping to the space, and ducting for the heaters.

It should be noted that eliminating the furnace serving this area may not be an option since a portion serves the meeting hall. Either a smaller furnace can be acquired to only handle that portion of the meeting hall, or the other furnace serving the hall could be increased in size.

Oil infrared heaters have a life expectancy of about 15 years according to ASHRAE. The savings over the life of the project would be about 2,550 gallons #2 fuel oil, 16,650 kWh, and \$10,500.

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

ECM-FH4 Install Infrared Heaters in Garage Area

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil				
\$	kW	kWh	Gallons	\$	\$	Years	Years
5,300	0	1,110	170	700	1.0	NA	NA

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

This measure was evaluated independently of all other ECMs. Actual energy savings may be less if implemented in conjunction with other measures due to interactive effects.

This measure is recommended.

4.1.5 ECM-FH5 Replacement of T-12 Fixtures

This building is lit entirely by either 4 lamp T12 fixtures, or 2 lamp 8' T12 fixtures. T8 fixtures with electronic ballasts are more efficient and consume less energy. This ECM considered replacing all T12 lights with T8s.

The total energy saving for this measure was calculated by applying the existing and proposed fixture wattages to the estimated times of operation. For this building, the lights were estimated to be on only 800 hours per year due to the limited occupancy. The difference resulted in an annual savings of 5,240 kWh and about 6.5 kW per year. Supporting calculations, including all assumptions for lighting hours and the annual energy usage for each fixture are provided in Appendix F.

Lighting has an expected life of 15 years, according to the manufacturer, and total energy savings over the life of the project are estimated at 78,600 kWh and \$19,500.

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

ECM-FH5 Replacement of T-12 Fixtures

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil				
\$	kW	kWh	Gallons	\$	\$	Years	Years
16,600	6.5	5,240	0	1,300	0.2	10,000	12.8

* This Incentive is shown per the 2011 Direct Install Program. For other incentives, see section 5.

This measure is recommended.

4.1.6 ECM-FH6 Replace Kitchen Electric DHW Heater with On-Demand Propane

Domestic hot water is produced by an electric hot water heater which draws 4.5 kW, and provides 120°F hot water for the dishwasher and bar area with an 80 gallon storage tank. Kitchens require large hot water heaters; however, when water is not required, significant stand-by losses occur. To keep the water warm, the heating elements of the tank will turn on, and heat will escape through conduction with the air in the kitchen. Since the kitchen and bar area are not used often, standby heat losses from the tank are elevated. This ECM assessed replacing the 80 gallon hot water heater with a propane fired tank less unit. Instantaneous hot water heaters do not have a reservoir, and only heat hot water when needed.

To calculate the savings associated with replacing the 80 gallon hot water heater with an instantaneous unit, the daily hot water consumption was calculated, along with the amount of time the heater is in stand-by mode. According to the Department of Energy, domestic hot water heaters lose about 2.5% of their stored energy every hour. By implementing this ECM, the fire house is expected to save about 2,830 kWh and 4.5 kW per year. Based on usage, the kitchen would only use about 10 gallons of propane for hot water heating per year. This results in a net savings of about \$700 annually.

Instantaneous heaters have an estimated lifespan of about 13 years according to ASHRAE and manufacturer data. This ECM would use 130 gallons of propane over its lifetime, but would save about 36,790 kWh, and \$9,100.

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

ECM-FH6 Replace Kitchen Electric DHW Heater with On-Demand Propane

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Propane				
\$	kW	kWh	Gallons	\$	\$	Years	Years
4,000	4.5	2,830	(10)	700	300	5.7	5.3

* Incentive shown is available through the New Jersey Smart Start program. See Section 5 for other incentive opportunities.

This measure is recommended.

4.2 Sub Station

4.2.1 ECM SS-1 Install Ceiling Insulation

The roof of the sub station is pitched with a vaulted ceiling and does not have an attic space. The roof is constructed of sheet metal and supported by a metal internal frame. Drawings for the construction were unavailable; however, it is likely there is a thin layer of insulation board. The roof has an estimated thermal resistance of R-4.3. Since it would be difficult to add batt fiberglass insulation to the ceiling, this ECM investigated spraying on 3" of fire retardant insulation to the ceiling, which would increase the R-Value to 15.4.

To calculate the savings associated with adding insulation, the existing thermal losses through the roof were calculated with the existing roof construction and compared with the thermal losses through the roof with the added spray on insulation. The difference between the existing and proposed conditions was

compared with yearly temperature bin data from Newark, NJ. The calculated savings associated with adding 3” inches of roof insulation would be approximately 190 gallons of #2 fuel oil per year.

Roof insulation has a life expectancy of about 24 years according to the ASHRAE, and the total energy savings over the life of the project would be about 4,560 gallons of fuel oil and \$12,000.

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

ECM-SS1 Install Ceiling Insulation

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil				
\$	kW	kWh	Gallons	\$	\$	Years	Years
3,000	0	0	190	500	3.0	NA	6.0

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

This measure was evaluated independently of all other ECMs. Actual energy savings may be less if implemented in conjunction with other measures due to interactive effects.

This measure is recommended.

4.2.2 ECM SS-2 Replace Furnace with Oil Fired Condensing Furnace

The building is heated by a single oil fired furnace manufactured by International Heater, with an estimated 125 MBtu capacity and 68% efficiency. Condensing furnaces can reach efficiencies of about 97% but typically operate at about 92%. The ECM examined the energy savings potential of installing a condensing furnace.

To calculate the savings of installing a new furnace the same methodology as ECM 4.1.2 was used. The existing efficiency of 68% was compared to the efficiency of the new furnace. The existing building #2 oil usage was obtained from the utility information. Knowing the usage with a 68% efficient furnace, the projected usage was calculated with a 92% furnace. This measure has the potential to save about 170 gallons of #2 fuel oil annually.

Condensing furnaces have a life expectancy of about 18 years according to ASHRAE. The savings over the life of the project would be about 3,060 gallons of fuel oil and \$7,200.

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

ECM SS-2 Replace Furnace with Oil Fired Condensing Furnace

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
6,300	0	0	170	400	0.1	3,800	15.8	6.3

* This Incentive is shown per the 2011 Direct Install Program. For other incentives, see section 5.

This measure was evaluated independently of all other ECMs. Actual energy savings may be less if implemented in conjunction with other measures due to interactive effects.

This measure is not recommended in lieu of ECM SS-5.

4.2.3 ECM SS-3 Increase Wall Insulation

The walls are constructed of sheet metal, and have a small amount of insulation on to the walls. Based on the construction and known thermal properties of the wall materials, the wall R-values were calculated to be about R-5.2. Low R-values in the building envelope allow more heat transfer which requires the furnace to use more oil for heating. This ECM assessed the energy reduction from blowing 3" of spray foam insulation on the walls. Adding this amount of insulation would increase the R-value of the walls to about R-16.

To calculate the savings that could be achieved with the increase in R-value, the existing heat loss through the walls was compared with the proposed heat loss with the added insulation. Heat losses were determined using temperature bin data from Newark, NJ. The savings that could be realized from adding wall insulation would be approximately 160 gallons of #2 fuel oil per year annually.

Insulation has an expected life of about 24 years according to the ASHRAE. The energy savings over the life of the project would be about 3,840 gallons of #2 fuel oil and \$9,600.

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

ECM SS-3 Increase Wall Insulation

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
3,100	0	0	160	400	2.1	NA	7.8	NA

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

This measure was evaluated independently of all other ECMs. Actual energy savings may be less if implemented in conjunction with other measures due to interactive effects.

This measure is recommended.

4.2.4 ECM SS-4 Lighting Replacements

The sub station is lit by (12) 2 lamp T12 fixtures with magnetic ballasts. The restroom has a single 60 W incandescent bulbs. These fixtures are considered inefficient by today's standards, and this ECM demonstrated the energy and cost savings that could be achieved if T8 fixtures with electronic ballasts, and compact fluorescents (CFL) were installed.

To calculate the energy savings from installing new fixtures, the existing energy consumption of the T12 fixtures was compared with the proposed energy consumption of the T8 and CFL fixtures. Hourly usage was estimated based on discussions with building personnel. It was assumed that the fixtures would be on an average of two hours per day, or about 730 hours per year in both existing and proposed scenarios. By installing new fixtures, the sub station could save about 240 kWh and \$100 per year.

Lighting has an expected life of about 15 years according to the manufacturer. The energy savings over the life of the project would be about 3,600 kWh and \$1,500.

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

ECM SS-4 Lighting Replacements

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil				
\$	kW	kWh	Gallons	\$	\$	Years	Years
1,500	0.3	230	0	100	0	15.0	6.0

* This Incentive is shown per the 2011 Direct Install Program. For other incentives, see section 5.

This measure is recommended.

4.2.5 ECM SS-5 Replace Oil Furnace with Oil Fired Infrared Heaters

The Milford Sub Station is heated by a 125 MBtu oil fired furnace which is about 68% efficient. This ECM evaluated replacing the furnace with a single 125 MBtu oil fired infrared (IR) heater.

To determine the savings of installing an infrared heater the calculations from section 4.1.4 were utilized. A block load was generated to determine the heating load, then the efficiencies and effectiveness of the furnace and IR heaters was compared.

Based on the higher efficiencies and effectiveness of the IR heaters, the building could save about 230 gallons of #2 fuel oil and about 990 kWh in fan savings. The implementation costs were based on a single 125 MBH 40' infrared heater. An additional small space heater may be required to keep water pipes in the restroom from freezing. This will depend on the size of the infrared heaters and location.

Radiant heaters have an expected life of about 15 years according to ASHRAE. The energy savings over the life of the project would be about 14,850 kWh, 3,450 gallons of fuel oil, and \$13,500.

The implementation cost and savings related to this ECM are presented in appendix L and summarized below:

ECM SS-5 Replace Oil Furnace with Oil Fired Infrared Heaters

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
3,900	0	990	230	900	2.5	NA	4.3	NA

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

This measure was evaluated independently of all other ECMs. Actual energy savings may be less if implemented in conjunction with other measures due to interactive effects.

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. For each percent savings over the 15% minimum the incentive increases by \$0.005/kWh and \$0.05/therm, not to exceed a total of \$0.13/kWh and \$1.45/therm.

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. For each percent savings over the 15% minimum the incentive increases by \$0.005/kWh and \$0.05/therm, not to exceed a total of \$0.09/kWh and \$1.05/therm.

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

Below 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 \$50,000 per entity. These funds have been made available to 501 municipalities within 11 counties across the State of New Jersey.

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 by 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 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 fire house is eligible for about \$300 towards the development of an Energy Reduction Plan. The sub station would be eligible for about \$100. 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 both buildings is estimated to exceed the 15% minimum, the building is eligible to receive monies based as discussed above in section 5.1.1.

According to the program, fuel oil may be used to calculate savings in order to get to the 15% mark, but there are no incentives given for the reduction of #2 oil gallons.

Under the P4P program, the fire house is eligible for a total of \$2,300 in incentives lowering the project payback from 11.4 to 10.9 years. The sub station would be eligible for about \$300 in P4P incentives, lowering the payback from 8.0 to 7.9 years if all measures were implemented. Calculations can be seen in Appendix M.

5.2.2 New Jersey Smart Start Program

The fire house and sub station are eligible for Smart Start Program Incentives, including lighting replacement and furnace replacement, however, in many cases, the money available for the Direct Install Program is more than what Smart Start provides. It is up to the borough to make the final decision on which incentive to apply for since incentives cannot be applied for under two different programs.

It is recommended that the fire house apply for the Smart Start Program for an on demand hot water heater because it is not available under the Direct Install Program. The Smart Start Program will pay 300 for the new unit.

5.2.3 Energy Efficient and Conservation Block Grant

Both the fire house and sub station are owned by local government which makes them 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 ARRA Initiative “Energy Efficiency Programs through the Clean Energy Program”

The fire house and the sub station both pay the Societal Benefits charge on their monthly utility bill and therefore are not eligible for this incentive.

5.2.5 Direct Install Program

Milford Township is potentially eligible to receive funding from the Direct Install Program. This money can be in conjunction with the Energy Efficiency and Conservation Block Grant.

The total implementation cost for all ECMs potentially eligible for Direct Install funding in the fire house is about \$32,000. This program would pay 60%, or about \$19,200 of these initial costs. These ECMs include the furnace replacement and lighting. The total implementation cost for all ECMs potentially eligible for Direct Install funding in the Sub Station is about \$7,800. This program would pay about \$4,700 of these initial costs. These ECMs also include furnace replacement and lighting upgrades.

In order to apply for this program the borough must contact the Direct Install contractor for Hunterdon County, Donnelly Energy Solutions. 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°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 buildings use oil fired furnaces for heating, and the fire house uses DX cooling for AC requirements. This equipment is not compatible with a geothermal energy source. Therefore, to take advantage of a GHP system, the existing mechanical equipment would have to be removed; 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 because the extent of HVAC system renovation needed for implementation greatly outweighs the savings over the life of the equipment.

6.2 Solar

6.2.1 Photovoltaic Rooftop Solar Power Generation

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

The PVWATTS solar power generation model was utilized to calculate PV power generation. The closest city available in the model is Atlantic City, New Jersey and a fixed tilt array type was utilized to calculate energy production. The PVWATT solar power generation model is provided in Appendix P.

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

Installation of (PV) arrays in the state New Jersey will allow the owner to participate in the New Jersey solar renewable energy certificates program (SREC). This is a program that has been set up to allow entities with large amounts of environmentally unfriendly emissions to purchase credits from zero emission (PV) solar-producers. An alternative compliance penalty (ACP) is paid for by the high emission producers and is set each year on a declining scale of 3% per year. One SREC credit is equivalent to

1000 kilowatt hours of PV electrical production; these credits can be traded for period of 15 years from the date of installation. The cost of the ACP penalty for 2010 is \$600; this is the amount that must be paid per SREC by the high emission producers. The expected dollar amount that will be paid to the PV producer for 2011 is expected to be \$700/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/ SREC per year and this number was utilized in the cash flow for this report.

The system costs for PV installations were derived from contractor budgetary pricing in the state of New Jersey for estimates of total cost of system installation. 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.

6.2.1.2 Fire House

Over the past year the fire house had a maximum electric demand of 33.5, a minimum of 22.8, and an average of 27.3. The existing load does not justify the maximum incentive load cap of 50 kW. The average monthly kW was used to determine the size of the system for the building. The fire house does have large south facing roof area that would be ideal for a PV system. Based on a 27 kW system, the cost would be about \$6.00/Watt, or \$6,000/kW.

6.2.1.3 Sub Station

Electric demand data was not available for the Sub Station, but based on its equipment load in the building, a 2 kW system was selected for calculations. The building has ample roof space and land to support this size system. For a 2 kW system the cost would be about \$7.00/Watt or about \$7,000/kW.

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

Fire House Photovoltaic (PV) Rooftop Solar Power Generation – 27 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
162,000	0	31,940	0	7,700	7,700	20,250	15,500	21.0	6.1

*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

Sub Station Photovoltaic (PV) Rooftop Solar Power Generation – 2 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
14,000	0	2,370	0	700	700	1,500	1,200	20.0	6.6

*Incentive based on New Jersey Renewable Energy Program for non-residential applications of \$0.75 per Watt of installed capacity

** Estimated Solar Renewable Energy Certificate Program (SREC) for 15 years at \$487/1000 kWh

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

6.2.2 Solar Thermal Hot Water Plant

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

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

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

Currently, an incentive is not available for installation of thermal solar systems. A Federal tax credit of 30% of installation cost for the thermal applications is available; however, the Borough 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 O and summarized as follows:

Solar Thermal Domestic Hot Water Plant – Fire House

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
12,200	0	190	0	100	100	NA	>25	NA

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

This measure is not recommended on either building.

Projected savings for installing a solar hot water plant in the Sub Station were not calculated due to extremely low demand for hot water at this site.

6.3 Wind

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

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

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

The most important part of any small wind generation project is the mean annual wind speed at the height of which the turbine will be installed. In the Milford area, the map indicates a mean annual wind speed of about 10.5 miles per hour. For the fire house, there are site restrictions such as parking lots and surrounding structures that would greatly affect a tower location. The Sub Station does not have as many obstructions.

A wind speed map and aerial site photo are included in Appendix P.

This measure is not recommended due to the low mean annual wind speed.

6.4 Combined Heat and Power Generation (CHP)

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

Any proposed CHP project will need to consider many factors, such as existing system load, use of thermal energy produced, system size, natural gas fuel availability, and proposed plant location. The fire house and Sub Station has sufficient need for electrical generation and the ability to use most of the thermal byproduct during the winter, thermal usage during the summer months is low. Thermal energy produced by the CHP plant in the warmer months will be wasted. An absorption chiller could be installed to utilize the heat to produce chilled water; however, there is no chilled water distribution system in either building. The most viable selection for a CHP plant at this location would be a reciprocating engine propane 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 an extensive renovation, and the project would not pay back within the useful lifetime of the equipment.

6.6 Demand Response Curtailment

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

Utility Curtailment is an agreement with the utility provider's 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 utility provider offers incentives to the CSP to participate in this program. Enrolling in the program will require program participants to drop electrical load or turn on emergency generators during high electrical demand conditions or during emergencies. Part of the program also will require that program participants reduce their required load or run emergency generators with notice to test the system.

A pre-approved CSP will require a minimum of 100 kW of load reduction to participate in any curtailment program.

This measure is not recommended because the facilities do not have adequate load to meet the required minimum load reduction.

7.0 EPA PORTFOLIO MANAGER

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

Both the fire house and the sub station are considered low energy consumers per Portfolio Manager. The Fire House has a Site Energy Usage Index (EUI) of 52 kBTU/ft²/year and the Sub Station has an EUI of 42 kBTU/ft²/year. The average for these types of buildings is about 78 kBTU/ft²/year. The EUI can be further improved by addressing wasted energy from such sources as excess ventilation, poor building envelope components, and inefficient lighting systems. The Fire House EUI could be reduced to about 32, and the Sub Station could be reduced to about 17 kBTU/ft²/year.

The EPA Portfolio Manager did not generate an energy rating score for these buildings because more than 10% of the floor area falls into the category "Other", which is not eligible for an energy star rating.

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

The user name and password for the building's EPA Portfolio Manager Account has been provided to John Phillips, Fire Chief for the Borough of Milford.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The energy audit conducted by CHA at the Milford Fire House and Milford Sub Station in Milford, New Jersey identified potential ECMs for insulation upgrade, furnace replacement, infrared heaters, lighting upgrades, and domestic hot water heaters. Potential annual savings of \$6,300 may be realized for the recommended ECMs, with a summary of the costs, savings, and paybacks as follows:

8.1 Milford Fire House

ECM-FH1 Install Roof Insulation in Meeting Hall

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Fuel Oil #2				
\$	kW	kWh	Gallons	\$	\$	Years	Years
5,300	0	30	210	600	1.7	NA	8.8

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

ECM-FH2 Replace Furnaces with Oil Fired Condensing Furnaces

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Fuel Oil #2				
\$	kW	kWh	Gallons	\$	\$	Years	Years
16,000	0	0	400	1,100	0.2	9,600	14.5

*This Incentive is shown per the 2011 Direct Install Program. For other incentives, see section 5.

ECM-FH4 Install Infrared Heaters in Garage Area

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil				
\$	kW	kWh	Gallons	\$	\$	Years	Years
5,300	0	1,110	170	700	1.0	NA	7.6

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

ECM-FH5 Replacement of T-12 Fixtures

Budgetary Cost	Annual Utility Savings			ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil				
\$	kW	kWh	Gallons	\$	\$	Years	Years
16,600	6.5	5,240	0	1,300	0.2	10,000	12.8

* This Incentive is shown per the 2011 Direct Install Program. For other incentives, see section 5.

ECM-FH6 Replace Kitchen Electric DHW Heater with On-Demand Propane

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Propane	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
4,000	4.5	2,830	(10)	700	1.3	300	5.7	5.3

* Incentive shown is available through the New Jersey Smart Start program. See Section 5 for other incentive opportunities.

8.2 Milford Sub Station**ECM-SS1 Install Ceiling Insulation**

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
3,000	0	0	190	500	3.0	NA	6.0	NA

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

ECM SS-3 Increase Wall Insulation

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
3,100	0	0	160	400	2.1	NA	7.8	NA

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

ECM SS-4 Lighting Replacements

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
1,500	0.3	230	0	100	0	900	15.0	6.0

* This Incentive is shown per the 2011 Direct Install Program. For other incentives, see section 5.

ECM SS-5 Replace Oil Furnace with Oil Fired Infrared Heaters

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		#2 Fuel Oil	Total				
\$	kW	kWh	Gallons	\$		\$	Years	Years
3,900	0	990	230	900	2.5	NA	4.3	NA

*There are no incentives available through the New Jersey Pay For Performance or Direct Install Programs for this ECM. See Section 5.0 for other incentive opportunities.

APPENDIX A

Utility Usage Analysis

New Jersey BPU Energy Audit Program

CHA Project No.: 22312

Milford Fire Company

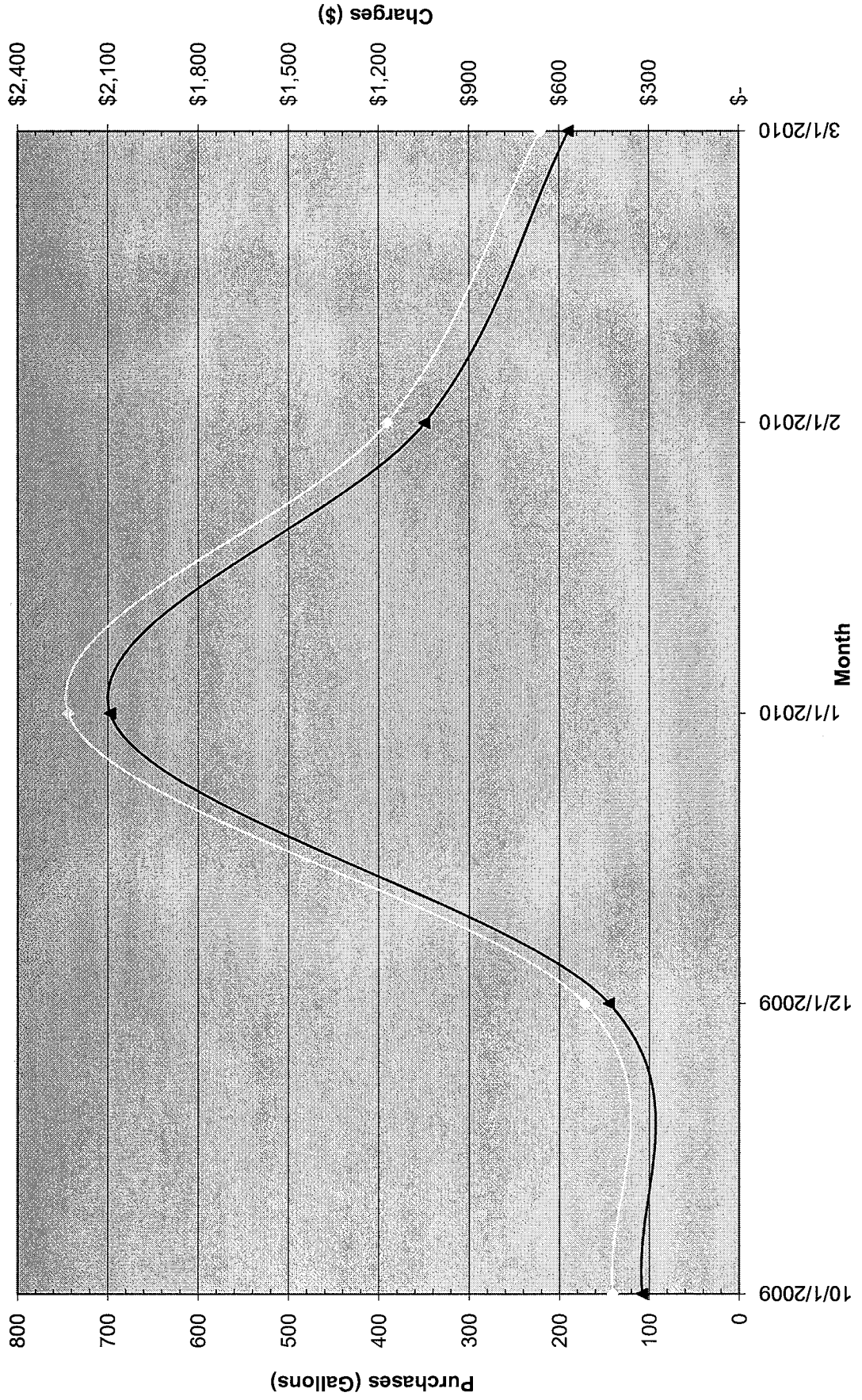
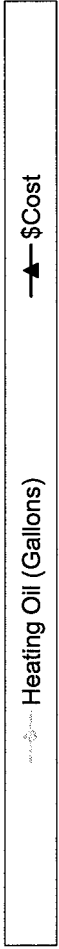
NJBIOHEATOIL

21 Water Street

Account No.: 29167

Month	Heating Oil (Gallons)	\$Cost		\$/Gallon	
10/1/2009	141	\$	322.98	\$	2.291
12/1/2009	172	\$	434.99	\$	2.529
1/1/2010	744	\$	2,093.00	\$	2.813
2/1/2010	391	\$	1,047.76	\$	2.680
3/1/2010	221	\$	569.19	\$	2.576
Total	1,669	\$	4,467.92	\$	2.677

Oil Usage- Milford Fire Hall

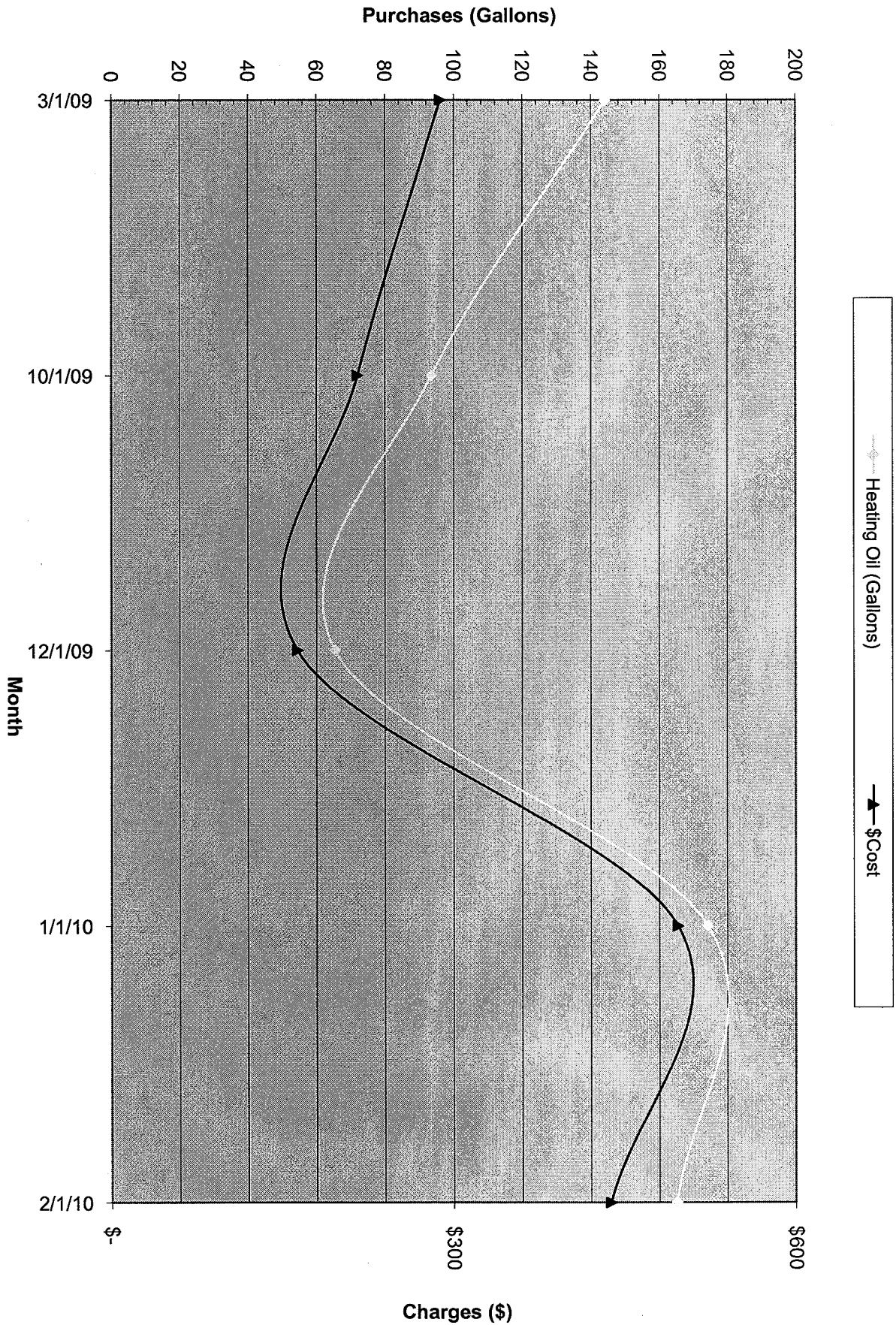


New Jersey BPU Energy Audit Program
CHA Project No.: 22312
Milford Sub Station
NJBIOHEATOIL

530 Little York Mt. Pleasant Road

Month	Heating Oil (Gallons)	\$Cost		\$/Gallon	
3/1/09	144	\$	288.26	\$	1.999
10/1/09	94	\$	216.12	\$	2.309
12/1/09	66	\$	163.68	\$	2.499
1/1/10	174	\$	496.58	\$	2.849
2/1/10	165	\$	437.61	\$	2.649
Total	643	\$	1,602.25	\$	2.493

Oil Usage - Milford Sub Station



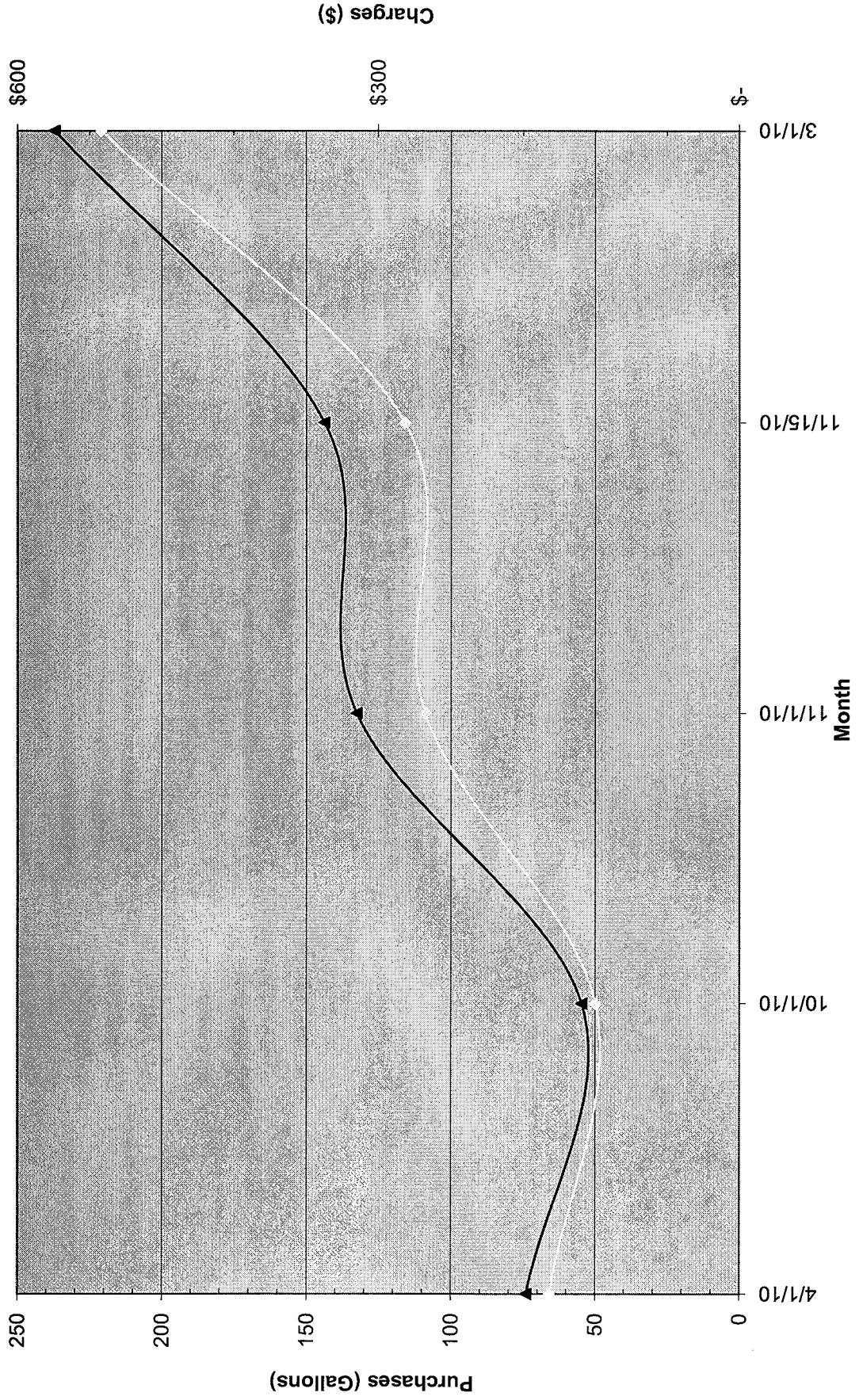
New Jersey BPU Energy Audit Program
CHA Project No.: 22312
Milford Fire Company
Propane

21 Water Street

Month	Propane (Gallons)	\$Cost		\$/Gallon
4/1/09	66	\$	177.54	\$ 2.690
10/1/09	50	\$	131.26	\$ 2.625
11/1/09	109	\$	318.35	\$ 2.921
11/15/09	116	\$	345.08	\$ 2.975
3/1/10	221	\$	569.19	\$ 2.576

Total	562	\$	1,541.42	\$ 2.743

Propane Usage- Milford Firehouse



New Jersey BPU Energy Audit Program
CHA Project No.: 22312
Milford Fire Company
JCP&L

21 Water Street

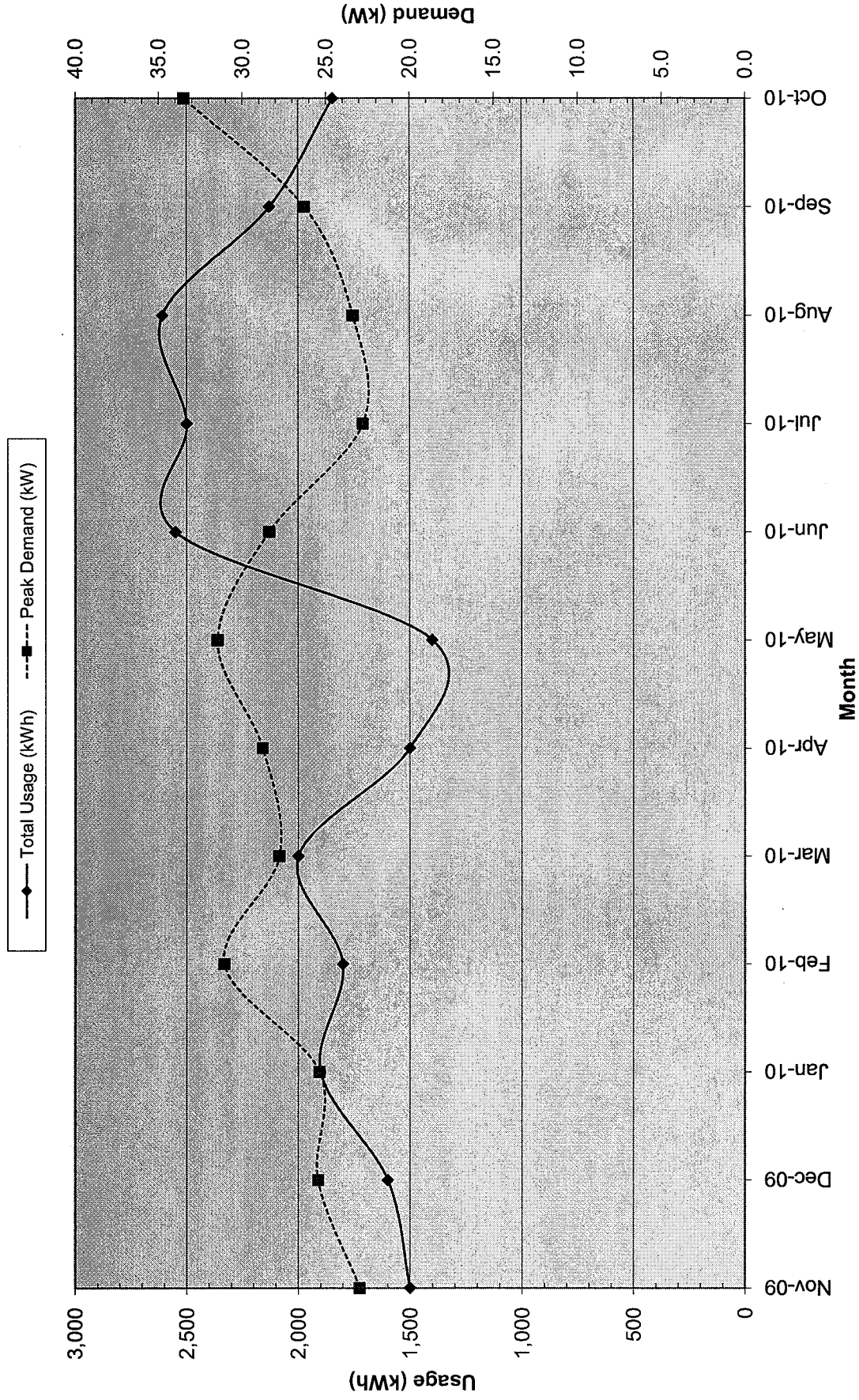
Account No.:

10 00 03 3672 3 0

62085665

Month	Charges		Unit Costs	
	Consumption (kWh)	Demand (kW)	Blended Rate (\$/kWh)	Demand (\$/kW)
November-09	1,500	23.0	\$ 0.241	\$ 4.54
December-09	1,600	25.5	\$ 0.241	\$ 4.54
January-10	1,900	25.4	\$ 0.241	\$ 4.54
February-10	1,800	31.1	\$ 0.241	\$ 4.54
March-10	2,000	27.8	\$ 0.241	\$ 4.54
April-10	1,500	28.8	\$ 0.241	\$ 4.54
May-10	1,400	31.5	\$ 0.241	\$ 4.54
June-10	2,550	28.4	\$ 0.241	\$ 4.54
July-10	2,500	22.8	\$ 0.241	\$ 4.54
August-10	2,609	23.4	\$ 0.215	\$ 4.54
September-10	2,129	26.3	\$ 0.240	\$ 4.30
October-10	1,845	33.5	\$ 0.268	\$ 4.54
Total	23,333	33.5	\$ 0.240	\$ 4.52
Most Recent Yr	23,333	33.5	\$ 0.240	\$ 4.52

Electric Usage - Milford Township Fire Company

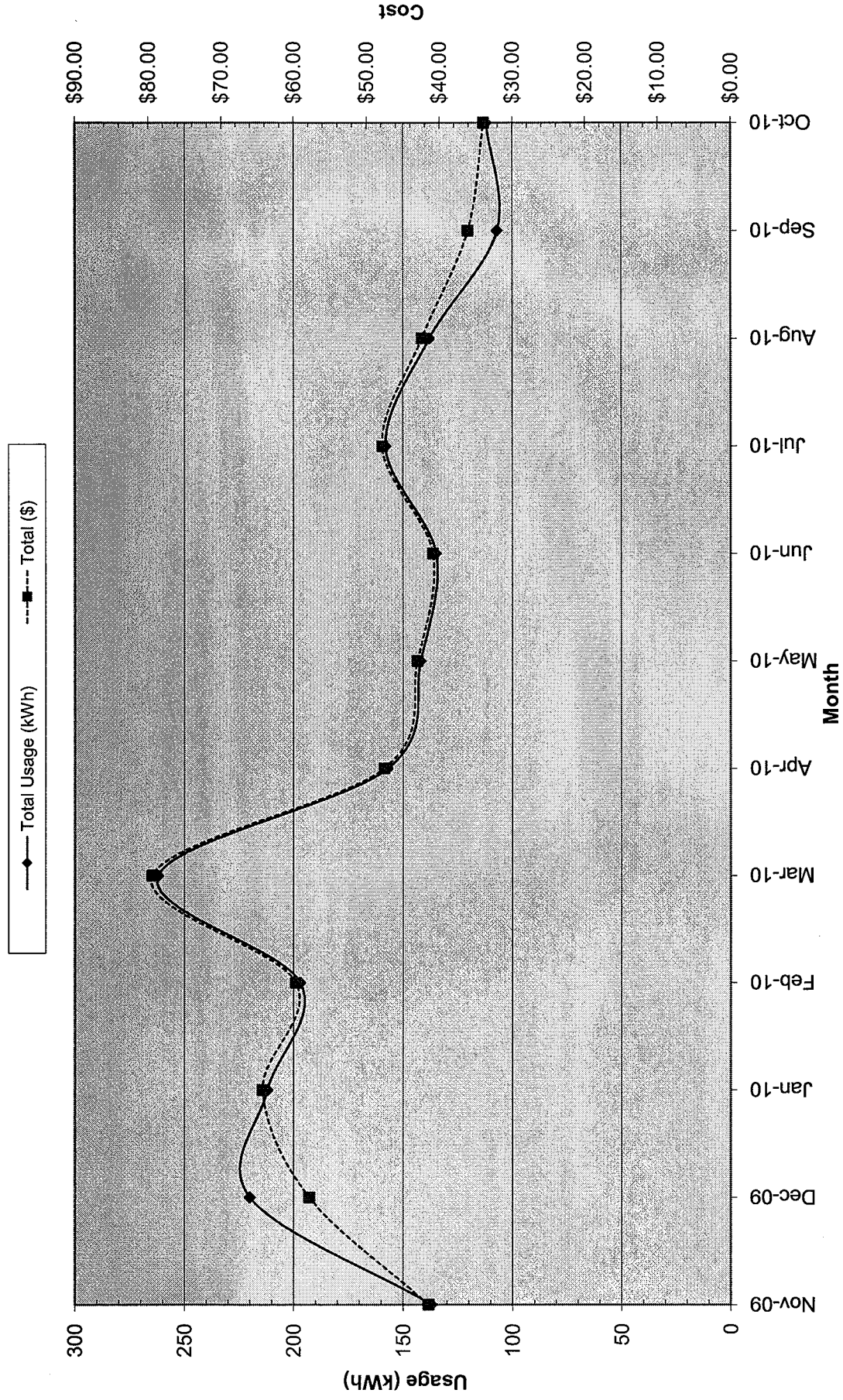


New Jersey BPU Energy Audit Program
CHA Project No.: 22312
Milford Fire Company
JCP&L

530 Little York Mt. Pleasant Rd.
Account No.: 10 00 02 9881 7 6

Month	Consumption (kWh)	Charges	Unit Costs
		Total (\$)	Blended Rate (\$/kWh)
November-09	137	\$41.51	\$ 0.303
December-09	220	\$57.83	\$ 0.263
January-10	212	\$64.24	\$ 0.303
February-10	197	\$59.69	\$ 0.303
March-10	262	\$79.39	\$ 0.303
April-10	157	\$47.57	\$ 0.303
May-10	142	\$43.03	\$ 0.303
June-10	135	\$40.91	\$ 0.303
July-10	158	\$47.87	\$ 0.303
August-10	138	\$42.43	\$ 0.307
September-10	107	\$36.10	\$ 0.337
October-10	112	\$33.94	\$ 0.303
Total	1,977	\$594.50	\$ 0.301
Most Recent Yr	1,977	\$594.50	\$ 0.301

Electric Usage - Milford Township Sub Station



New Jersey BPU Energy Audit Program

CHA Project No.: 22312

Milford Fire Company

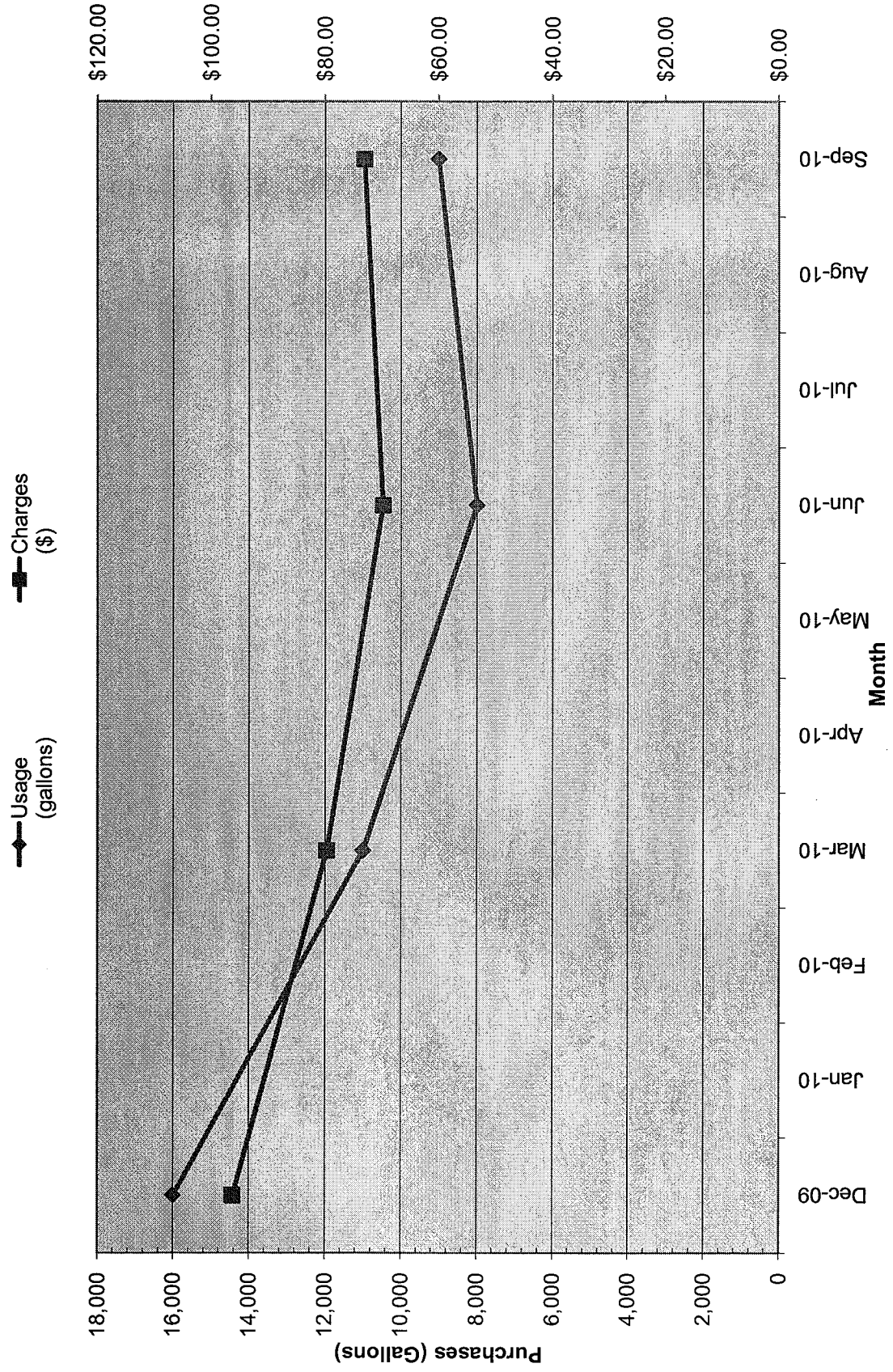
Borough of Milford - Water

21 Water Street

Account No.: 0263

Month	Usage (gallons)	Charges (\$)	Rate (\$/1000 Gal)
December-09	16,000	\$96.20	\$ 6.01
March-10	11,000	\$79.70	\$ 7.25
June-10	8,000	\$69.80	\$ 8.73
September-10	9,000	\$73.10	\$ 8.12
Total	44,000	\$318.80	\$ 7.25

Water Usage - Milford Township Fire Hall



APPENDIX B

ECM-FH1 Install Roof Insulation in Meeting Hall

Max Roof Load Calculation:				
Cooling				
Roof Area	U-Value	Cooling Delta T °F	Return Air Factor	BTUH
	5300	0.07	1	25,504
Heating				
Roof Area	U-Value	Heating Delta T °F	Return Air Factor	BTUH
	5300	0.07	1	48,552

Milford Township
CHA #22312
Building: Firehouse

Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1.00

ECM 1 Install Roof Insulation in Meeting Hall

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
6" Blown in Insulation	5300	SF	\$ 0.42	\$ 0.33		\$ 2,204	\$ 2,151	\$ -	\$ 4,355	

\$ 4,355	Subtotal
\$ 435.50	10% Contingency
\$ 479.05	Contractor
\$ -	10% O&P
\$ 5,270	0% Engineering
\$ 5,270	Total

APPENDIX C

ECM-FH2 Replace Boilers with Oil Fired Condensing Boilers

Milford Township
CHA #22312
Building: Firehouse

ECM-2 Replace Furnaces with Oil Fired Condensing Furnaces

Existing Fuel	#2 Oil	▼
Proposed Fuel	#2 Oil	▼

Item	Value	Units	Formula/Comments
Baseline Fuel Cost	\$ 2.68		
Proposed Fuel Cost	\$ 2.68		
Baseline Fuel Use	1,669	Gals #2	Based on historical utility data
Existing Boiler Plant Efficiency	70%		Estimated
Baseline Boiler Load	162,043	Mbtu/yr	Baseline Fuel Use x Existing Efficiency x 138.7 Mbtu/Gals #2
Baseline Fuel Cost	\$ 4,468		
Proposed Furnace Efficiency	92%		Based on an Adams Furnace with an AFUE of up to 97%
Proposed Fuel Use	1,270	Gals #2	Baseline Boiler Load / Proposed Efficiency / 138.7 Mbtu/Gals #2
Proposed Fuel Cost	\$ 3,400		
Annual Savings	399	Gals #2	
Annual Savings	\$ 1,068	/yr	

Milford Township
CHA #22312
Building: Firehouse

Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1.00

ECM-2 Replace Furnaces with Oil Fired Condensing Furnaces

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
Furnace Removal	3	EA		\$ 250		\$ -	\$ 923	\$ -	\$ 923	
125 MBTU Oil Furnace	2	EA	\$ 2,500	\$ 300		\$ 4,950	\$ 738	\$ -	\$ 5,688	Based on Adams Condensing Oil Fired and Means
140 MBTU Oil Furnace	1	LS	\$ 2,800	\$ 350		\$ 2,772	\$ 431	\$ -	\$ 3,203	Based on Adams Condensing Oil Fired and Means
Ductwork Modifications	1	LS	\$ 200	\$ 100		\$ 198	\$ 123	\$ -	\$ 321	Sheetmetal
Miscellaneous Piping /Venting	3	LS	\$ 300	\$ 300		\$ 891	\$ 1,107	\$ -	\$ 1,998	

\$ 12,132	Subtotal
\$ 2,426	20% Contingency
\$ 1,456	Contractor
\$ -	10% O&P
\$ 16,014	0% Engineering
\$ 16,014	Total

APPENDIX D

ECM-FH3 Install Wall Insulation on North Wall

Milford Township
CHA #22312
Building: Firehouse

ECM 3 Increase Wall Insulation on North Wall

Total Existing Wall Area	1,930 sf
Existing U-value	0.14 Btu/hr(sf°F)
Existing R-value	7.0
Proposed U-value	0.036 Btu/hr(sf°F)
Proposed R-value	16 3.5" fiberglass batt insulation
Heating Efficiency	75%
Cooling Efficiency	100%

Existing Cooling	3,016 Btu/hr
Max. North Wall Cooling Load	0 Btu/hr
Max. East Wall Cooling Load	0 Btu/hr
Max. South Wall Cooling Load	0 Btu/hr
Max. West Wall Cooling Load	0 Btu/hr

Proposed Cooling	1,325 Btu/hr
Max. North Wall Cooling Load	0 Btu/hr
Max. East Wall Cooling Load	0 Btu/hr
Max. South Wall Cooling Load	0 Btu/hr
Max. West Wall Cooling Load	0 Btu/hr

Unoccupied Cooling Setpoint	60 F
Unoccupied Cooling Total	30 F

Existing Cooling Total	18,520,800 Btu/yr
Proposed Cooling Total	8,919,432 Btu/yr
Savings	9,601,368 Btu/yr
Input	68 Gallons Oil#2

Existing Heating	9,444 Btu/hr
Existing Heating Load Temp Diff.	50 F
Existing Max. Wall Heating Load	9,444 Btu/hr
Heating On Point	60 F

Proposed Heating	3,733 Btu/hr
Proposed Max. Heating Load	3,733 Btu/hr

Unoccupied Heating Setpoint	70 F
Unoccupied Heating Total	60 F

Existing Heating Total	18,520,800 Btu/yr
Proposed Heating Total	8,919,432 Btu/yr
Savings	9,601,368 Btu/yr
Input	68 Gallons Oil#2

Avg Outdoor Air Temp. Bins °F	Existing Equipment Bln Hours	Occupied Equipment Bln Hours	Unoccupied Equipment Bln Hours	Occupied				Unoccupied				Existing Heating Load (Btu/yr)	Existing Cooling Load (kWh/yr)	Existing Heating Load (Btu/yr)	Proposed Cooling Load (kWh/yr)	Proposed Heating Load (Btu/yr)
				Existing Heat Gain (Btu/hr)	Existing Heat Loss (Btu/hr)	Proposed Heat Loss (Btu/hr)	Existing Heat Gain (Btu/hr)	Proposed Heat Gain (Btu/hr)	Existing Heat Loss (Btu/hr)	Proposed Heat Loss (Btu/hr)	Existing Heating Load (Btu/yr)					
102.5	0	0	0	3,016	-	-	3,016	1,325	-	-	0	-	-	-	-	-
97.5	3	0	3	2,552	-	-	1,121	795	-	-	1	-	-	0	-	-
92.5	34	3	31	2,088	-	-	917	265	-	-	3	-	-	1	-	-
87.5	131	12	119	1,624	-	-	713	-	-	-	2	-	-	1	-	-
82.5	500	48	452	1,160	-	-	510	-	-	-	6	-	-	3	-	-
77.5	620	59	561	696	-	-	306	-	-	-	4	-	-	2	-	-
72.5	664	63	601	232	-	-	102	-	-	-	2	-	-	1	-	-
67.5	854	81	773	-	-	-	-	-	-	-	-	-	-	-	-	-
62.5	927	88	839	-	-	-	-	-	-	-	-	-	-	-	-	-
57.5	600	57	543	-	-	-	-	-	-	-	-	-	-	-	-	-
52.5	610	58	552	-	-	-	-	-	-	-	-	-	-	-	-	-
47.5	611	58	553	-	-	-	-	-	-	-	-	-	-	-	-	-
42.5	656	62	594	-	-	-	-	-	-	-	-	-	-	-	-	-
37.5	1,023	97	926	-	-	-	-	-	-	-	-	-	-	-	-	-
32.5	734	70	664	-	-	-	-	-	-	-	-	-	-	-	-	-
27.5	334	32	302	-	-	-	-	-	-	-	-	-	-	-	-	-
22.5	252	24	228	-	-	-	-	-	-	-	-	-	-	-	-	-
17.5	125	12	113	-	-	-	-	-	-	-	-	-	-	-	-	-
12.5	47	4	43	-	-	-	-	-	-	-	-	-	-	-	-	-
7.5	22	2	20	-	-	-	-	-	-	-	-	-	-	-	-	-
2.5	13	1	12	-	-	-	-	-	-	-	-	-	-	-	-	-
-2.5	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-
-7.5	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTALS	8,760	834	7,926	-	-	-	-	-	-	-	-	17,572,367.86	-	-	8	6,819,452

Max North Wall Load Calculation:					
Wall Area	1060	U-Value	Cooling		BTUH
			Cooling Delta	Return Air Factor	
		0.14	20	1	3,016
Wall Area	1060	U-Value	Heating		BTUH
			Heating Delta	Return Air Factor	
		0.14	56	1	8,444

Milford Township
CHA #22312
Building: Firehouse

Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1.00

ECM 3 Increase Wall Insulation on North Wall

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
3.5" Fiberglass Insulation	1060	SF	\$ 0.84	\$ 0.36		\$ 881	\$ 469	\$ -	\$ 1,351	
2 layers 5/8" sheet rock	1060	SF	\$ 0.85	\$ 1.68		\$ 893	\$ 2,185	\$ -	\$ 3,078	
10' High Metal Stud wall	40	EA	\$ 15	\$ 9		\$ 594	\$ 443	\$ -	\$ 1,037	

\$ 5,466	Subtotal
\$ 546.58	10% Contingency
\$ 601.24	Contractor
\$ -	10% O&P
\$ -	0% Engineering
\$ 6,614	Total

APPENDIX E

ECM-FH4 Install Infrared Heaters in Garage Area

Milford Township
CHA #22312
Building: Firehouse

ECM 4: Install Infrared Heaters in Garage Area

Building Footprint	2,500	SF
Oil Heat Content	138,700	Btu/Gal
Oil Heat Content	138,700	Btu/Gal #2
Building Balance Temp.	60	*F
Internal Gains	18,758	btu/h
Unocc Internal Gain factor	0.3	
Ave Occ Internal Gain Factor	0.6	

Ex Occupied Htg Temp.	70	*F
Ex Unoccupied Htg Temp.	55	*F
Occupied Heating UA	583	btu/hr/*F
Unoccupied Heating UA	583	btu/hr/*F

Heating Energy Savings #2 Oil	169	gallons/year
Electric Energy Savings	1,114	kWh/yr

Existing Burner Efficiency	70.0%	Existing unit heater burner efficiency
Existing Heat Distribution Effectiveness	85.0%	Heat Distribution Factor per ASHRAE Handbook - Fundamentals for Unit Heaters
Proposed Burner Efficiency	87.0%	Based on Infrared Tube Heaters
Proposed Heat Distribution Effectiveness	100%	Heat Distribution Factor per ASHRAE Handbook - Fundamentals for Infrared Heaters

				EXISTING LOADS						PROPOSED LOADS								
				Occupied			Unoccupied			Occupied			Unoccupied					
Avg Outdoor Air Temp. Bins °F	Existing Equipment Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Existing Heating Energy Gallons #2	Proposed Heating Energy Gallons #2	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	M	N	
102.5	0	0	0	0	0	-11,250	0	0	-5,625	0	0	-11,250	0	0	-5,625	0	0	
97.5	3	0	3	0	0	-11,250	0	0	-5,625	0	0	-11,250	0	0	-5,625	0	0	
92.5	34	3	31	0	0	-11,250	0	0	-5,625	0	0	-11,250	0	0	-5,625	0	0	
87.5	131	12	119	0	0	-11,250	0	0	-5,625	0	0	-11,250	0	0	-5,625	0	0	
82.5	500	48	452	0	0	-11,250	0	0	-5,625	0	0	-11,250	0	0	-5,625	0	0	
77.5	620	59	561	0	0	-11,250	0	0	-5,625	0	0	-11,250	0	0	-5,625	0	0	
72.5	664	63	601	0	0	-11,250	0	0	-5,625	0	0	-11,250	0	0	-5,625	0	0	
67.5	854	81	773	1,462	873	-11,250	0	0	-5,625	1,462	873	-11,250	0	0	-5,625	0	0	
62.5	927	88	839	4,385	2,620	-11,250	0	0	-5,625	4,385	2,620	-11,250	0	0	-5,625	0	0	
57.5	600	57	543	7,308	4,366	-11,250	0	0	-5,625	7,308	4,366	-11,250	0	0	-5,625	-37	-25	
52.5	610	58	552	10,232	6,112	-11,250	1,462	832	-5,625	10,232	6,112	-11,250	1,462	832	-5,625	-19	-13	
47.5	611	58	553	13,155	7,859	-11,250	4,385	2,495	-5,625	13,155	7,859	-11,250	4,385	2,495	-5,625	15	10	
42.5	656	62	594	16,079	9,605	-11,250	7,308	4,158	-5,625	16,079	9,605	-11,250	7,308	4,158	-5,625	53	36	
37.5	1023	97	926	19,002	11,351	-11,250	10,232	5,821	-5,625	19,002	11,351	-11,250	10,232	5,821	-5,625	140	95	
32.5	734	70	664	21,925	13,098	-11,250	13,155	7,484	-5,625	21,925	13,098	-11,250	13,155	7,484	-5,625	141	96	
27.5	334	32	302	24,849	14,844	-11,250	16,079	9,148	-5,625	24,849	14,844	-11,250	16,079	9,148	-5,625	83	57	
22.5	252	24	228	27,772	16,590	-11,250	19,002	10,811	-5,625	27,772	16,590	-11,250	19,002	10,811	-5,625	76	52	
17.5	125	12	113	30,695	18,337	-11,250	21,925	12,474	-5,625	30,695	18,337	-11,250	21,925	12,474	-5,625	45	31	
12.5	47	4	43	33,619	20,083	-11,250	24,849	14,137	-5,625	33,619	20,083	-11,250	24,849	14,137	-5,625	19	13	
7.5	22	2	20	36,542	21,830	-11,250	27,772	15,800	-5,625	36,542	21,830	-11,250	27,772	15,800	-5,625	10	7	
2.5	13	1	12	39,466	23,576	-11,250	30,695	17,464	-5,625	39,466	23,576	-11,250	30,695	17,464	-5,625	7	5	
-2.5	0	0	0	42,389	25,322	-11,250	33,619	19,127	-5,625	42,389	25,322	-11,250	33,619	19,127	-5,625	0	0	
-7.5	0	0	0	45,312	27,069	-11,250	36,542	20,790	-5,625	45,312	27,069	-11,250	36,542	20,790	-5,625	0	0	
TOTALS	8760	834	7,926													534		365

Existing Building Ventilation & Infiltration (occ)	308 cfm
Overheat Ventilation Factor	1.05
Additional ventilation to offset overheat	15 cfm
Existing Building Ventilation & Infiltration (unocc)	308 cfm

Electrical Requirements for Heating Equipment

Unit	Htng Hrs	HP	kW	Efficiency	Power Factor	Annual kWh
Furnace	2,090	0.5	0.373	70%	0.8	1114
Total						1114

Avg. OA Temp *F	Heating Hrs	Assumed % Time of Operation	hrs of Operation
102.5	0	0%	0
97.5	0	0%	0
92.5	0	0%	0
87.5	0	0%	0
82.5	0	0%	0
77.5	0	0%	0
72.5	0	0%	0
67.5	0	0%	0
62.5	0	8%	0
57.5	600	15%	92
52.5	610	23%	141
47.5	611	31%	188
42.5	656	38%	252
37.5	1023	46%	472
32.5	734	54%	395
27.5	334	62%	206
22.5	252	69%	174
17.5	125	77%	96
12.5	47	85%	40
7.5	22	92%	20
2.5	13	100%	13
-2.5	0	100%	0
-7.5	0	100%	0
	5,027	42%	2090

Milford Township

CHA #22312

Building: Firehouse

ECM 4: Install Infrared Heaters in Garage Area

Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1.00

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
40' #2 Infrared Tube Heater 100MBH	1	EA	\$ 1,689	\$ 325		\$ 1,672	\$ 400	\$ -	\$ 2,072	Based on Omega II #2 Oil Fired Heater
#2 Oil Piping from Tank to IR Heaters	80	LF	\$ 5.10	\$ 2.73		\$ 404	\$ 269	\$ -	\$ 673	2" piping
Miscellaneous Gas Piping, Valves, etc.	2	EA	\$ 200	\$ 250		\$ 396	\$ 615	\$ -	\$ 1,011	
4" Class B Vent Piping	15	LF	\$ 6.70	\$ 10		\$ 99	\$ 185	\$ -	\$ 284	Use Common Vents
4" Chimney Cap	1	EA	\$ 11	\$ 10		\$ 11	\$ 12	\$ -	\$ 23	Use Common Vents
Roof Flashing	1	EA	\$ 28	\$ 10		\$ 28	\$ 12	\$ -	\$ 40	Use Common Vents
Miscellaneous electrical	1	LS		\$ 200		\$ -	\$ 246	\$ -	\$ 246	

\$4,349	Subtotal
\$435	10% Contingency
\$478	10% Contractor O&P
\$0	0% Engineering
\$5,262	Total

APPENDIX F

ECM-FH5 Replacement of T12 Fixtures

Milford Township
CHA #22312
Building: Firehouse

ECM 5 - Replacement of T12 Fixtures

Blended Electric Rate \$0.240 /kWh
Demand Rate

Area Description	EXISTING CONDITIONS									RETROFIT CONDITIONS								COST ANALYSIS				
	Number of Fixtures	Fixture Code	Watts per Fixture	Number of Non-Operational Fixtures	Watts per Non-Operational Fixtures	kW/Space	Exist Control	Annual Hours	Annual kWh	Number of Fixtures	Fixture Code	Watts per Fixture	kW/Space	Retrofit Control	Number of Controls	Annual Hours	Annual kWh	kW Saved	Annual kWh Saved	Annual \$ Saved	Retrofit Cost	Simple Payback
Lounge	4	F44EIS	164	0	167.3	0.7	Switch	800	525	4	F44ILL-R	102	0.408	switch	0	800	326.4	0.2	198	\$ 48	\$ 502	10.5
Rec Room	17	F44EIS	164	0	167.3	2.8	Switch	730	2035	17	F44ILL-R	102	1.734	switch	0	730	1265.82	1.1	769	\$ 185	\$ 2,133	11.5
CD Room	4	F82EE	123	0	125.5	0.5	Switch	800	394	4	F82ILL	109	0.436	switch	0	800	348.8	0.1	45	\$ 11	\$ 502	46.6
Main Truck Bay	30	F82EE	123	0	125.5	3.7	Switch	800	2952	30	F82ILL	109	3.27	switch	0	800	2616	0.4	336	\$ 81	\$ 3,764	46.6
Kitchen	4	F44EIS	164	0	167.3	0.7	Switch	800	525	4	F44ILL-R	102	0.408	switch	0	800	326.4	0.2	198	\$ 48	\$ 502	10.5
Main Kitchen	7	F44EIS	164	0	167.3	1.1	Switch	800	918	7	F44ILL-R	102	0.714	switch	0	800	571.2	0.4	347	\$ 83	\$ 878	10.5
Main Hall	55	F44EIS	164	0	167.3	9.0	Switch	800	7216	55	F44ILL-R	102	5.61	switch	0	800	4488	3.4	2728	\$ 655	\$ 6,901	10.5
Meeting Room	8	F44EIS	164	0	167.3	1.3	Switch	800	1050	8	F44ILL-R	102	0.816	switch	0	800	652.8	0.5	397	\$ 95	\$ 1,004	10.5
Main Office	2	F44EIS	164	0	167.3	0.3	Switch	800	262	2	F44ILL-R	102	0.204	switch	0	800	163.2	0.1	99	\$ 24	\$ 251	10.5
Stairs	1	F82EE	123	0	125.5	0.1	Switch	8760	1077	1	F82ILL	109	0.109	switch	0	8760	954.84	0.0	123	\$ 29	\$ 125	4.3
TOTALS -	132			0		20.213			16954	132			13.7				11713.46	6.5	5241	\$ 1,259	\$ 16,563	13.2

APPENDIX G

ECM-FH6 Replace Electric DHW Heater with On-Demand Propane

Milford Township
CHA #22312
Building: Firehouse

ECM 6: Replace Kitchen Electric DHW Heater with On Demand Propane

Summary

* Replace Electric DHW Heater w/ tankless, Condensing, Liquid Propane-Fired DHW Heater

Item	Value	Units	Formula/Comments
Occupied days per week	7	days/wk	
Water supply Temperature	50	°F	Temperature of water coming into building
Hot Water Temperature	120	°F	
Hot Water Usage per day	2.25	gal/day	Calculated from usage below
Annual Hot Water Energy Demand	478	MBTU/yr	Energy required to heat annual quantity of hot water to setpoint
Existing Tank Size	80	Gallons	
Hot Water Temperature	120	°F	Per manufacturer nameplate
Average Room Temperature	65	°F	Per building personnel
Standby Losses (% by Volume)	2.5%		(2.5% of stored capacity per hour, per U.S. Department of Energy)
Standby Losses (Heat Loss)	0.9	MBH	
Annual Standby Hot Water Load	8,000	MBTU/yr	
Total Annual Hot Water Demand (w/ standby losses)	8,508	Mbtu/yr	Building demand plus standby losses
Existing Water Heater Efficiency	88%		Estimated
Total Annual Energy Required	9,888	Mbtu/yr	
Total Annual Electric Required	2,833	kWh/yr	Electrical Savings
Average Annual Electric Demand	0.32	kW	
Peak Electric Demand	4.50	kW	Per Manufacturer's Nameplate (Demand Savings)
New Tank Size	0	Gallons	tankless
Hot Water Temperature	120	°F	
Average Room Temperature	65	°F	
Standby Losses (% by Volume)	2.5%		(2.5% of stored capacity per hour, per U.S. Department of Energy)
Standby Losses (Heat Loss)	0.0	MBH	
Annual Standby Hot Water Load	0	MBTU/yr	
Prop Annual Hot Water Demand (w/ standby losses)	8,78	MBTU/yr	
Proposed Avg. Hot water heater efficiency	94%		Based on Bosch GWH C 920 ESC LP
Proposed Total Annual Energy Required	508	MBTU/yr	
Proposed Fuel Use	6	Gals/year	Standby Losses and inefficient DHW heater eliminated
Elec Utility Demand Unit Cost	\$0.00	\$/kW	
Elec Utility Supply Unit Cost	\$0.24	\$/kWh	
Propane Utility Unit Cost	\$2.80	\$/Gal	
Existing Operating Cost of DHW	\$680	\$/yr	
Proposed Operating Cost of DHW	\$16	\$/yr	
Annual Utility Cost Savings	\$665	\$/yr	

Daily Hot Water Demand				
FIXTURE	*BASE WATER USE GPM (GP USE)	DURATION OF USE (MIN)	Uses/ Month	TOTAL HW GAL/Month
Kitchen Sinks	2.5	10	2	50%
Dishwasher	10	NA	2	100%
Miscellaneous Kitchen Sink Use	2.5	1	10	0.5
			Total	68

Milford Township
CHA #22312
Building: Firehouse

Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1.00

ECM 6: Replace Kitchen Electric DHW Heater with On Demand Propane

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
Condensing Gas Hot Water Heater	1	EA	\$ 2,062	\$ 300		\$ 2,041	\$ 369	\$ -	\$ 2,410.38	Bosch GWH C 920 ESC
Hot Water Heater Removal	1	EA		\$ 150		\$ -	\$ 185	\$ -	\$ 184.50	Liquid Propane
Venting	1	LS	\$ 50	\$ 200		\$ 50	\$ 246	\$ -	\$ 295.50	
Hot Water Piping Modifications	10	LF	\$ 4	\$ 4		\$ 42	\$ 52		\$ 94.35	
Propane Piping to Heater	20	LF	\$ 5	\$ 3		\$ 101	\$ 67		\$ 168.14	
Miscellaneous Piping and Valves	1	LS	\$ 50	\$ 100		\$ 50	\$ 123	\$ -	\$ 172.50	

\$ 3,325.37	Subtotal
\$ 332.54	10% Contingency
\$ 365.79	10% Contractor O&P
\$ -	Engineering
\$ 4,024	Total

APPENDIX H

ECM-SS1 Install Ceiling Insulation

Milford Township
CHA #22312
Building: Sub Station

ECM 1 Install Ceiling Insulation

Existing Roof Area	1,600 sf
Existing U-value	0.23 Btu/hr(s°F)
Existing R-value	4.3
Proposed R-value	15.4 Adding 3" Spray Foam Insulation
Proposed U-value	0.065 Btu/hr(s°F)
Heating System Efficiency	85%
Cooling System Efficiency	91.04%
Heating On Temp	50 F

Existing Cooling Load Temp Diff	73 F
Existing Max Roof Cooling Load	0 Btu/hr
Proposed Cooling Load	Btu/hr
Occupied Cooling Setpoint	103 F
Unoccupied Cooling Setpoint	50 F

Existing Heating	11.5
Design Heating for Allentown, PA	42 F
Existing Heating Load Temp Diff	15,887 Btu/hr
Existing Max. Roof Heating Load	Btu/hr
Proposed Heating Load	Btu/hr
Occupied Heating Setpoint	63 F
Unoccupied Heating Setpoint	50 F

Existing Heating Total	24,939,321 Btu/yr
Proposed Heating Total	15,397,617 Btu/yr
Savings	18,021,705 Btu/yr
Savings	181 Gals. Oil #2

Existing Cooling Total	1,111,132 kWh/yr
Proposed Cooling Total	822,966 kWh/yr
Savings	288,166 kWh/yr

Avg Outdoor Air Temp. Bins °F	Existing Equipment Bin Hours	Occupied			Unoccupied			Existing Cooling Load (kW/hr)	Existing Heating Load (Btu/yr)	Proposed Cooling Load (kW/hr)	Proposed Heating Load (Btu/yr)
		Existing Heat Gain (Btu/hr)	Proposed Heat Gain (Btu/hr)	Existing Heat Loss (Btu/hr)	Proposed Heat Loss (Btu/hr)	Existing Heat Gain (Btu/hr)	Proposed Heat Gain (Btu/hr)				
102.5	0	957	268	-	-	4,785	1,338	-	-	-	-
97.5	3	-	-	-	-	2,871	803	-	-	-	-
92.5	34	-	-	-	-	957	268	-	-	-	-
87.5	131	-	-	-	-	-	-	-	-	-	-
82.5	500	-	-	-	-	-	-	-	-	-	-
77.5	620	-	-	-	-	-	-	-	-	-	-
72.5	684	-	-	-	-	-	-	-	-	-	-
67.5	854	-	-	-	-	-	-	-	-	-	-
62.5	927	-	-	-	-	-	-	-	-	-	-
57.5	600	-	-	-	-	-	-	-	-	-	-
52.5	610	-	-	-	-	-	-	-	-	-	-
47.5	611	-	-	-	-	-	-	-	-	-	-
42.5	656	-	-	-	-	-	-	-	-	-	-
37.5	1,023	-	-	-	-	-	-	-	-	-	-
32.5	734	-	-	-	-	-	-	-	-	-	-
27.5	334	-	-	-	-	-	-	-	-	-	-
22.5	252	-	-	-	-	-	-	-	-	-	-
17.5	125	-	-	-	-	-	-	-	-	-	-
12.5	47	-	-	-	-	-	-	-	-	-	-
7.5	22	-	-	-	-	-	-	-	-	-	-
2.5	13	-	-	-	-	-	-	-	-	-	-
-2.5	0	-	-	-	-	-	-	-	-	-	-
-7.5	0	-	-	-	-	-	-	-	-	-	-
TOTALS	8,760	521	8,239	-	-	-	-	-	25,019,321	-	6,997,617

Max Roof Load Calculation:			
Roof Area		U-Value	0.23
Heating		Heating Delta T °F	42
Return Air Factor		1	15,887
BTUH		15,887	

Milford Township
CHA #22312
Building: Sub Station

ECM 1 Install Ceiling Insulation

Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1.00

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
3" Sprayed On Foam Insulation	1,650	SF	\$ 0.78	\$ 0.41	\$ 0	\$ 1,274	\$ 832	\$ 99	\$ 2,205	3 inches
Miscellaneous Costs	1	LS	\$ -	\$ 250.00	\$ -	\$ -	\$ 308	\$ -	\$ 308	Removing Lights, and other obstructions

\$ 2,513	Subtotal
\$ 251.27	10% Contingency
\$ 276.40	Contractor
\$ -	10% O&P
\$ -	0% Engineering
\$ 3,040	Total

APPENDIX I

ECM-SS2 Replace Furnace with Oil Fired Condensing Furnace

Milford Township
CHA #22312
Building: Sub Station

ECM-2 Replace Furnace with Oil Fired Condensing Furnace

Existing Fuel	#2 Oil	▼
Proposed Fuel	#2 Oil	▼

Item	Value	Units	Formula/Comments
Baseline Fuel Cost	\$ 2.49		
Proposed Fuel Cost	\$ 2.49		
Baseline Fuel Use	643	Gals #2	Based on historical utility data
Existing Boiler Plant Efficiency	68%		Estimated
Baseline Boiler Load	60,626	Mbtu/yr	Baseline Fuel Use x Existing Efficiency x 138.7 Mbtu/Gals #2
Baseline Fuel Cost	\$ 1,602		
Proposed Boiler Plant Efficiency	92%		
Proposed Fuel Use	475	Gals #2	Based on an Adam's Furnace with an AFUE of up to 97%
Proposed Fuel Cost	\$ 1,184		Baseline Boiler Load / Proposed Efficiency / 138.7 Mbtu/Gals #2
Annual Savings	168	Gals #2	
Annual Savings	\$ 418	/yr	

Milford Township
CHA #22312
Building: Sub Station

Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1.00

ECM-2 Replace Furnace with Oil Fired Condensing Furnace

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
Furnace Removal	1	EA		\$ 250		\$ -	\$ 308	\$ -	\$ 308	
125 MBTU Oil Furnace	1	EA	\$ 2,500	\$ 221		\$ 2,475	\$ 272	\$ -	\$ 2,747	Based on Adams Condensing Oil Fired
Miscellaneous Piping /Venting	1	LS	\$ 300	\$ 300		\$ 297	\$ 369	\$ -	\$ 666	
Ductwork Modifications	15	LF	\$ 14	\$ 11		\$ 208	\$ 203	\$ -	\$ 411	Metal Ducting
Miscellaneous Piping /Venting	1	LS	\$ 300	\$ 300		\$ 297	\$ 369	\$ -	\$ 666	

\$ 4,797	Subtotal
\$ 959	20% Contingency
\$ 576	Contractor
\$ -	10% O&P
\$ -	0% Engineering
\$ 6,332	Total

APPENDIX J

ECM-SS3 Increase Wall Insulation

CONDUCTION				
	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.	Room Heat Gain
North Exposure	551	0.19	42	4,431 Btu/h
East Exposure	551	0.19	42	4,431 Btu/h
South Exposure	504	0.19	42	4,053 Btu/h
West Exposure	504	0.19	42	4,053 Btu/h
	Total:			16,970 Btu/h

16,970

Milford Township
CHA #22312
Building: Sub Station

Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1.00

ECM 3 Increase Wall Insulation

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
3" Sprayed On Foam Insulation	1708	SF	\$ 0.78	\$ 0.41	\$ 0	\$ 1,319	\$ 861	\$ 102	\$ 2,283	
Miscellaneous Costs	1	LS	\$ -	\$ 250	\$ -	\$ -	\$ 308	\$ -	\$ 308	

\$ 2,590	Subtotal
\$ 259.02	10% Contingency
\$ 284.93	Contractor
\$ -	10% O&P
\$ 3,134	0% Engineering
\$ 3,134	Total

APPENDIX K

ECM-SS4 Replace Lighting

Milford Township
CHA #22312
Building: Sub Station

ECM 4 - Lighting Replacement

Blended Electric Rate \$ 0.301 /kWh

Area Description	EXISTING CONDITIONS										RETROFIT CONDITIONS								COST ANALYSIS					
	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	Number of Controls	Daily Hours	Annual Hours	Annual kWh	kW Saved	Annual kWh Saved	Annual \$ Saved	Retrofit Cost	Simple Payback
Main Area	12	F42EIS	82	0	83.6	1.0	Switch	2	730	718	12	F42ILL	59	0.708	switch	0	0	730	516.84	0.3	201	\$ 61	\$ 1,506	24.9
Bathroom	1	I60/1	60	0	61.2	0.1	Switch	2	730	44	1	CF13/1	13	0.013	switch	0	0	730	9.49	0.0	34	\$ 10	\$ 18	
TOTALS -	13			0		1.044				762	12			0.7					526.33	0.3	236	\$ 71	\$ 1,524	21.5

APPENDIX L

ECM-SS5 Replace Oil Furnace with Oil Fired Infrared Heaters

Milford Township
CHA #22312
Building: Firehouse

ECM 5: Replace Oil Furnace with Oil Fired Infrared Heaters

Building Footprint	1,600	SF
Oil Heat Content	138,700	Btu/Gal
Oil Heat Content	138,700	Btu/Gal #2
Building Balance Temp.	0	*F
Internal Gains	4,952	btu/h
Unocc Internal Gain factor	0.03	
Ave Occ Internal Gain Factor	0.5	

Ex Occupied Htg Temp.	53	*F
Ex Unoccupied Htg Temp.	53	*F
Occupied Heating UA	807	btu/hr/*F
Unoccupied Heating UA	607	btu/hr/*F

Heating Energy Savings #2 Oil	234	gallons/year
Electric Energy Savings	989	kWh/yr

Existing Burner Efficiency	68.0%	Existing unit heater burner efficiency
Existing Heat Distribution Effectiveness	85.0%	Heat Distribution Factor per ASHRAE Handbook - Fundamentals for Unit Heaters
Proposed Burner Efficiency	87.0%	Based on Infrared Tube Heaters
Proposed Heat Distribution Effectiveness	100%	Heat Distribution Factor per ASHRAE Handbook - Fundamentals for Infrared Heaters

				EXISTING LOADS						PROPOSED LOADS							
				Occupied			Unoccupied			Occupied			Unoccupied			Existing Heating Energy Gallons #2	Proposed Heating Energy Gallons #2
Avg Outdoor Air Temp. Bins *F	Existing Equipment Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH		
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	M	N
102.5	0	0	0	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
97.5	3	2	1	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
92.5	34	8	26	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
87.5	131	30	101	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
82.5	500	37	463	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
77.5	620	40	580	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
72.5	664	51	613	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
67.5	854	55	799	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
62.5	927	36	891	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
57.5	600	36	564	0	0	-2,476	0	0	-149	0	0	-2,476	0	0	-149	0	0
52.5	610	36	574	304	156	-2,476	304	130	-149	304	156	-2,476	304	130	-149	0	0
47.5	611	39	572	3,339	1,717	-2,476	3,339	1,431	-149	3,339	1,717	-2,476	3,339	1,431	-149	34	23
42.5	656	61	595	6,375	3,278	-2,476	6,375	2,732	-149	6,375	3,278	-2,476	6,375	2,732	-149	72	48
37.5	1023	44	979	9,411	4,839	-2,476	9,411	4,033	-149	9,411	4,839	-2,476	9,411	4,033	-149	169	112
32.5	734	20	714	12,447	6,400	-2,476	12,447	5,334	-149	12,447	6,400	-2,476	12,447	5,334	-149	161	107
27.5	334	15	319	15,483	7,961	-2,476	15,483	6,634	-149	15,483	7,961	-2,476	15,483	6,634	-149	91	61
22.5	252	7	245	18,518	9,522	-2,476	18,518	7,935	-149	18,518	9,522	-2,476	18,518	7,935	-149	83	55
17.5	125	3	122	21,554	11,083	-2,476	21,554	9,236	-149	21,554	11,083	-2,476	21,554	9,236	-149	48	32
12.5	47	1	46	24,590	12,644	-2,476	24,590	10,537	-149	24,590	12,644	-2,476	24,590	10,537	-149	21	14
7.5	22	1	21	27,626	14,205	-2,476	27,626	11,838	-149	27,626	14,205	-2,476	27,626	11,838	-149	11	7
2.5	13	0	13	30,661	15,766	-2,476	30,661	13,139	-149	30,661	15,766	-2,476	30,661	13,139	-149	7	5
-2.5	0	0	0	33,697	17,327	-2,476	33,697	14,440	-149	33,697	17,327	-2,476	33,697	14,440	-149	0	0
-7.5	0	0	0	36,733	18,888	-2,476	36,733	15,740	-149	36,733	18,888	-2,476	36,733	15,740	-149	0	0
TOTALS	8760	521	8,239													696	463

Existing Building Ventilation & Infiltration (occ)	241 cfm
Overheat Ventilation Factor	1.20
Additional ventilation to offset overheat	48 cfm
Existing Building Ventilation & Infiltration (unocc)	241 cfm

Electrical Requirements for Heating Equipment

Existing Equipment						
Unit	Htng Hrs	HP	kW	Efficiency	Power Factor	Annual kWh
Furnace	1,857	0.5	0.373	70%	0.8	989
Total						989

Avg. OA Temp °F	Heating Hrs	Assumed % Time of Operation	hrs of Operation
102.5	0	0%	0
97.5	0	0%	0
92.5	0	0%	0
87.5	0	0%	0
82.5	0	0%	0
77.5	0	0%	0
72.5	0	0%	0
67.5	0	0%	0
62.5	0	8%	0
57.5	0	15%	0
52.5	0	23%	0
47.5	611	31%	188
42.5	656	38%	252
37.5	1023	46%	472
32.5	734	54%	395
27.5	334	62%	206
22.5	252	69%	174
17.5	125	77%	96
12.5	47	85%	40
7.5	22	92%	20
2.5	13	100%	13
-2.5	0	100%	0
-7.5	0	100%	0
	3,817	49%	1,857

Milford Township

CHA #22312

Building: Firehouse

ECM 5: Replace Oil Furnace with Oil Fired Infrared Heaters

Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1.00

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
40' #2 Infrared Tube Heater 125MBH	1	EA	\$ 1,900	\$ 325		\$ 1,881	\$ 400	\$ -	\$ 2,281	Based on Omega II #2 Oil Fired Heater
#2 Oil Piping from Tank to IR Heaters	40	LF	\$ 5.10	\$ 2.73		\$ 202	\$ 134	\$ -	\$ 336	2" piping
4" Class B Vent Piping	15	LF	\$ 6.70	\$ 10		\$ 99	\$ 185	\$ -	\$ 284	Use Common Vents
4" Chimney Cap	1	EA	\$ 11	\$ 10		\$ 11	\$ 12	\$ -	\$ 23	Use Common Vents
Roof Flashing	1	EA	\$ 28	\$ 10		\$ 28	\$ 12	\$ -	\$ 40	Use Common Vents
Miscellaneous electrical	1	LS		\$ 200		\$ -	\$ 246	\$ -	\$ 246	

\$3,210	Subtotal
\$321	10% Contingency
\$353	10% Contractor O&P
\$0	0% Engineering
\$3,884	Total

APPENDIX M

New Jersey Pay For Performance Incentive Program

Milford Township
CHA #22312
Building: Firehouse

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 governments or non-profit organizations.

Total Building Area (Square Feet)	6,500
Is this audit funded by the NJ BPU (Y/N)	Yes

Bureau of Public Utilities (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)	\$5,604	\$0
Existing Usage (from utility)	23,333	0
Proposed Savings	9,187	0
Existing Total MMBtus	80	
Proposed Savings MMBtus	31	
% Energy Reduction	39.4%	
Proposed Annual Savings	\$4,726	

Does not Include Water Savings

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

	Incentives \$		
	Elec	Gas	Total
Incentive #1	\$0	\$0	\$325
Incentive #2	\$1,194	\$0	\$1,194
Incentive #3	\$827	\$0	\$827
Total All Incentives	\$2,021	\$0	\$2,346

Total Project Cost	\$53,746	Does not include Water Savings implementation costs
--------------------	----------	---

	Allowable Incentive	
% Incentives #1 of Utility Cost*	5.8%	\$325
% Incentives #2 of Project Cost**	2.2%	\$1,194
% Incentives #3 of Project Cost**	1.5%	\$827
Total Eligible Incentives***	\$2,346	
Project Cost w/ Incentives	\$51,399	

Project Payback (years)	
w/o Incentives	w/ Incentives
11.4	10.9

* 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

Milford Township
CHA #22312
Building: Sub 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 governments or non-profit organizations.
 The incentive values represented below are applicable through December 31, 2010.

Total Building Area (Square Feet)	1,600
Is this audit funded by the NJ BPU (Y/N)	Yes

Bureau of Public Utilities (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	#2 Fuel Oil
Existing Cost (from utility)	\$5,604	\$0	\$1,602.25
Existing Usage (from utility)	1,977	0	643
Proposed Savings	1,191	0	380
Existing Total MMBtus	96		
Proposed Savings MMBtus	57		
% Energy Reduction	59.2%		
Proposed Annual Savings	\$2,036		

Fuel Oil can be used to reach the 15% threshold but there are no incentives available for oil or other gas.

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

	Incentives \$		
	Elec	Gas	Total
Incentive #1	\$0	\$0	\$80
Incentive #2	\$155	\$0	\$155
Incentive #3	\$107	\$0	\$107
Total All Incentives	\$262	\$0	\$342

Total Project Cost	\$17,897	Does not include Water Savings implementation costs
--------------------	----------	---

		Allowable Incentive
% Incentives #1 of Utility Cost*	1.4%	\$80
% Incentives #2 of Project Cost**	0.9%	\$155
% Incentives #3 of Project Cost**	0.6%	\$107
Total Eligible Incentives***		\$342
Project Cost w/ Incentives		\$17,555

Project Payback (years)	
w/o Incentives	w/ Incentives
8.8	8.6

* 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 N

Photovoltaic (PV) Rooftop Solar Power Generation



AC Energy & Cost Savings



Milford Firehouse

Station Identification	
City:	Newark
State:	New_Jersey
Latitude:	40.70° N
Longitude:	74.17° W
Elevation:	9 m
PV System Specifications	
DC Rating:	27.0 kW
DC to AC Derate Factor:	0.770
AC Rating:	20.8 kW
Array Type:	Fixed Tilt
Array Tilt:	40.7°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	24.0 ¢/kWh

Results			
Month	Solar Radiation (kWh/m ² /day)	AC Energy (kWh)	Energy Value (\$)
1	3.36	2235	536.40
2	4.05	2413	579.12
3	4.58	2928	702.72
4	4.84	2861	686.64
5	5.30	3153	756.72
6	5.33	2973	713.52
7	5.27	3003	720.72
8	5.25	2971	713.04
9	5.06	2883	691.92
10	4.46	2715	651.60
11	3.15	1937	464.88
12	2.87	1868	448.32
Year	4.46	31941	7665.84

Output Hourly Performance Data

Output Results as Text

About the Hourly Performance Data

Saving Text from a Browser

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

Please send questions and comments regarding PVWATTS to Webmaster

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**Milford
Firehouse**

Cost of Electricity \$0.240 \$/kWh

Photovoltaic (PV) Rooftop Solar Power Generation-27 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
\$162,000	0.0	31,940	0	\$7,700	0	\$7,700	\$20,250	21.0	6.1

Note: Budgetary cost is based on \$6,000/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) 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



AC Energy & Cost Savings



Milford Sub Station

Station Identification	
City:	Newark
State:	New_Jersey
Latitude:	40.70° N
Longitude:	74.17° W
Elevation:	9 m
PV System Specifications	
DC Rating:	2.0 kW
DC to AC Derate Factor:	0.770
AC Rating:	1.5 kW
Array Type:	Fixed Tilt
Array Tilt:	40.7°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	30.0 ¢/kWh

Results			
Month	Solar Radiation (kWh/m ² /day)	AC Energy (kWh)	Energy Value (\$)
1	3.36	166	49.80
2	4.05	179	53.70
3	4.58	217	65.10
4	4.84	212	63.60
5	5.30	234	70.20
6	5.33	220	66.00
7	5.27	222	66.60
8	5.25	220	66.00
9	5.06	214	64.20
10	4.46	201	60.30
11	3.15	144	43.20
12	2.87	138	41.40
Year	4.46	2366	709.80

Output Hourly Performance Data

Output Results as Text

About the Hourly Performance Data

Saving Text from a Browser

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

Please send questions and comments regarding PVWATTS to Webmaster

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**Milford
Sub Station**

Cost of Electricity \$0.301 \$/kWh

Photovoltaic (PV) Rooftop Solar Power Generation-2 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						
\$14,000	0.0	2,370	0	\$700	\$0	\$1,500	\$1,200	20.0	6.6

Note: Budgetary cost is based on \$7,000/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



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 $\pm 30\%$ for monthly values and $\pm 10\%$ 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.

Please send questions and comments to Webmaster

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APPENDIX O

Solar Thermal Domestic Hot Water Plant


[Home](#)
[What Can I Do?](#)
[Electric Choice](#)
[Home Energy](#)
[FAQs](#)
LEARN
[Fact Sheets](#)
[Lesson Plans](#)
PLAY
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NETWORK
[Organizations](#)
[Businesses](#)
[Events Calendar](#)
BROWSE
[Resources](#)
[Solar](#)
[Wind](#)
[Biomass](#)
[Geothermal](#)
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Interactive Energy Calculators

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

[Carbon Pollution Calculator](#)
[Electric Power Pollution Calculator](#)
[PV System Economics](#)
[Solar Water Heating](#)
[What's a Watt?](#)
RENEWABLE ENERGY
THE INFINITE POWER
OF TEXAS

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	
3 Diameter (feet)	3	58 Water Inlet Temperature (Degrees F)	58
80 Capacity (gallons)	80	70 Ambient Temperature (Degrees F)	70
28.4 Surface Area (calculated - sq ft)	28.4	120 Hot Water Temperature (Degrees F)	120
NaN Effective R-value	NaN	5 Hot Water Usage (Gallons per Day)	5
Energy Use			
106		Heat Delivered in Hot Water (BTU/hr)	
0		Heat loss through insulation (BTU/hr)	

Gas vs. Electric Water Heating		
Gas		Electric
0	Overall Efficiency	0.98
0	Conversion Efficiency	0.98
NaN BTU/hr	Power Into Water Heater	108.2 BTU/hr
Cost		
\$ 0.40 /Therm	Utility Rates	\$ 0.24 /kWh
\$ NaN	Yearly Water Heating Cost	\$ 66.6231
How Does Solar Compare?		
Solar Water Heater Cost: \$ 12182		Percentage Solar: 70
NaN years for gas	Payback Time for Solar System	261.213 years for electric

NJBPU Energy Audits
CHA #22312
Milford
Fire House

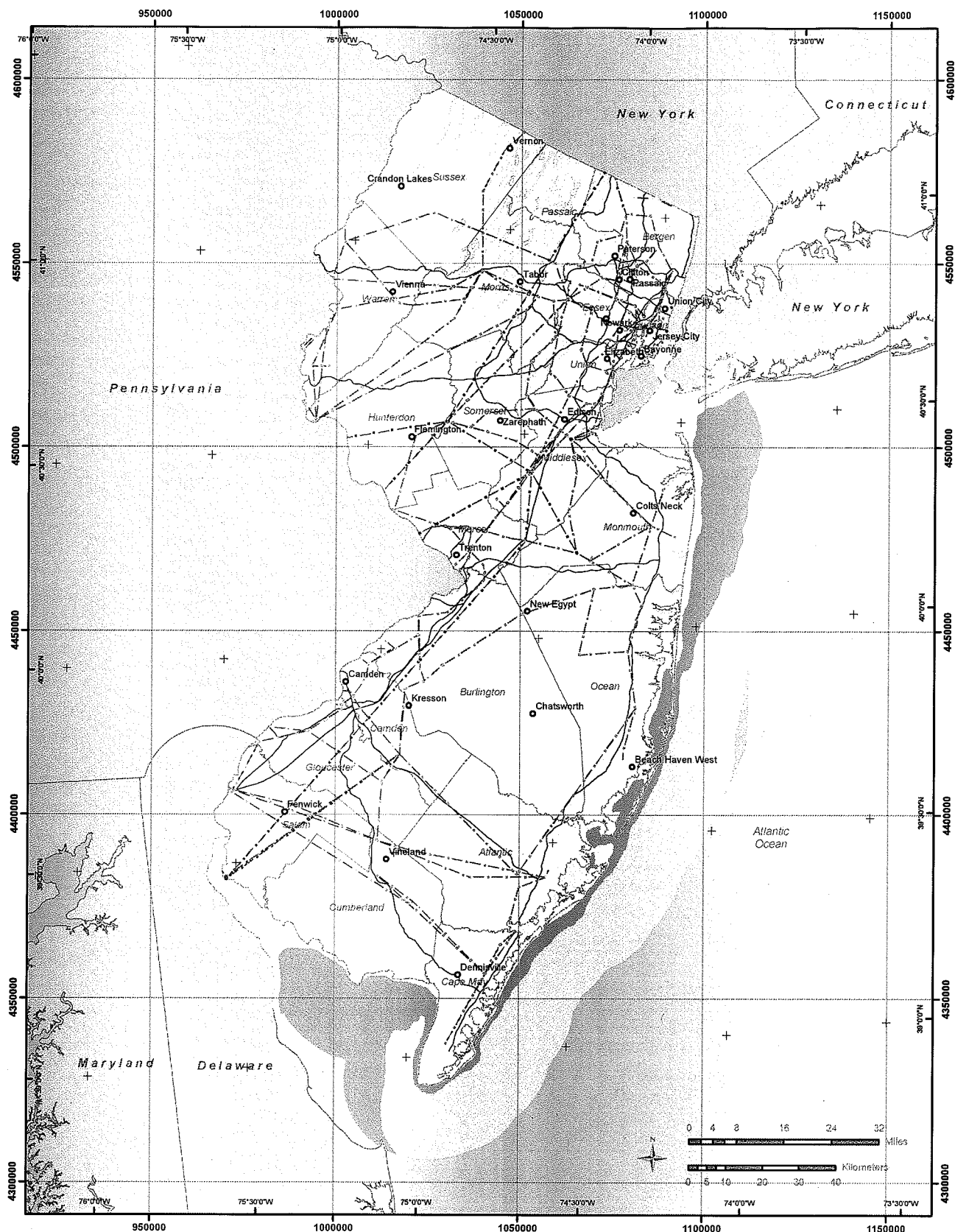
Multipliers	
Material:	0.99
Labor:	1.23
Equipment:	1

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
Synergy Solar Thermal System	1	EA	\$ 2,400	\$ 1,200		\$ 2,376	\$ 1,476	\$ -	\$ 3,852	
Piping modifications	1	LS	\$ 1,500	\$ 2,000		\$ 1,485	\$ 2,460	\$ -	\$ 3,945	
Electrical modifications	1	LS	\$ 400	\$ 500		\$ 396	\$ 615	\$ -	\$ 1,011	
65 Gallon Storage Tank	1	EA	\$ 300	\$ 200		\$ 300	\$ 200	\$ -	\$ 500	
10 Gallon Drip Tank	1	EA	\$ 100	\$ 80		\$ 100	\$ 80	\$ -	\$ 180	
						\$ -	\$ -	\$ -	\$ -	

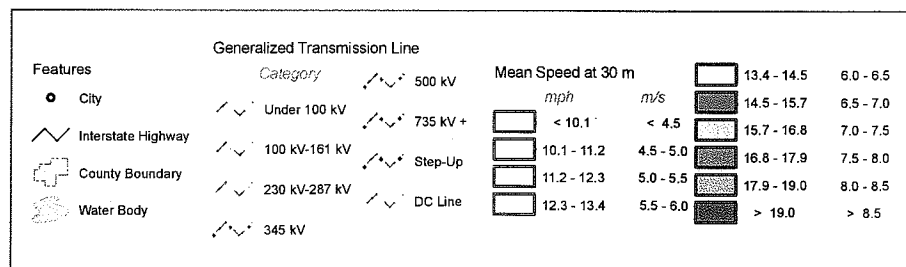
\$ 9,488	Subtotal
\$ 949	10% Contingency
\$ 949	10% Contractor O&P
\$ 949	10% Engineering
\$12,334	Total

APPENDIX P

Wind



Wind Resource of New Jersey *Mean Annual Wind Speed at 30 Meters*



AWS Truewind

Projection: Transverse 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 Q

EPA Portfolio Manager



STATEMENT OF ENERGY PERFORMANCE

Milford Fire Company

Building ID: 2558991

For 12-month Period Ending: September 30, 2010¹

Date SEP becomes ineligible: N/A

Date SEP Generated: January 21, 2011

Facility

Milford Fire Company
21 Water Street
Milford, NJ 08848

Facility Owner

Borough of Milford
P.O. Box 25
Milford, NJ 08848

Primary Contact for this Facility

John Phillips
PO Box 25
Milford, NJ 08848

Year Built: 1930

Gross Floor Area (ft²): 6,500Energy Performance Rating² (1-100) N/A**Site Energy Use Summary³**

Electricity - Grid Purchase(kBtu)	80,122
Fuel Oil (No. 2) (kBtu)	231,474
Propane (kBtu)	23,548
Natural Gas - (kBtu) ⁴	0
Total Energy (kBtu)	335,144

Energy Intensity⁵

Site (kBtu/ft ² /yr)	52
Source (kBtu/ft ² /yr)	81

Emissions (based on site energy use)

Greenhouse Gas Emissions (MtCO ₂ e/year)	31
---	----

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	-48%
Building Type	Fire Station/Police Station

Meets Industry Standards⁶ for Indoor Environmental Conditions:

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

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

Matt Pittinger
16 Main Street West Suite 830
Rochester, NY 14614

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	Milford Fire Company	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	21 Water Street, Milford, NJ 08848	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		☐
Milford Fire House (Other)				
CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☒
Gross Floor Area	6,500 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	16Hours(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: Milford Fire House (kWh (thousand Watt-hours)) Space(s): Entire Facility Generation Method: Grid Purchase		
Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
09/01/2010	09/30/2010	2,129.00
08/01/2010	08/31/2010	2,609.00
07/01/2010	07/31/2010	2,500.00
06/01/2010	06/30/2010	2,550.00
05/01/2010	05/31/2010	1,400.00
04/01/2010	04/30/2010	1,500.00
03/01/2010	03/31/2010	2,000.00
02/01/2010	02/28/2010	1,800.00
01/01/2010	01/31/2010	1,900.00
12/01/2009	12/31/2009	1,600.00
11/01/2009	11/30/2009	1,500.00
Milford Fire House Consumption (kWh (thousand Watt-hours))		21,488.00
Milford Fire House Consumption (kBtu (thousand Btu))		73,317.06
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		73,317.06
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐
Fuel Type: Fuel Oil (No. 2)		
Meter: Milford Fire House Oil (Gallons) Space(s): Milford Fire House		
Start Date	End Date	Energy Use (Gallons)
03/01/2010	09/30/2010	221.00
02/01/2010	02/28/2010	391.00
01/01/2010	01/31/2010	744.00
12/01/2009	12/31/2009	172.00
10/01/2009	11/30/2009	141.00
Milford Fire House Oil Consumption (Gallons)		1,669.00
Milford Fire House Oil Consumption (kBtu (thousand Btu))		231,474.44
Total Fuel Oil (No. 2) Consumption (kBtu (thousand Btu))		231,474.44
Is this the total Fuel Oil (No. 2) consumption at this building including all Fuel Oil (No. 2) meters?		☐
Fuel Type: Propane		

Meter: Milford Fire House Propane (Gallons) Space(s): Entire Facility		
Start Date	End Date	Energy Use (Gallons)
11/01/2009	11/14/2009	109.00
10/01/2009	10/31/2009	50.00
Milford Fire House Propane Consumption (Gallons)		159.00
Milford Fire House Propane Consumption (kBtu (thousand Btu))		14,571.97
Total Propane Consumption (kBtu (thousand Btu))		14,571.97
Is this the total Propane consumption at this building including all Propane 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
Milford Fire Company
21 Water Street
Milford, NJ 08848

Facility Owner
Borough of Milford
P.O. Box 25
Milford, NJ 08848

Primary Contact for this Facility
John Phillips
PO Box 25
Milford, NJ 08848

General Information

Milford Fire Company	
Gross Floor Area Excluding Parking: (ft ²)	6,500
Year Built	1930
For 12-month Evaluation Period Ending Date:	September 30, 2010

Facility Space Use Summary

Milford Fire House	
Space Type	Other - Fire Station/Police Station
Gross Floor Area(ft ²)	6,500
Number of PCs ^o	N/A
Weekly operating hours ^o	16
Workers on Main Shift ^o	N/A

Energy Performance Comparison

Performance Metrics	Evaluation Periods		Comparisons		
	Current (Ending Date 09/30/2010)	Baseline (Ending Date 09/30/2010)	Rating of 75	Target	National Average
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft ²)	52	52	0	N/A	78
Source (kBtu/ft ²)	81	81	0	N/A	157
Energy Cost					
\$/year	\$ 740.97	\$ 740.97	N/A	N/A	\$ 1,120.94
\$/ft ² /year	\$ 0.11	\$ 0.11	N/A	N/A	\$ 0.17
Greenhouse Gas Emissions					
MtCO ₂ e/year	31	31	0	N/A	47
kgCO ₂ e/ft ² /year	5	5	0	N/A	8

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.



STATEMENT OF ENERGY PERFORMANCE

Milford Sub Station

Building ID: 2559118
 For 12-month Period Ending: October 31, 2010¹
 Date SEP becomes ineligible: N/A

Date SEP Generated: January 21, 2011

Facility
 Milford Sub Station
 530 Little York Mt. Pleasant Road
 Milford, NJ 08848

Facility Owner
 Borough of Milford
 P.O. Box 25
 Milford, NJ 08848

Primary Contact for this Facility
 John Phillips
 PO Box 25
 Milford, NJ 08848

Year Built: 1981
Gross Floor Area (ft²): 1,600

Energy Performance Rating² (1-100) N/A

Site Energy Use Summary³

Electricity - Grid Purchase(kBtu)	6,746
Fuel Oil (No. 2) (kBtu)	60,453
Natural Gas - (kBtu) ⁴	0
Total Energy (kBtu)	67,199

Energy Intensity⁵

Site (kBtu/ft ² /yr)	42
Source (kBtu/ft ² /yr)	52

Emissions (based on site energy use)
 Greenhouse Gas Emissions (MtCO₂e/year) 5

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	-67%
Building Type	Fire Station/Police Station

Meets Industry Standards⁶ for Indoor Environmental Conditions:

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

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

Matt Pittinger
 16 Main Street West Suite 830
 Rochester, NY 14614

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	Milford Sub 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	530 Little York Mt. Pleasant Road, Milford, NJ 08848	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		☐
Milford Sub Station (Other)				
CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☒
Gross Floor Area	1,600 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	0(Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	10Hours(Optional)	Is this the total number of hours per week that the space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	5(Optional)	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100.		☐

ENERGY 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))
10/01/2010	10/31/2010	112.00
09/01/2010	09/30/2010	107.00
08/01/2010	08/31/2010	138.00
07/01/2010	07/31/2010	158.00
06/01/2010	06/30/2010	135.00
05/01/2010	05/31/2010	142.00
04/01/2010	04/30/2010	157.00
03/01/2010	03/31/2010	262.00
02/01/2010	02/28/2010	197.00
01/01/2010	01/31/2010	212.00
12/01/2009	12/31/2009	220.00
11/01/2009	11/30/2009	137.00
Electricity Consumption (kWh (thousand Watt-hours))		1,977.00
Electricity Consumption (kBtu (thousand Btu))		6,745.52
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		6,745.52
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐
Fuel Type: Fuel Oil (No. 2)		
Meter: Oil (Gallons) Space(s): Entire Facility		
Start Date	End Date	Energy Use (Gallons)
01/01/2010	01/31/2010	174.00
12/01/2009	12/31/2009	66.00
Oil Consumption (Gallons)		240.00
Oil Consumption (kBtu (thousand Btu))		33,285.72
Total Fuel Oil (No. 2) Consumption (kBtu (thousand Btu))		33,285.72
Is this the total Fuel Oil (No. 2) consumption at this building including all Fuel Oil (No. 2) 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

Milford Sub Station
530 Little York Mt. Pleasant Road
Milford, NJ 08848

Facility Owner

Borough of Milford
P.O. Box 25
Milford, NJ 08848

Primary Contact for this Facility

John Phillips
PO Box 25
Milford, NJ 08848

General Information

Milford Sub Station	
Gross Floor Area Excluding Parking: (ft ²)	1,600
Year Built	1981
For 12-month Evaluation Period Ending Date:	October 31, 2010

Facility Space Use Summary

Milford Sub Station	
Space Type	Other - Fire Station/Police Station
Gross Floor Area(ft ²)	1,600
Number of PCs ^o	0
Weekly operating hours ^o	10
Workers on Main Shift ^o	5

Energy Performance Comparison

Performance Metrics	Evaluation Periods		Comparisons		
	Current (Ending Date 10/31/2010)	Baseline (Ending Date 09/30/2010)	Rating of 75	Target	National Average
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft ²)	42	45	0	N/A	78
Source (kBtu/ft ²)	52	55	0	N/A	157
Energy Cost					
\$/year	N/A	N/A	N/A	N/A	N/A
\$/ft ² /year	N/A	N/A	N/A	N/A	N/A
Greenhouse Gas Emissions					
MtCO ₂ e/year	5	6	0	N/A	9
kgCO ₂ e/ft ² /year	3	4	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 R

Building Summaries and ROI Calculation

Milford Township
CHA #22312

Engineer: Frank Cuttita/Matt Pittinger

Utility Costs	
\$ 0.240	\$/kWh blended
	\$/kWh supply
\$ 2.74	\$/Gal Propane
\$ 12.91	\$/kgals
\$ 2.68	\$/gallon Oil#2

Firehouse																			
	Item	Savings							Cost	Simple Payback	Life Expectancy	Simple Projected Lifetime Savings							ROI
		kW	kWh	Propane (gals)	Oil #2 (gals)	cooling kWh	kgal/yr	\$				kW	kWh	Propane	Oil	cooling kWh	kgal/yr	Savings	
	<u>Mechanical</u>																		
ECM-1	Increase Roof Insulation	0	0	0	211	34	0	\$ 572	\$ 5,270	9.2	24	0	0	0	5,055	823	0	\$ 13,731	1.6
ECM-2	Replace Furnaces	0	0	0	474	0	0	\$ 1,268	\$ 16,014	12.6	18	0	0	0	8,527	-	0	\$ 22,827	0.4
ECM-3	Increase Wall Insulation	0	0	0	90	10	0	\$ 242	\$ 6,614	27.3	24	0	0	0	2,151	236	0	\$ 5,815	-0.1
ECM-4	Replace Boiler with Infrared Heaters in Garage	0	1,114	0	169	0	0	\$ 719	\$ 5,262	7.3	15	0	16,705	0	2,532	-	0	\$ 10,791	1.1
ECM-5	Lighting Replacements	6.5	5,241	0	0	0	0	\$ 1,259	\$ 16,563	13.2	15	98	78,613	0	-	-	0	\$ 18,882	0.1
ECM-6	Replace DHW Heater with Instantaneous Propane	4.5	2,833	(6)	0	0	0	\$ 665	\$ 4,024	6.1	13	59	36,824	-73	-	-	0	\$ 8,645	1.1
Total		11	9,187	(6)	943	44	0	\$ 4,726	\$ 53,746	11.4									

Milford Township
CHA #22312

Engineer: Matt Pittinger

Utility Costs	
\$ 0.301	\$/kWh blended
NA	\$/kWh supply
NA	\$/Gal Propane
NA	\$/kgals
\$ 2.49	\$/gallon Oil#2

Sub Station																			
	Item	Savings							Cost	Simple Payback	Life Expectancy	Simple Projected Lifetime Savings							ROI
		kW	kWh	Propane (gals)	Oil #2 (gals)	cooling kWh	kgal/yr	\$				kW	kWh	Propane	Oil	cooling kWh	kgal/yr	Savings	\$
	<u>Mechanical</u>																		
ECM-1	Increase Roof Insulation	0	0	0	149	0	0	\$ 372	\$ 3,040	8.2	24	0	0	0	3,584	-	0	\$ 8,934	1.9
ECM-2	Replace Furnaces	0	0	0	168	0	0	\$ 418	\$ 6,332	15.1	18	0	0	0	3,018	-	0	\$ 7,524	0.2
ECM-3	Increase Wall Insulation	0	0	0	122	0	0	\$ 305	\$ 3,134	10.3	24	0	0	0	2,937	-	0	\$ 7,321	1.3
ECM-4	Lighting Replacements	0.3	201	0	0	0	0	\$ 61	\$ 1,506	24.9	15	4	3,022	0	-	-	0	\$ 909	-0.4
ECM-5	Replace Furnaces with #2 Oil Infrared Heaters	0	989	0	234	0	0	\$ 880	\$ 3,884	4.4	15	0	14,842	0	3,505	-	0	\$ 13,200	2.4
Total		0	1,191	0	673	0	0	\$ 2,036	\$ 17,897	8.8									

APPENDIX S

Block Load Models

Milford Township
 CHA #22312
 Building: Firehouse

Garage Area Walls Windows and Doors

<u>Doors</u>					
	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet
North				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
	Sub-total			0.0	0.0
East	17.0	10.0	2	340.0	108.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
	Sub-total			340.0	108.0
South	12.0	10.0	1	120.0	44.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
	Sub-total			120.0	44.0
West				0.0	0.0
				0.0	0.0
				0.0	0.0
	Sub-total			0.0	0.0
Total				460.0	152.0
				LF/SF 0.33	

Walls

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet	
North	50.0	12.0	1	600.0	124.0	All wall quantities must remain equal to 1
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	Ave. height
				50.0	600.0	124.0

All wall quantities must remain equal to 1

Ave. height
12.0

Average height wall automatically linked

East	<
------	---

Ave. height
12.0

Average height wall automatically linked

South		50.0	12.0	1	600.0	124.0	
					0.0	0.0	
					0.0	0.0	
					0.0	0.0	
					0.0	0.0	
					0.0	0.0	
		50.0			600.0	124.0	Ave. height 12.0

Ave. height
12.0

Average height wall automatically linked

West		0.0	0.0	Ave. height #DIV/0!
		0.0	0.0	
		0.0	0.0	
		0.0	0.0	
		0.0	0.0	
		0.0	0.0	
0.0		0.0	0.0	

Ave. height
#DIV/0!

Average height auto linked to block load sheet

Windows

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet
North				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
		Sub-total	0.0	0.0	

East		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
Sub-total		0.0	0.0

South		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
Sub-total		0.0	0.0

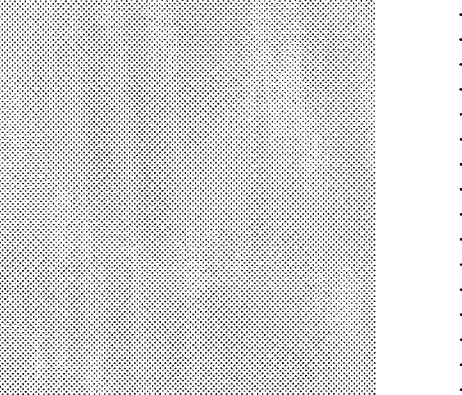
West		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
		0.0	0.0
Sub-total		0.0	0.0

Total

LF/SF
#DIV/0!

Building Volume Calculator

Width(ft)	Length (ft)	Height(ft)	Count	Volume (cf)
105	110	15	1	173,250



Total 173,250 CF

HEAT GAIN/LOSS WORKSHEET

Project Name: Milford Township
 Location: Linwood, NJ
 Building Name: Firehouse
 Engineer: Frank Cuffia/Matt Pittinger

Project No.: CHA #22312
 Site Elevation: 17 Feet
 Date: 12/01/10
 Specific Volume: 14.00 CF/#

Building/Facility Designation: Garage Area of the Firehouse

Outdoor Winter Design DB Temperature	14 *F	Indoor Winter Design DB Temperature	70 *F
Outdoor Summer Design DB Temperature	91 *F	Indoor Summer Design DB Temperature	90 *F
Outdoor Summer Design WB Temperature	73 *F	Indoor Summer Design WB Temperature	60 *F
Outdoor Summer Humidity Ratio	0.0121 ##	Indoor Air (70°F) Humidity Ratio	0.0079 ##

ENVELOPE DESCRIPTIONS (Descriptions are from Interior to Exterior)

Walls (Select One - Type X)	R Value	Wall Type
☐ Steel Siding, 4" Insulation, Steel Siding	15.2	1
☐ Plaster or Gypsum, frame construction, 5" Insulation, 1" stucco	18.2	1
☐ 4" WH CMU, 1" Insulation, Finished Exterior	5.2	2
☐ Plaster or Gypsum, frame construction, 3" Insulation, 8" LW CMU	7.8	5
☐ 4" Face Brick, 2" Concrete, 1" Insulation, Exterior Finish	5.1	12
☐ 4" Face Brick, 4" Concrete, 1" Insulation, Exterior Finish	4.0	11
☐ Interior Finish, 2" Insulation, 8" CMU, 4" Face Brick	10.9	16
☐ Finished Surface, 8" LW CMU (filled), Air Space, 4" Face Brick	11.1	16
☐ Stucco or Gypsum, 2.5" Insul, Face Brick	14.3	10
☐ 4" Block, 1" insulation, 8" Block	19.9	16
☒ U value calculator	13.4	

Roofs (Select One)	R Value	Roof Type
☐ Tectum Deck, 3.3" Insul., BU Roof	13.0	1
☐ Steel Deck, 5" Insul., BU Roof	18.2	1
☐ Attic Roof with 6" Insul.	25.0	4
☐ 4" HW Concrete Deck, BU Roof	2.7	2
☒ Ceiling, 3" Insulation, 4" Concrete Deck, BU Roof	14.9	4
☐ Ceiling, 4" Concrete Deck, 3" Insulation, BU Roof	18.5	13
☐ Ceiling, 4" Concrete Deck, 6" Insulation, BU Roof	21.7	14
☐ Ceiling, Wood Deck, 6" Insulation, Felt & Membrane	22.7	10
☐ Wood Deck, 6" insulation, Felt & Membrane	18.0	
☐ U value calculator	15.2	

Windows (Select One)	U Value
☒ Aluminum Frame, 1/8" SP Glazing	1.05
☐ Aluminum Frame, 1/4" DP Glazing	0.60
☐ Aluminum Frame, 3/16" DP Glazing	0.62
☐ Aluminum Frame, 1/2" DP Glazing	0.50
☐ Skylights	0.90
☐ Other	1.05

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

BUILDING CHARACTERISTICS

Roof Area: 2,500 SF
 Occupied Area: 2,500 SF
 Return Plenum?: n

	Gross Wall Length	Average Wall Height	Ceiling Height	Window Area	Door Area	Net Wall Area
North Exposure	60 Ft	12.0 Ft	10.0 Ft	0 SF	0 SF	600 SF
East Exposure	50 Ft	12.0 Ft	10.0 Ft	0 SF	340 SF	260 SF
South Exposure	50 Ft	12.0 Ft	10.0 Ft	0 SF	120 SF	480 SF
West Exposure	0 Ft	12.0 Ft	10.0 Ft	0 SF	0 SF	0 SF
Occupied Forced Ventilation	0 cfm	0.0 AC/hr				
Unoccupied Forced Ventilation	0 cfm	0.0 AC/hr				

HEAT GAIN/LOSS WORKSHEET

Project Name: Milford Township
 Location: Linwood, NJ
 Building Name: Firehouse
 Engineer: Frank Cuttita/Matt Pittinger

Project No.: CHA #22312
 Site Elevation: 17 Feet
 Date: 12/01/10

Specific Volume 14.00 CF/#

Building/Facility Designation: Garage Area of the Firehouse

COOLING HEAT GAINS TO THE ROOM - SENSIBLE

SOLAR GAINS

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

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain
North Exposure	500	0.07	20 °F	1.0	746 Btu/hr
East Exposure	160	0.07	39 °F	1.0	466 Btu/hr
South Exposure	380	0.07	27 °F	1.0	766 Btu/hr
West Exposure	0	0.07	22 °F	1.0	0 Btu/hr
Roof	5,300	0.0670	73 °F	1.0	25,922 Btu/hr
Fenestration	0	1.05	1 °F		0 Btu/hr
Doors	460	0.14	27 °F		1,735 Btu/hr
Ceiling	2,500	0.14	0 °F		0 Btu/hr
Partition		0.05	0 °F		0 Btu/hr
Floor	2,500	0.04	0 °F		0 Btu/hr
					29,635 Btu/h

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

Lights	1.00 w/sf x	2,500 Occ Area =	2.5 kW x 3.4x	1.0 RAF =	8,533 Btu/h
Plug Load	0.20 w/sf x	2,500 Occ Area =	0.5 kW x 3.4x	1.0 RAF =	1,707 Btu/h
People	5 people x	255 btu/person x	100% time in space =		1,275 Btu/h
Computer Work Stations		1 Units x	120 W/Unit x	3414 =	410 Btu/h
Equipment	2.0 kW x 3.413 =				6,826 Btu/h
Misc.					0 Btu/h
					18,750 Btu/h

VENTILATION AND INFILTRATION

		Infiltration Factor	Perimeter Ratio	Coef	Temp. Diff.	Room Heat Gain
Walls	1,040 SF	0.15 CFM/SF		1.04	1 °F	176 Btu/h
Doors	460 SF	0.25 CFM/LF	0.33 LF/SF	1.04	1 °F	43 Btu/h
Windows	0 SF	0.35 CFM/LF	0.00 LF/SF	1.04	1 °F	0 Btu/h
Ventilation	0 cfm			1.04	1 °F	0 Btu/h
						219 Btu/h
Infiltration	194 cfm	0.1 AC/hr				

COOLING HEAT GAINS TO THE RA PLENUM - SENSIBLE

4,950

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain	1
North Exposure	100	0.07	20	1.0	149 Btu/hr	
East Exposure	100	0.07	39	1.0	291 Btu/hr	
South Exposure	100	0.07	27	1.0	201 Btu/hr	
West Exposure	0	0.07	22	1.0	0 Btu/hr	
Roof	5,300	0.07	73	0.0	0 Btu/hr	
						642 Btu/h

INTERNAL HEAT GAINS

Lights	1.00 wsf x	2,500 Occ Area =	2.5 kW x3413x	0.00 RAF =	0 Btu/h
Misc.					0 Btu/h
					0 Btu/h

SENSIBLE HEAT GAINS - TEMP. DEPENDENT

Solar	0
Conduction to Room	29,635
Conduction to Plenum	642
Ventilation and Infiltration	219
Sub Total	30,495

SENSIBLE HEAT GAINS - TEMP. INDEPENDENT

Internal Gains to Room	18,750
Internal Gains to Plenum	0
Sub Total	18,750

HEAT GAIN/LOSS WORKSHEET

Project Name: Milford Township
 Location: Linwood, NJ
 Building Name: Firehouse
 Engineer: Frank Cuffita/Matt Pittinger

Project No.: CHA #22312
 Site Elevation: 17 Feet
 Date: 12/01/10

Specific Volume: 14.00 CF/#

Building/Facility Designation: Garage Area of the Firehouse

LATENT COOLING LOADS

Infiltration

		Infiltration Factor	Air Density	Humidity Ratio Dif.
Walls	5,600 SF	0.15 CFM/SF	4.629	0.0042 ##
Doors	480 SF	0.25 CFM/LF	4.629	0.0042 ##
Windows	0 SF	0.35 CFM/LF	4.629	0.0042 ##
Ventilation	0 cfm		4.629	0.0042 ##
People	5 people	1.00 time in space		250 Btu/hr/person

Room Heat Gain
16,496 Btu/h
746 Btu/h
0 Btu/h
0 Btu/h
1,250 Btu/h

18,492 Btu/h

Cooling Load Summary

	Sensible	Latent	Total
Temperature Dependent Gains	30,495	18,492	48,988
Temperature Indep. Gains	18,750	0	18,750
Total	49,245	18,492	67,737

SHR= 0.73

Building Cooling Load: 5.6 Tons at 443 SF/Ton

Building Air Flow to Condition Space based on a 12°F Temp Rise is

3,880 CFM
1.55 CFM/sf

HEATING CALCULATION

CONDUCTION

	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.
North Exposure	1,060	0.07	56
East Exposure	260	0.07	56
South Exposure	480	0.07	56
West Exposure	0	0.07	56
Fenestration	0	1.05	56
Roof	5,300	0.0670	56
Doors	460	0.14	56
Ceiling	2,500	0.14	5
Partition	0	0.05	0
Floor	2,500	0.04	0

Room Heat Gain

4,430 Btu/h
1,087 Btu/h
2,006 Btu/h
0 Btu/h
0 Btu/h
19,886 Btu/h
3,598 Btu/h
1,736 Btu/h
0 Btu/h
0 Btu/h

Ventilation and Infiltration

		Infiltration Factor	Coef	Temp. Difference
Walls	1,800 SF	0.15 CFM/SF	1.04	56
Doors	460 SF	0.25 CFM/LF	1.04	56
Windows	0 SF	0.35 CFM/LF	1.04	56
Ventilation Load	0 cfm		1.04	56

Air Flow

270 cfm
38 cfm
0 cfm
0 cfm

Room Heat Gain

15,782 Btu/h
2,221 Btu/h
0 Btu/h
0 Btu/h
18,004 Btu/h

Total Ventilation & Infiltration Load

308 cfm

Building Heating Load: 50,745 btu/h
 20.3 btu/sf

Milford Township
CHA #22312
Building: Firehouse

Reconcile Thermal Model

Building Footprint	2,610 SF	Ex Occupied Cng Temp.	90 °F	Ex Occupied Htg Temp.	70 °F
Heating Efficiency	70%	Ex Unoccupied Cng Temp.	78 °F	Ex Unoccupied Htg Temp.	55 °F
Cooling Efficiency	61.3 kW/ton	Unoccupied Cooling UA	-30276 btu/hr°F	Occupied Heating UA	585 btu/hr°F
Internal Gains	187.53 btu/h	Cooling Occ Enthalpy Setpoint	-30276 btu/hr°F	Unoccupied Heating UA	585 btu/hr°F
Unoc Internal Gain factor	0.3	Cooling Unocc Enthalpy Setpoint	27.5 Btu/lb		
Ave Occ Internal Gain Factor	0.6				
Economizer available (Y/N)	No				
Heat Distribution Effectiveness	85%				

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

Avg Outdoor Air Temp. Bins °F	A	Avg Outdoor Air Enthalpy	Total Bin Hours	B	Occupied		Unoccupied		EXISTING LOADS						Existing Heating Energy therms	M		
					Hours	C	Hours	D	Occupied		Unoccupied		Unoccupied				Unoccupied	
									Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH			Envelope Load BTUH	Ventilation Load BTUH
102.5		49.1	0	0	0	0	0	-378,454	-31,434	-11,250	-741,770	-29,938	-5,625	0				
97.5		42.5	3	0	0	0	0	-227,073	-21,830	-11,250	-590,389	-20,790	-5,625	0				
92.5		39.5	34	3	31	3	119	-75,691	-17,464	-11,250	-439,007	-16,632	-5,625	0				
87.5		36.6	131	12	48	48	452	0	0	-11,250	-287,625	-12,613	-5,625	0				
82.5		34.0	500	620	59	601	684	0	0	-11,250	-136,244	-9,009	-5,625	0				
77.5		31.6	620	684	63	81	773	0	0	-11,250	0	0	-5,625	0				
72.5		29.2	684	854	63	81	773	0	0	-11,250	0	0	-5,625	0				
67.5		27.0	854	927	88	57	543	1,462	873	-11,250	0	0	-5,625	0				
62.5		24.5	927	610	58	57	543	4,385	2,620	-11,250	0	0	-5,625	0				
57.5		21.4	610	611	58	58	552	7,308	4,366	-11,250	0	0	-5,625	0				
52.5		18.7	611	656	62	62	926	10,232	6,112	-11,250	1,462	832	-5,625	-37				
47.5		16.2	656	1,023	70	70	664	13,155	7,859	-11,250	4,385	2,495	-5,625	-19				
42.5		14.4	1,023	734	32	32	302	16,079	9,605	-11,250	7,308	4,158	-5,625	15				
37.5		12.6	734	334	24	24	228	19,002	11,351	-11,250	10,232	5,821	-5,625	53				
32.5		10.7	334	252	125	125	113	21,925	13,098	-11,250	13,155	7,484	-5,625	141				
27.5		8.6	252	125	47	47	43	24,849	14,844	-11,250	16,079	9,148	-5,625	83				
22.5		6.8	125	47	22	22	20	27,772	16,590	-11,250	19,002	10,811	-5,625	76				
17.5		5.5	47	22	13	13	12	30,895	18,337	-11,250	21,925	12,474	-5,625	45				
12.5		4.1	22	13	0	0	0	33,619	20,083	-11,250	24,849	14,137	-5,625	19				
7.5		2.6	13	0	0	0	0	36,542	21,830	-11,250	27,772	15,800	-5,625	10				
2.5		1.0	0	0	0	0	0	39,466	23,576	-11,250	30,695	17,464	-5,625	7				
-2.5		0.0	0	0	0	0	0	42,389	25,322	-11,250	33,619	19,127	-5,625	0				
-7.5		-1.5	0	0	0	0	0	45,312	27,069	-11,250	36,542	20,790	-5,625	0				
TOTALS			8,760	834	7,926									534				

Existing Building Ventilation & Infiltration (occ)

Overheat Ventilation Factor

Additional ventilation to offset overheat

Existing Building Ventilation & Infiltration (unocc)

Economizer Ventilation (from AHU's)

Energy Use Indices (calculated)

Base Case	534
Heating	1,669
Target ->	32.0%

308 cfm

1.05

15 cfm

308 cfm

Milford Township
CHA #22312
Building: Sub Station

<u>Doors</u>					
	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet
North	3.0	7.0	1	21.0	20.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
Sub-total				21.0	20.0
East	0.0	0.0	0	0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
Sub-total				0.0	0.0
South	3.0	7.0	1	21.0	20.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
Sub-total				21.0	20.0
West	10.0	12.0	3	360.0	132.0
				0.0	0.0
				0.0	0.0
Sub-total				360.0	132.0
Total				402.0	172.0
				LF/SF	0.43

Walls

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet	
North	38.0	14.0	1	532.0	104.0	All wall quantities must remain equal to 1
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
	38.0			532.0	104.0	Average height wall automatically linked
					Ave. height 14.0	

East	42.0	12.0	1	504.0	108.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
	42.0			504.0	108.0	Average height wall automatically linked
					Ave. height 12.0	

South	38.0	14.0	1	532.0	104.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
	38.0			532.0	104.0	Average height wall automatically linked
					Ave. height 14.0	

West	42.0	12.0	1	504.0	108.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
	42.0			504.0	108.0	Average height auto linked to block load sheet
					Ave. height 12.0	

Windows

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet
North				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	0.0	0.0

East				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	0.0	0.0

South				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	0.0	0.0

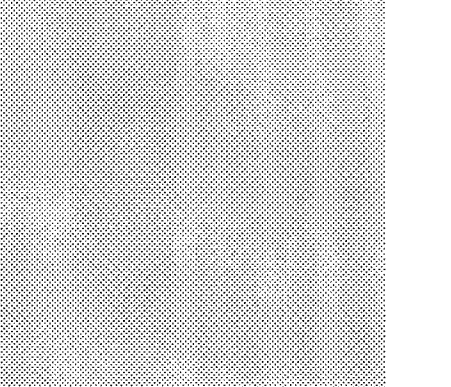
West				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	0.0	0.0

Total 0.0 0.0

LF/SF #DIV/0!

Building Volume Calculator

Width(ft)	Length (ft)	Height(ft)	Count	Volume (cf)
105	110	15	1	173,250



Total

173,250 CF

HEAT GAIN/LOSS WORKSHEET

Project Name: Milford Township
 Location: Linwood, NJ
 Building Name: Sub Station
 Engineer: Matt Pittinger

Project No.: CHA #22312
 Site Elevation: 17 Feet
 Date: 12/01/10

Specific Volume: 14.00 CF/#

Building/Facility Designation: _____

Outdoor Winter Design DB Temperature: 14°F
 Outdoor Summer Design DB Temperature: 91°F
 Outdoor Summer Design WB Temperature: 73°F
 Outdoor Summer Humidity Ratio: 0.0121 ##

Indoor Winter Design DB Temperature: 55°F
 Indoor Summer Design DB Temperature: 72°F
 Indoor Summer Design WB Temperature: 60°F
 Indoor Air (70°F) Humidity Ratio: 0.0079 ##

ENVELOPE DESCRIPTIONS (Descriptions are from Interior to Exterior)

Walls (Select One - Type X)

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

Roofs (Select One)

	R Value	Roof Type
Tectum Deck, 3.3" Insul., BU Roof	13.0	1
Steel Deck, 5" Insul., BU Roof	18.2	1
Attic Roof with 8" Insul.	25.0	4
4" HW Concrete Deck, BU Roof	2.7	2
Ceiling, 3" Insulation, 4" Concrete Deck, BU Roof	14.9	4
Ceiling, 4" Concrete Deck, 3" Insulation, BU Roof	18.5	13
Ceiling, 4" Concrete Deck, 6" Insulation, BU Roof	21.7	14
Ceiling, Wood Deck, 6" Insulation, Felt & Membrane	22.7	10
Wood Deck, 6" Insulation, Felt & Membrane	18.0	
x U value calculator	4.3	

Windows (Select One)

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

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

BUILDING CHARACTERISTICS

Roof Area: 1,650 SF
 Occupied Area: 1,600 SF

Return Plenum? n

	Gross Wall Length	Average Wall Height	Ceiling Height	Window Area	Door Area	Net Wall Area
North Exposure	38 Ft	14.0 Ft	15.0 Ft	0 SF	21 SF	511 SF
East Exposure	42 Ft	12.0 Ft	15.0 Ft	0 SF	0 SF	504 SF
South Exposure	38 Ft	14.0 Ft	15.0 Ft	0 SF	21 SF	511 SF
West Exposure	42 Ft	12.0 Ft	15.0 Ft	0 SF	360 SF	144 SF
Occupied Forced Ventilation	0 cfm	0.0 AC/hr				
Unoccupied Forced Ventilation	0 cfm	0.0 AC/hr				

HEAT GAIN/LOSS WORKSHEET

Project Name: Milford Township
 Location: Linwood, NJ
 Building Name: Sub Station
 Engineer: Matt Pittinger

Project No.: CHA #22312
 Site Elevation: 17 Feet
 Date: 12/01/10

Specific Volume 14.00 CF/#

Building/Facility Designation

COOLING HEAT GAINS TO THE ROOM - SENSIBLE

SOLAR GAINS

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

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain
North Exposure	549	0.19	20 °F	1.0	2,128 Btu/hr
East Exposure	630	0.19	39 °F	1.0	4,762 Btu/hr
South Exposure	549	0.19	27 °F	1.0	2,873 Btu/hr
West Exposure	270	0.19	22 °F	1.0	1,151 Btu/hr
Roof	5,300	0.2320	73 °F	1.0	89,768 Btu/hr
Fenestration	0	1.05	19 °F		0 Btu/hr
Doors	402	0.14	27 °F		1,516 Btu/hr
Ceiling	1,600	0.14	0 °F		0 Btu/hr
Partition		0.05	0 °F		0 Btu/hr
Floor	1,600	0.04	0 °F		0 Btu/hr
					102,197 Btu/h

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

Lights	0.62 w/sf x	1,600 Occ Area =	1.0 kW x 3.4x	1.0 RAF =	3,386 Btu/h
Plug Load	0.10 w/sf x	1,600 Occ Area =	0.2 kW x 3.4x	1.0 RAF =	546 Btu/h
People	5 people x	255 btu/person x	80% time in space =		1,020 Btu/h
Computer Work Stations		0 Units x	120 W/Unit x	3414 =	0 Btu/h
Equipment	0.0 kW x 3.413 =				0 Btu/h
Misc.					0 Btu/h
					4,952 Btu/h

VENTILATION AND INFILTRATION

		Infiltration Factor	Perimeter Ratio	Coef	Temp. Diff.	Room Heat Gain
Walls	1,998 SF	0.17 CFM/SF		1.04	19 °F	7,275 Btu/h
Doors	402 SF	0.35 CFM/LF	0.43 LF/SF	1.04	19 °F	1,289 Btu/h
Windows	0 SF	0.35 CFM/LF	0.00 LF/SF	1.04	19 °F	0 Btu/h
Ventilation	0 cfm			1.04	19 °F	0 Btu/h
						8,565 Btu/h
Infiltration	400 cfm	0.1 AC/hr				

COOLING HEAT GAINS TO THE RA PLENUM - SENSIBLE

4,950

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain	1
North Exposure	-38	0.19	20	1.0	-147 Btu/hr	
East Exposure	-126	0.19	39	1.0	-952 Btu/hr	
South Exposure	-38	0.19	27	1.0	-199 Btu/hr	
West Exposure	-126	0.19	22	1.0	-537 Btu/hr	
Roof	5,300	0.23	73	0.0	0 Btu/hr	
						-1,836 Btu/h

INTERNAL HEAT GAINS

Lights	0.62 w/sf x	1,600 Occ Area =	1.0 kW x3413x	0.00 RAF =	0 Btu/h
Misc.					0 Btu/h
					0 Btu/h

SENSIBLE HEAT GAINS - TEMP. DEPENDENT

Solar	0
Conduction to Room	102,197
Conduction to Plenum	-1,836
Ventilation and Infiltration	8,565
Sub Total	108,926

SENSIBLE HEAT GAINS - TEMP. INDEPENDENT

Internal Gains to Room	4,952
Internal Gains to Plenum	0
Sub Total	4,952

HEAT GAIN/LOSS WORKSHEET

Project Name: Milford Township
 Location: Linwood, NJ
 Building Name: Sub Station
 Engineer: Matt Pittinger

Project No.: CHA #22312
 Site Elevation: 17 Feet
 Date: 12/01/10

Specific Volume 14.00 CF/#

Building/Facility Designation

LATENT COOLING LOADS

Infiltration

		Infiltration Factor	Air Density	Humidity Ratio Dif.
Walls	4,972 SF	0.17 CFM/SF	4.629	0.0042 ##
Doors	402 SF	0.35 CFM/LF	4.629	0.0042 ##
Windows	0 SF	0.35 CFM/LF	4.629	0.0042 ##
Ventilation	0 cfm		4.629	0.0042 ##
People	5 people	0.80 time in space		250 Btu/hr/person

Room Heat Gain
16,599 Btu/h
1,182 Btu/h
0 Btu/h
0 Btu/h
1,000 Btu/h

18,781 Btu/h

Cooling Load Summary

	Sensible	Latent	Total
Temperature Dependent Gains	108,926	18,781	127,708
Temperature Indep. Gains	4,952	0	4,952
Total	113,878	18,781	132,659

SHR= 0.86

Building Cooling Load 11.1 Tons at 145 SF/Ton

Building Air Flow to Condition Space based on a 12°F Temp Rise is

9,238 CFM
 5.77 CFM/sf

HEATING CALCULATION

CONDUCTION

	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.
North Exposure	1,060	0.19	41
East Exposure	504	0.19	41
South Exposure	511	0.19	41
West Exposure	144	0.19	41
Fenestration	0	1.05	41
Roof	5,300	0.2320	41
Doors	402	0.14	41
Ceiling	1,600	0.14	5
Partition	0	0.05	0
Floor	1,650	0.04	0

Room Heat Gain

8,422 Btu/h
4,005 Btu/h
4,060 Btu/h
1,144 Btu/h
0 Btu/h
50,418 Btu/h
2,302 Btu/h
1,111 Btu/h
0 Btu/h
0 Btu/h

Ventilation and Infiltration

		Infiltration Factor	Coef	Temp. Difference
Walls	2,219 SF	0.17 CFM/SF	1.04	41
Doors	402 SF	0.35 CFM/LF	1.04	41
Windows	0 SF	0.35 CFM/LF	1.04	41
Ventilation Load	0 cfm		1.04	41

Air Flow

377 cfm
 60 cfm
 0 cfm
 0 cfm

Room Heat Gain

16,144 Btu/h
2,576 Btu/h
0 Btu/h
0 Btu/h
18,720 Btu/h

Total Ventilation & Infiltration Load

437 cfm

Building Heating Load 90,183 btu/h

56.4 btu/sf

**Milford Township
CHA #22312
Building: Sub Station**

Reconcile Thermal Model

Building Footprint	1600 SF	Ex Occupied Chg Temp.	53 °F
Heating Efficiency	88%	Ex Unoccupied Chg Temp.	53 °F
Cooling Efficiency	83% kW/hon	Ex Occupied Htg Temp.	607 btu/h°F
Internal Gains	0.03	Ex Unoccupied Htg Temp.	607 btu/h°F
Unoc Internal Gain Factor	0.032 btu/h	Occupied Cooling UA	-41444 btu/h°F
Ave Occ Internal Gain Factor	0.5	Unoccupied Cooling UA	-41444 btu/h°F
Economizer available (YN)	No	Cooling Occ Embdry Suboint	27.5 Btu/h
Heat Distribution Effectiveness	85%	Cooling Unocc Embdry Suboint	27.5 Btu/h

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

Avg Outdoor Air Temp. Bins °F	A	Avg Outdoor Air Enthalpy	Total Bin Hours	B	Occupied			Unoccupied			Existing Heating Energy therms	M		
					Equipment Bin Hours	C	Unoccupied Bin Hours	D	Occupied				Unoccupied	
									Envelope Load BTUH	Ventilation Load BTUH			Internal Gain BTUH	Envelope Load BTUH
102.5		49.1		0	0	0	0	0	-2,476	0	0	-149	0	
97.5		42.5		3	2	0	0	0	-2,476	0	0	-149	0	
92.5		39.5		34	8	26	0	0	-2,476	0	0	-149	0	
87.5		36.6		131	30	101	0	0	-2,476	0	0	-149	0	
82.5		34.0		500	37	463	0	0	-2,476	0	0	-149	0	
77.5		31.6		620	40	580	0	0	-2,476	0	0	-149	0	
72.5		29.2		664	51	613	0	0	-2,476	0	0	-149	0	
67.5		27.0		854	55	799	0	0	-2,476	0	0	-149	0	
62.5		24.5		927	36	891	0	0	-2,476	0	0	-149	0	
57.5		21.4		600	36	564	0	0	-2,476	0	0	-149	0	
52.5		18.7		610	38	574	304	156	-2,476	304	130	-149	0	
47.5		16.2		611	39	572	3,339	1,717	-2,476	3,339	1,431	-149	34	
42.5		14.4		656	61	595	6,375	3,278	-2,476	6,375	2,732	-149	72	
37.5		12.6		1,023	44	979	9,411	4,839	-2,476	9,411	4,033	-149	169	
32.5		10.7		734	20	714	12,447	6,400	-2,476	12,447	5,334	-149	161	
27.5		8.6		334	15	319	15,483	7,961	-2,476	15,483	6,634	-149	91	
22.5		6.8		252	7	245	18,518	9,522	-2,476	18,518	7,935	-149	83	
17.5		5.5		125	3	122	21,554	11,083	-2,476	21,554	9,236	-149	48	
12.5		4.1		47	1	41	24,590	12,644	-2,476	24,590	10,537	-149	21	
7.5		2.6		22	1	21	27,626	14,205	-2,476	27,626	11,838	-149	11	
2.5		1.0		13	0	13	30,661	15,766	-2,476	30,661	13,139	-149	7	
-2.5		0.0		0	0	0	33,697	17,327	-2,476	33,697	14,440	-149	0	
-7.5		-1.5		0	0	0	36,733	18,888	-2,476	36,733	15,740	-149	0	
TOTALS				8,760	521	8,219							696	

Existing Building Ventilation & Infiltration (occ)

Overheat Ventilation Factor

Additional Ventilation to offset overheat

Existing Building Ventilation & Infiltration (unocc)

Economizer Ventilation (from AHU's)

Energy Use Indices (calculated)

Base Case	696
Heating Target ->	643
	108.3%

241 cfm

1.20

48 cfm

241 cfm

APPENDIX T

Equipment Inventory and Lighting

Milford Township
CHA #22312
Building: Firehouse

Description	Qty	Manufacturer Name	Model No.	Serial Number	Equipment Type	Capacity/Size	Operation Hours	Areas Served	Estimated Efficiency	Approximate Age	Useable Life Expectancy (Years)
DHW Heater	1	Bradford White	M28OR6DS5	BEG294794	Electric	80 Gallon, 4.5 kW	As Needed	Kitchen	98%	5	19
DHW Heater	1	Bradford White	M250056DS	FF12083170	Electric	50 Gallon, 4.5 kW	As Needed	Restrooms, Kitchen Sinks	98%	5	19
DHW Heater	1	Bradford White	NA	NA	Electric	5 gallon, 1.5 kW	Point of Use	Sink in Hall	98%	>10	19
AC System	1	Trane	TTP060D100A0	P216V311	DX	5 tons	Summer Occupied Hours	Engine Room	NA	11	15
AC System	1	Trane	TTP060D100A0	N341MM71F	DX	5 tons	Summer Occupied Hours	Bar	NA	12	15
AC System	1	Trane	TTP060D100A0	P045NGC1F	DX	5 tons	Summer Occupied Hours	Main Hall	NA	5	15
AC System	1	Trane	TTP060D100A0	N331RP61F	DX	5 tons	Summer Occupied Hours	Main Hall	NA	5	15
Emergency Generator	1	Guardian Elite	NA	NA	Propane Fired	NA	When Power is out	Whole Building	NA	10	15
Propane Heater	1	Glo-warm	NA	NA	NA	NA	Heating Season		NA	5	13
Furnace	1	Williamson	T167-12-1	NA	#2 Oil	~125 MBTU	Heating Season	Main Hall	70%	>25	18
Furnace	1	Williamson	T167-12-1	NA	#2 Oil	~125 MBTU	Heating Season	Main Hall/Garage Bay	70%	>25	18
Furnace	1	Metzger	WHBU-12A	981014011	#2 Oil	140 MBTU	Heating Season	Bar Area	70%	>25	18

Milford Township
CHA #22312
Building: Sub Station

Description	Qty	Manufacturer Name	Model No.	Serial Number	Equipment Type	Capacity/Size	Operation Hours	Areas Served	Estimated Efficiency	Approximate Age	Useable Life Expectancy (years)
DHW Heater	1	International	NA	NA	Electric	5 gallon	As Needed	Bathroom	98%	5	13
Furnace	1	International Heater	NA	NA	#2 Oil				68%	>25	18

Milford Township
CHA #22312
Building: Firehouse

Existing Lighting

Blended Electric Rate
Demand Rate

\$0.240 /kWh

Area Description	EXISTING CONDITIONS								
	Number of Fixtures	Fixture Code	Watts per Fixture	Number of Non-Operational Fixtures	Watts per Non-Operational Fixtures	kW/Space	Exist Control	Annual Hours	Annual kWh
Lounge	4	F44EIS	164	0	167.3	0.7	Switch	800	525
Rec Room	17	F44EIS	164	0	167.3	2.8	Switch	730	2035
CD Room	4	F82EE	123	0	125.5	0.5	Switch	800	394
Main Truck Bay	30	F82EE	123	0	125.5	3.7	Switch	800	2952
Kitchen	4	F44EIS	164	0	167.3	0.7	Switch	800	525
Main Kitchen	7	F44EIS	164	0	167.3	1.1	Switch	800	918
Main Hall	55	F44EIS	164	0	167.3	9.0	Switch	800	7216
Meeting Room	8	F44EIS	164	0	167.3	1.3	Switch	800	1050
Main Office	2	F44EIS	164	0	167.3	0.3	Switch	800	262
Stairs	1	F82EE	123	0	125.5	0.1	Switch	8760	1077
TOTALS -	132			0		20.213			16954

Milford Township
CHA #22312
Building: Sub Station

Existing Lighting

Blended Electric Rate
Demand Rate

\$ 0.301 /kWh

EXISTING CONDITIONS										
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
Main Area	12	F42EIS	82	0	83.6	1.0	Switch	2	730	718
TOTALS -	12			0		0.984				718

APPENDIX U

3rd Party Electric Suppliers for JCP&L

Licensed Electric Generation Suppliers

(December 2010)

To sell electric generation service in New Jersey, electric power suppliers must be licensed by the New Jersey Board of Public Utilities (NJ BPU). They must also be registered with the local public utility to sell electric generation service in that utility's service area. Below is a list of suppliers who are licensed with the NJ BPU and are registered to sell electric generation service in the Jersey Central Power & Light Company service territory.

Supplier Name	Phone No.
Blue Star Energy services, Inc	866-258-3782
BOC Energy Services	800-247-2644
* Champion Energy Services, Inc.	877-653-5090
* Clearview Electric, Inc	800-746-4702
Commerce Energy, Inc.	800-556-8457
* Con Edison Solutions, Inc.	888-686-1383
	Residential: 1-877-997-9995
	Commercial/Industrial:
* Constellation NewEnergy, Inc.	888-635-0827
* Direct Energy, LLC	800-260-0300
* Dominion Retail, Inc.	800-264-4754
* Energy Plus Holdings, LLC	1-877-866-9193
* FirstEnergy Solutions Corp.	800-977-0500
* Gateway Energy Services Corp.	800-313-8333
* GDF Suez Energy Resources NA	888-644-1014
* Gerdau Ameristeel	732-721-6600
* Glacial Energy	877-569-2841
* Hess Corp	800-437-7872
* Hudson Energy Services, LLC	877-HUDSON9
* Integrys Energy Services, Inc.	877-763-9977
* Liberty Power Holdings, LLC	866-POWER-99
* NextEra Energy Services NewJersey	877-528-2890
* Palmco Power NJ, LLC	877-726-5862
* Pepco Energy Services, Inc.	800-ENERGY-9
* PP&L EnergyPlus, LLC	888-289-7693
* Public Power & Utility of New Jersey, LLC	888-354-4415
* Sempra Energy Solutions	877-2SEMPRA
* South Jersey Energy	800-756-3749
* UGI Energy Services	800-427-8545
* Verde Energy USA, Inc	1-800-388-3862
* Viridian Energy PA, LLC	866-663-2508

Contact the supplier directly to verify whether or not new customers are being accepted.

* Registered Supplier with FirstEnergy in Jersey Central Power & Light Service Territory.