CITY OF LINWOOD
PUBLIC WORKS GARAGE
ENERGY ASSESSMENT

for

NEW JERSEY
BOARD OF PUBLIC UTILITIES

CHA PROJECT NO. 22215

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Prepared by:

CLOUGH HARBOUR & ASSOCIATES LLP

6 Campus Drive
Parsippany, NJ 07054

(973) 538-2120

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION

The Public Works Garage, built in 1955, is approximately 3,800 SF. Located at 550 Hamilton Avenue, the building is a single story structure except for two offices on a second level.

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 Public Works Garage in Linwood, New Jersey. The facility, constructed in 1955, is approximately 3,800 SF and consists of a single story structure with offices in the loft. The following areas were evaluated for energy conservation measures:

- Lighting replacement
- Domestic hot water heater replacement
- Insulation upgrade
- Installation of infrared heaters

Various potential Energy Conservation Measures (ECMs) were identified for the above categories. Potential annual savings of $800 for the recommended ECMs may be realized with a payback of 7.9 years.

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

ECM-3 Replace Electric Domestic Hot Water Heater

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
4,500	4.5	3,900	(20)	0	600	0	600	(0.3)	300	7.5	7.0

* Incentive shown is per the New Jersey Smart Start Program, Gas Water Heating Application. See section 5.0 for other incentive opportunities.

ECM-4 Lighting Replacements

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
2,400	0.3	1,300	0	0	200	0	200	0.2	300	12.0	10.5

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

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

- ECM-2 Install Infrared Heaters

3.0 EXISTING CONDITIONS

3.1 Building – General

The Public Works Garage was constructed in 1955, and is approximately 3,800 SF. The building is predominantly a single level, with offices on a second level. The building's front exterior wall is constructed of 4" face brick and 8" concrete masonry unit (CMU) block. The remaining exterior walls are constructed of 8" CMU block with stucco top finish. The roof assembly is supported by steel joists with 1-1/2" metal decking, 2" rigid insulation, rubber membrane, and stone ballasts.

The building has one large main bay and one secondary bay that house the DPW vehicles and equipment. The main bay has three overhead doors and contains the DPW offices in the loft, break area, tool storage room. There is also a small restroom. The main bay has a natural gas fired unit heater, air compressor, and domestic hot water heater.

The secondary bay was originally the Public Works garage. This 1,650 SF area has an overhead garage door on each end. This bay is separated from the main vehicle area by an insulated wall. The bay is used primarily for storage and is heated.

The garage has four pedestrian doors; three leading into the main bay and one leading into the secondary bay. The doors are in good condition and are sealed properly. There are two windows on the eastern side that allow natural light in for the DPW offices.

The building is operational Monday through Friday from 8:00 am to 5:00 pm. Eight DPW workers utilize the building sporadically throughout the day.

3.2 Utility Usage

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

From October 2009 through September 2010, electric usage was approximately 62,000 kWh at a cost of about $9,900. Analyzing electricity bills during this period showed that the building was charged at a blended unit cost of $0.16 per kWh. Electricity usage was generally higher in the winter months due to the unit heater blowers running. During the same timeframe, the building heat produced by natural gas-fired equipment required about 1,040 therms. Based on the annual cost of about $1,600, the blended price for natural gas was $1.54 per therm. Natural gas consumption is highest in the winter months when the building is in heating mode.

Review of potable water utility bills from October 2009 through September 2010 determined the facility used a total of 65,000 gallons of water over the course of a year. At a total cost of about $500, the unit cost for water was found to be $7.45 per kGal. Utility data can be found in Appendix A.

The Public Works facility already is using a third party electricity supplier and the rates appear reasonable when compared to the state average.

3.3 HVAC Systems

The main garage is heated with one natural gas unit heater with an existing efficiency of about 70%. There is no air conditioning in the garage areas. The secondary bay is heated with a Reznor gas fired unit heater with an existing efficiency of about 70%. The offices in the loft have a small two ton rooftop unit which provides heating and cooling. Heating capacity is about 80 MBH. Ducts attached to this unit supply the office area only. The rooftop unit has a heating efficiency of about 80% and cooling efficiency of about 12 EER.

There is a small exhaust fan in the restroom which is controlled by a light switch.

3.4 Lighting/Electrical Systems

3.4.1 Interior Lighting

The building utilizes about 130 fluorescent fixtures for most lighting requirements. About half the lights are T-12 fluorescent fixtures with magnetic ballasts, while the other half are newer T-8 lamps and electronic ballasts.

3.4.2 Exterior Lighting

The exterior lighting primarily consists of six metal halide wall mounted floodlights, approximately 300 watts each, which are activated dusk to dawn.

3.5 Control Systems

3.5.1 HVAC Controls

The controls for the rooftop unit consist of a wall mounted thermostat. Temperature setpoints are 68°F for heating and 73°F for cooling during occupied times, and 60°F heating and 80°F during unoccupied times. The unit heaters are controlled by a manual wall mounted thermostat and are usually set at 68°F during the day and set back to 55°F at night.

3.5.2 Lighting/Electrical Controls

Lighting controls are manual switches located in each space.

All outside lighting is operated with a photocell.

3.6 Plumbing Systems

The restroom contains a low flow toilet and standard flow sink. Domestic hot water is generated by two heaters. One heater is a small electric point of use unit with 1.5 gallon capacity which serves the restroom. The other heater is a GE 30 gallon tank type with a 4.5 kW electric element. Both water heaters are in average condition.

4.0 ENERGY CONSERVATION MEASURES

4.1 ECM-1 Increase Wall Insulation

The exterior walls of the main and secondary garage areas are constructed of 4" concrete block with no insulation. This ECM addressed adding 2" polyisocyanurate board insulation (R-14) and sheetrock to the interior side of the CMU block walls in both garage bays to minimize heat energy losses.

To calculate the savings, the heat losses through the exterior walls were found using the existing walls' R value of 6 and bin weather data for Atlantic City, NJ. The values were then totaled to determine the existing annual heat losses. The heat loss values were then determined with a thermal resistance which included the additional R-14 insulation which would bring the new R value to 20. The annual energy savings of adding insulation to the exterior block walls is expected to be about 30 therms.

This measure was evaluated and the savings were less than $100; therefore, it is not recommended as part of the study. See Appendix B for calculations.

Wall board insulation has an expected life of 20 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 600 therms and $1,000.

4.2 ECM-2 Install Infrared Heaters

The main area garage bay is heated by one Rheem gas fired unit heater suspended from the ceiling. It has an input of 80 MBH and an existing efficiency of about 70%. The other smaller truck bay area is heated with a Reznor gas fired unit heater with input of 140 MBH. This heater has an existing efficiency of about 70%. It is intended to replace both heaters with two new gas fired infrared heaters.

The proposed infrared heaters have a burner efficiency of 85% and will transfer heat more effectively via radiation. Using historical utility data and applying efficiency improvements, it was determined that the annual heating gas energy required using infrared heaters is about 870 therms. Electrical energy savings will also be realized by eliminating the need to operate the air circulation fans utilized by the existing unit heaters. The electrical energy saving was calculated by applying the annual heating operating hours from the bin data spreadsheet to the power requirement for the existing unit heaters and proposed infrared heaters. The total annual electrical savings for this ECM is estimated to be 1,390 kWh.

Implementation of this measure requires running natural gas piping from the existing unit heater locations to the new infrared heaters. New exhaust flue stacks and electrical wiring will also be necessary. To calculate the budgetary cost, two infrared heaters were used as outlined in the cost estimate. The quantity, size, and capacity of the heaters were used for estimating purposes only. Exact heater selection and sizing cannot be completed without generating a heating load profile for the space.

Infrared heaters have an expected life of 18 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 6,660 therms and 25,020 kWh, totaling $14,400.

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

ECM-2 Install Infrared Heaters

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
9,100	0	1,390	370	0	800	0	800	0.5	NA	11.4	NA

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

This measure is not recommended.

4.3 ECM-3 Replace Electric Domestic Hot Water Heater with Gas Fired Heater

Domestic hot water is generated by two electric hot water heaters. One is a point of use heater, the other a 30 gallon tank heater. Due to a moderate demand for hot water in the building, there are extended periods of time with little or no use. However, the 30 gallon tank heater must still heat the water. Energy required maintaining the hot water temperature setpoint during times of zero demand are known as standby losses. This measure evaluated replacing the existing 30 gallon heater with a tankless, gas-fired, condensing hot water heater to eliminate standby losses.

According to the U.S. Department of Energy, 2.5% of stored capacity is lost every hour during hot water heater standby. This value was applied to the total volume of the existing hot water heater storage tanks to determine the annual standby losses. Proposed efficiency was based on the Navien tankless, condensing hot water heater; it was calculated that 3,900 kWh would be saved per year. A more detailed hot water demand analysis may be necessary to verify proper sizing. The new water heater will require gas piping, venting, electrical connections, and minor water piping.

Tankless hot water heaters have an expected life of 13 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 50,700 kWh, (260) therms, and $7,800.

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

ECM-3 Replace Electric Domestic Hot Water Heater with Gas Fired Heater

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
4,500	4.5	3,900	(20)	0	600	0	600	(0.3)	300	7.5	7.0

* Incentive shown is per the New Jersey Smart Start Program, Gas Water Heating Application. See section 5.0 for other incentive opportunities.

This measure is recommended.

4.4 ECM-4 Lighting Replacements

During the site visit, a comprehensive fixture survey was conducted of the entire building. Each switch and circuit was identified, as well as the number of fixtures, locations, approximate operating times, and existing wattage consumption. The lighting in this building is mixed. A portion of the main bay and the

entire secondary bay have older T-12 lamps with magnetic ballasts; some areas such as the offices have T-8 lamps with electronic ballasts. This measure addressed the expected energy savings of replacing the existing T-12 fixtures with T-8 fluorescent lamps and electronic ballasts.

Energy savings for this measure were calculated by applying the existing and proposed fixture wattages to the estimated time of operation to determine their annual electricity consumptions. The difference resulted in an annual savings of about 1,330 kWh per year. Supporting calculations, including all assumptions for lighting hours and the annual energy usage for each fixture is provided in Appendix E.

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 19,500 kWh, totaling $3,000.

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

ECM-4 Lighting Replacements

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
2,400	0.3	1,300	0	0	200	0	200	0.2	300	12.0	10.5

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

This measure is recommended.

5.0 PROJECT INCENTIVES

5.1 Incentives Overview

5.1.1 New Jersey Pay For Performance Program

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

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

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

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

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

5.1.2 New Jersey Smart Start Program

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

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

5.1.3 Energy Efficient and Conservation Block Grant

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

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

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

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

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

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

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

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

Funding for this program is dispersed on a first come, first serve basis until all funds are exhausted. The program does not limit the municipality to a minimum or maximum incentive, and the availability of funding cannot be determined prior to application. If the municipality meets all qualifications, the

application must be submitted to TRC Energy Solutions for review. TRC will then determine the amount of the incentive based on projected energy savings of the project. It is important to note that all applications for this incentive must be submitted before implementation of energy conservation measures.

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

5.1.5 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, this 3,800 square foot building is eligible for about $200 toward development of an Energy Reduction Plan. When calculating the total amount under Incentives #2 and #3, all energy conservation measures are applicable as the amount received is based on building wide energy improvements. Since the overall energy reduction for the building is estimated to exceed the 15% minimum, the building is eligible to receive monies based on Incentives #2 and #3 as discussed above in section 5.1.1. In total, incentives through the NJ P4P program are expected to total about $2,500, reducing the total project payback from 15.0 years to 13.4 years. See Appendix F for calculations.

5.2.2 New Jersey Smart Start Program

The Public Works building is eligible for several incentives available under New Jersey Smart Start Programs. The total amount of all qualified incentives is about $600 and includes installing a gas-fired tankless DHW heater and upgrades to the lighting systems.

5.2.3 Energy Efficient and Conservation Block Grant

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

5.2.4 Direct Install Program

This building is potentially eligible to receive funding from the Direct Install Program. This money will be in conjunction with the Energy Efficiency and Conservation Block Grant. The total implementation cost for all ECMs potentially eligible for Direct Install funding is about $11,500 and includes installing infrared heaters and lighting upgrades. This program would pay 60%, or about $6,900 of these initial costs. This funding has the potential to significantly affect the payback periods of Energy Conservation Measures. For the Public Works building, the Direct Install Program brings the project simple payback from about 15.0 years to approximately 10.5 years.

6.0 ALTERNATIVE ENERGY SCREENING EVALUATION

6.1 Geothermal

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

The building uses natural gas unit heaters and one roof top unit to meet the HVAC requirements. These systems would have to be removed and replaced with a new water source geothermal system. Due to the high cost of retrofitting, this measure is not recommended.

6.2 Solar

6.2.1 Photovoltaic Rooftop Solar Power Generation

The Public Works Garage was evaluated for the potential to install rooftop photovoltaic (PV) solar panels for power generation. The building's roof appears to have sufficient room to install a 10 kW solar cell array. 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. A structural analysis would be required to determine if the roof framing could support a cell array.

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

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

Installation of (PV) arrays in the state New Jersey will allow the owner to participate in the New Jersey solar renewable energy certificates program (SREC). This is a program that has been set up to allow entities with large amounts of environmentally unfriendly emissions to purchase credits from zero emission (PV) solar-producers. An alternative compliance penalty (ACP) is paid for by the high emission producers and is set each year on a declining scale of 3% per year. One SREC credit is equivalent to 1000 kilowatt hours of PV electrical production; these credits can be traded for period of 15 years from the date of installation. The expected dollar amount that will be paid to the PV producer is expected to be

$600/SREC credit. Payments that will be received from the PV producer will change from year to year dependent upon supply and demand. Renewable Energy Consultants is a third party SREC broker that has been approved by the New Jersey Clean Energy Program. As stated above there is no definitive way to calculate an exact price that will be received by the PV producer per SREC over the next 15 years. Renewable Energy Consultants estimated an average of $487/ SERC per year and this number was utilized in the cash flow for this report.

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

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

Budgetary Cost	Annual Utility Savings				Total Savings	New Jersey Renewable Energy Incentive*	New Jersey Renewable SREC**	Payback (without incentive)	Payback (with incentives)
	Electricity		Natural Gas	Total					
$	kW	kWh	Therms	$	$	$	$	Years	Years
70,000	0	12,500	0	2,000	2,000	7,000	6,100	>25	7.8

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

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 an electric water heater and, therefore, this measure would offer electric savings.

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

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

Solar Thermal Domestic Hot Water Plant

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

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

This measure is not recommended.

6.3 Wind

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

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

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

The most important part of any small wind generation project is the mean annual wind speed at the height of which the turbine will be installed. The Public Works Garage building is located in a semi residential neighborhood and a wind generator tower may be useful. A wind speed map is included in Appendix I.

This measure is recommended to be investigated further.

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 Public Works Garage building uses a gas fired roof top unit and gas furnaces to heat the garage bays. Significant modifications to these systems would be needed to allow for a CHP to work properly. Also, there is no need for the heat in the summer months, therefore this measure is not recommended.

6.5 Biomass Power Generation

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

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

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

The NJDEP evaluates biomass resources not identified in the RPS.

Examples of eligible facilities for a CORE incentive include:

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

* from NJOCE Website

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

6.6 Demand Response Curtailment

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

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

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

7.0 EPA PORTFOLIO MANAGER

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

The Public Works Building has a Site Energy Usage Index (EUI) of 34 kBTU/ft^2/year. The EUI can be improved by implementing the energy savings measures as described above. By implementing the measures discussed in this report, it is expected that the EUI can be reduced to approximately 21 kBTU/ft^2/year. The EPA Portfolio Manager did not generate an energy rating score for this building because the building type (Garage) is not eligible for an energy star rating.

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

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

8.0 CONCLUSIONS & RECOMMENDATIONS

The energy audit conducted by CHA at the Public Works Garage in Linwood, New Jersey identified potential ECMs for lighting replacement and domestic hot water heater replacement. Potential annual savings of $800 may be realized for the recommended ECMs, with a summary of the costs, savings, and paybacks as follows:

ECM-3 Replace Electric Domestic Hot Water Heater

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
4,500	4.5	3,900	(20)	0	600	0	600	(0.3)	300	7.5	7.0

* Incentive shown is per the New Jersey Smart Start Program, Gas Water Heating Application. See section 5.0 for other incentive opportunities.

ECM-4 Lighting Replacements

Budgetary Cost	Annual Utility Savings					Estimated Maintenance Savings	Total Savings	ROI	Potential Incentive*	Payback (without Incentive)	Payback (with Incentive)
	Electricity		Natural Gas	Water	Total						
$	kW	kWh	Therms	kGals	$	$	$		$	Years	Years
2,400	0.3	1,300	0	0	200	0	200	0.2	300	12.0	10.5

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

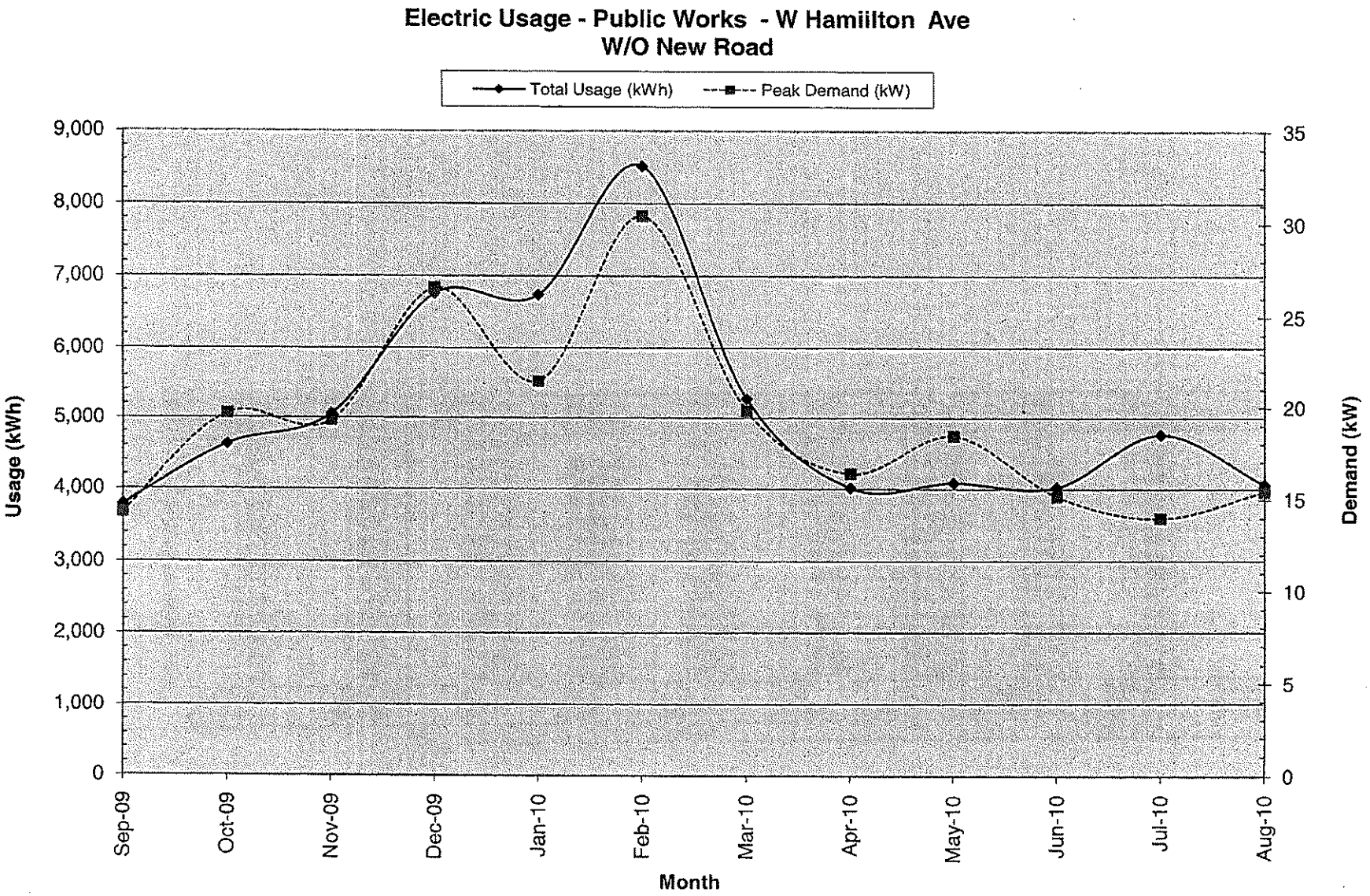
APPENDIX A

Utility Usage Analysis

City of Linwood
CHA Project Number: 22215
Public Works Garage

Account Number: 0100 8689 9993
Meter Number: 6408501

Month	Consumption (kWh)	Demand (kW)	Charges					Unit Costs		
			Total ($)	Supply ($)	Delivery ($)	Demand ($)	Consumption ($)	Blended Rate ($/kWh)	Consumption ($/kWh)	Demand ($/kW)
September-09	3,783	14.3	$752.19	$546.23	$205.96	$0.00	$752.19	0.1988	0.1988	-
October-09	4,619	19.7	$795.96	$556.48	$239.48	$0.00	$795.96	0.1723	0.1723	-
November-09	5,050	19.3	$845.26	$597.74	$247.52	$0.00	$845.26	0.1674	0.1674	-
December-09	6,756	26.6	$1,163.81	$816.27	$347.54	$0.00	$1,163.81	0.1723	0.1723	-
January-10	6,740	21.5	$1,087.39	$780.57	$306.82	$0.00	$1,087.39	0.1613	0.1613	-
February-10	8,510	30.4	$1,415.25	$1,005.31	$409.94	$0.00	$1,415.25	0.1663	0.1663	-
March-10	5,269	19.8	$875.42	$620.01	$255.41	$0.00	$875.42	0.1661	0.1661	-
April-10	4,016	16.4	$685.08	$479.01	$206.07	$0.00	$685.08	0.1706	0.1706	-
May-10	4,083	18.4	$713.21	$499.03	$214.18	$0.00	$713.21	0.1747	0.1747	-
June-10	4,023	15.2	$712.42	$485.00	$227.42	$0.00	$712.42	0.1771	0.1771	-
July-10	4,761	14.0	$742.61	$485.00	$257.61	$0.00	$742.61	0.1560	0.1560	-
August-10	4,061	15.4	$718.18	$485.00	$233.18	$0.00	$718.18	0.1768	0.1768	-
September-10	4,200	15.9	$240.66		$240.66	$0.00	$240.66	0.0573	0.0573	-
Total	65,871	30.4	$10,747.44	$7,355.65	$3,391.79	$0.00	$10,747.44	0.1632	0.1632	-
Most Recent Yr	62,088	30.4	$9,995.25	$6,809.42	$3,185.83	$0.00	$9,995.25	0.1610	0.1610	-



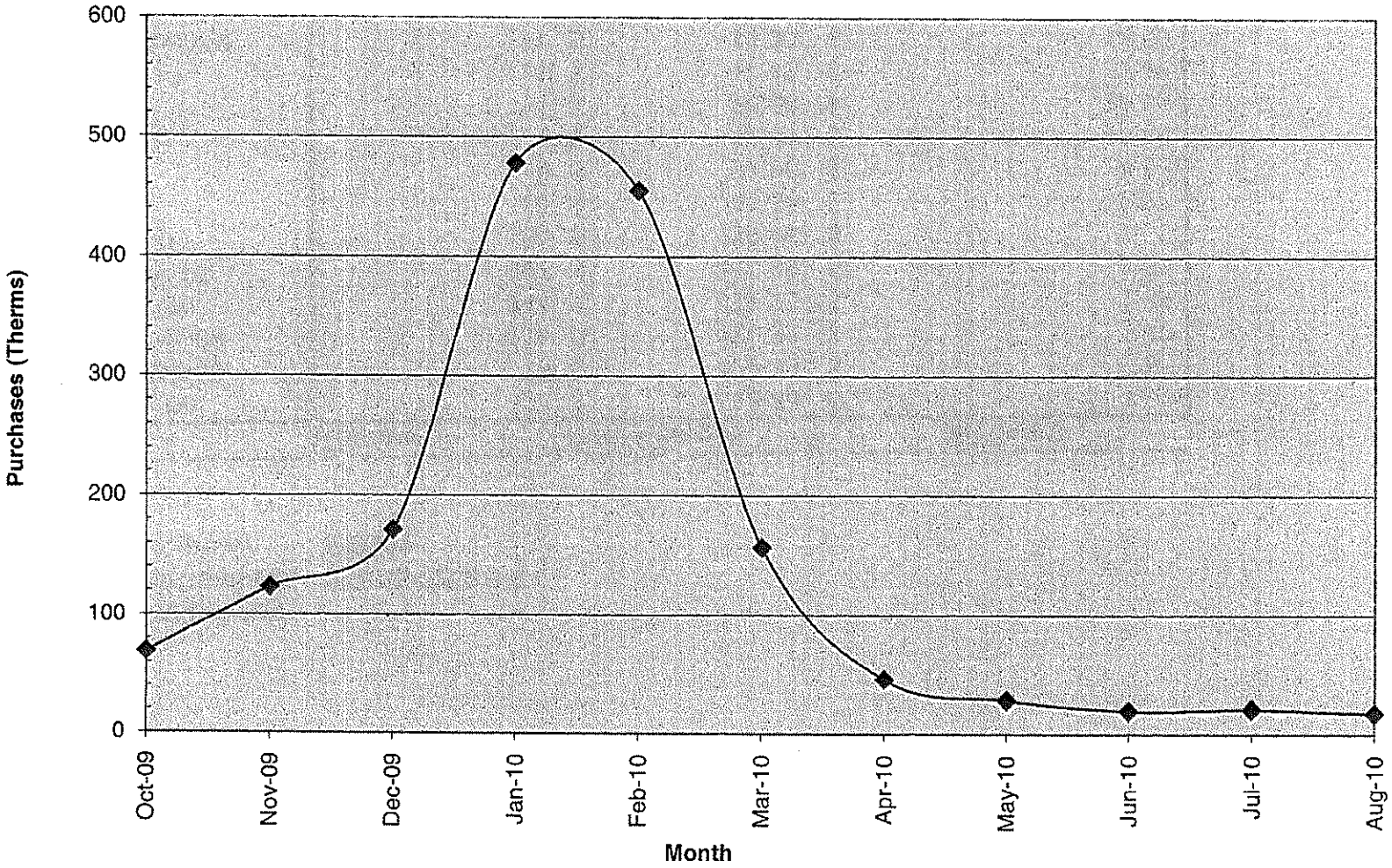
Electric Utility Data - Rev1
Public Works -Electricity Chart

City of Linwood
CHA Project Number: 22215
Public Works

550 Hamilton Ave
Account Number: **1 16 35 2752 0 6**
Meter Number: **332341**

Month	Therms	Total Charges	($/Therm)
October-09	38	$ 68.86	$ 1.81
November-09	78	$ 122.79	$ 1.57
December-09	115	$ 170.93	$ 1.49
January-10	344	$ 477.95	$ 1.39
February-10	327	$ 454.99	$ 1.39
March-10	104	$ 156.46	$ 1.50
April-10	20	$ 45.36	$ 2.27
May-10	6	$ 27.96	$ 4.53
June-10	1	$ 19.41	$ 18.84
July-10	1	$ 20.60	$ 20.60
August-10	1	$ 17.48	$ 17.48
September-10	1	$ 16.00	$ 16.00
Total	1,036	$ 1,599	$ 1.54

Natural Gas Usage - Public Works Garage



Gas Utility Data - Rev1
Public Works Gas Chart

City of Linwood
CHA Project Number: 22215
Public Works
New Jersey American Water

550 Hamilton Ave
Account Number: 18-1109082-6
Meter Number: 86466392

Month	Gallons	Total Charges	($/Gal.)
August-09	8000	$ 55.27	$ 6.91
September-09	5000	$ 37.95	$ 7.59
October-09	4000	$ 32.16	$ 8.04
November-09	5000	$ 37.95	$ 7.59
December-09	5000	$ 37.95	$ 7.59
January-10	6000	$ 43.75	$ 7.29
February-10	6000	$ 43.75	$ 7.29
March-10	4000	$ 32.16	$ 8.04
April-10	5000	$ 37.95	$ 7.59
May-10	6000	$ 43.75	$ 7.29
June-10	8000	$ 55.32	$ 6.92
July-10	6000	$ 43.74	$ 7.29
August-10	5000	$ 37.93	$ 7.59
September-10	5000	$ 37.93	$ 7.59
Total	65,000	$ 484	$ 7.45

ELECTRIC MARKETERS LIST

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

GAS MARKETERS LIST

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

RPL Holdings, Inc
601 Carlson Pkwy
Minnetonka, MN 55305

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

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

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

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

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

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

APPENDIX B

ECM-1 Increase Wall Insulation

City of Linwood,NJ
CHA #22215
Building: Public Works Garage

ECM-1 Increase Wall Insulation

Add insulation to a portion of the main bay and the entire length of the secondary bay.

4180

Total Existing Wall Area	1,124	sf
Existing U-value	0.07	Btu/hr/(sf*F)
Existing R-value	6.0	
Proposed U-value	0.05	Btu/hr/(sf*F)
Proposed R-value	20	Adding 2" board insulation (R-14)
Heating Efficiency	70%	
Cooling Efficiency	1.20	kW/ton

Existing Cooling

Max. North Wall Cooling Load	352	Btu/hr
Max. East Wall Cooling Load	1,685	Btu/hr
Max. South Wall Cooling Load	430	Btu/hr
Max. West Wall Cooling Load	542	Btu/hr

Existing Heating

Existing Heating Load Temp Diff.	51	F
Existing Max. Wall Heating Load	6,837	Btu/hr
Heating On Point	60	F

Proposed Cooling

Max. North Wall Cooling Load	264	Btu/hr
Max. East Wall Cooling Load	1,264	Btu/hr
Max. South Wall Cooling Load	(323)	Btu/hr
Max. West Wall Cooling Load	382	Btu/hr

Proposed Heating

Proposed Max. Heating Load	6,627	Btu/hr

Occupied Cooling Setpoint	72	F
Unoccupied Cooling Setpoint	80	F

Occupied Heating Setpoint	65	F
Unoccupied Heating Setpoint	55	F

Existing Cooling Total	58	kWh/yr
Proposed Cooling Total	43	kWh/yr
Savings	14	kWh/yr

Existing Heating Total	6,919,050	Btu/yr
Proposed Heating Total	5,189,287	Btu/yr
Savings	1,729,762	Btu/yr
Input	25	therms

				Occupied				Unoccupied							
Avg Outdoor Air Temp. Bins °F	Existing Equipment Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	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)	Existing Heat Loss (Btu/hr)	Proposed Heat Loss (Btu/hr)	Existing Cooling Load (kWh/yr)	Existing Heating Load (Btu/yr)	Proposed Cooling Load (kWh/yr)	Proposed Heating Load (Btu/yr)
97.5	9	3	6	2,249	1,687	-	-	2,249	1,687	-	-	2	-	2	-
92.5	69	25	44	1,808	1,356	-	-	1,606	1,205	-	-	12	-	9	-
87.5	132	47	85	1,367	1,025	-	-	964	723	-	-	15	-	11	-
82.5	344	123	221	926	695	-	-	321	241	-	-	18	-	14	-
77.5	566	202	364	485	364	-	-	-	-	-	-	10	-	7	-
72.5	755	270	485	44	33	-	-	-	-	-	-	1	-	1	-
67.5	780	279	501	-	-	-	-	-	-	-	-	-	-	-	-
62.5	889	318	572	-	-	-	-	-	-	-	-	-	-	-	-
57.5	742	265	477	-	-	-	-	-	-	-	-	-	-	-	-
52.5	627	224	403	-	-	562	422	-	-	-	-	-	148,930	-	111,698
47.5	725	259	466	-	-	937	703	-	-	187	141	-	285,255	-	213,941
42.5	795	284	511	-	-	1,311	984	-	-	562	422	-	601,474	-	451,105
37.5	784	280	504	-	-	1,686	1,265	-	-	937	703	-	957,407	-	718,055
32.5	682	244	438	-	-	2,061	1,546	-	-	1,311	984	-	1,237,899	-	928,424
27.5	345	123	222	-	-	2,435	1,827	-	-	1,686	1,265	-	1,332,368	-	999,276
22.5	229	82	147	-	-	2,810	2,108	-	-	2,061	1,546	-	803,259	-	602,444
17.5	189	68	122	-	-	3,185	2,389	-	-	2,435	1,827	-	618,976	-	464,232
12.5	70	25	45	-	-	3,559	2,670	-	-	2,810	2,108	-	581,670	-	436,253
7.5	20	7	13	-	-	3,934	2,951	-	-	3,185	2,389	-	241,660	-	181,245
2.5	8	3	5	-	-	4,309	3,232	-	-	3,559	2,670	-	76,539	-	57,404
-2.5	0	0	0	-	-	4,683	3,513	-	-	3,934	2,951	-	33,613	-	25,210
-7.5	0	0	0	-	-	5,058	3,794	-	-	4,309	3,232	-	-	-	-
TOTALS	8,760	3,129	5,631	-	-	5,433	4,075	-	-	4,683	3,513	-	-	-	-
												58	6,919,050	43	5,189,287

City of Linwood, NJ
CHA #22215
Public Works Garage

ECM-1 Increase Wall Insulation

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
2" Rigid Foam Board	1,124	SF	$ 0.84	0.36		$ 925	$ 490	$ -	$ 1,415	
2 layers 5/8" sheet rock	1,124	SF	0.8512	1.6758		$ 938	$ 2,279	$ -	$ 3,217	
15' High Metal Stud wall	70	LF	$ 17	$ 9		$ 1,166	$ 762	$ -	$ 1,929	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 6,560	Subtotal
$ -	0% Contingency
$ -	0% Contractor O&P
	Engineering
$ 6,560	**Total**

APPENDIX C

ECM-2 Replace unit Heater with Infrared Heater

City of Linwood,NJ
CHA #22215
Building: Public Works Garage

ECM-2: Replace Unit Heaters with Infrared Heaters

Building Footprint	5,800	SF	Ex Occupied Htg Temp.	65	°F	Heating Energy Savings	371 Therms/yr
Natural Gas Heat Content	100,000	Btu/Therm	Ex Unoccupied Htg Temp.	55	°F	Electric Energy Savings	1,985 kWh/yr
Building Balance Temp.	60	°F	Occupied Heating UA	559	btu/hr/°F		
Internal Gains	27,333	btu/h	Unoccupied Heating UA	558	btu/hr/°F		
Unocc Internal Gain factor	0.63						
Ave Occ Internal Gain Factor	0.7						

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	85.0%	Based on Reznor Infrared Tube Heaters
Proposed Heat Distribution Effectiveness	100%	Heat Distribution Factor per ASHRAE Handbook - Fundamentals for Infrared Heaters

					EXISTING LOADS						PROPOSED LOADS							
					Occupied			Unoccupied			Occupied			Unoccupied				
Avg Outdoor Air Temp. Bins °F	Avg Outdoor Air Enthalpy	Existing Equipment Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Existing Heating Energy Therms	Proposed Heating Energy Therms
A		B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	M	N
102.5	42.5	0	0	0	0	0	-26,553	0	0	-1,138	0	0	-26,553	0	0	-1,138	0	0
97.5	39.5	9	3	6	0	0	-26,553	0	0	-1,138	0	0	-26,553	0	0	-1,138	0	0
92.5	36.6	69	25	44	0	0	-26,553	0	0	-1,138	0	0	-26,553	0	0	-1,138	0	0
87.5	34	132	47	85	0	0	-26,553	0	0	-1,138	0	0	-26,553	0	0	-1,138	0	0
82.5	31.6	344	123	221	0	0	-26,553	0	0	-1,138	0	0	-26,553	0	0	-1,138	0	0
77.5	29.2	566	202	364	0	0	-26,553	0	0	-1,138	0	0	-26,553	0	0	-1,138	0	0
72.5	27	755	270	485	0	0	-26,553	0	0	-1,138	0	0	-26,553	0	0	-1,138	0	0
67.5	24.5	780	279	501	0	0	-26,553	0	0	-1,138	0	0	-26,553	0	0	-1,138	0	0
62.5	21.4	889	318	572	1,395	2,264	-26,553	0	0	-1,138	1,395	2,264	-26,553	0	0	-1,138	0	0
57.5	18.7	742	265	477	4,184	6,793	-26,553	0	0	-1,138	4,184	6,793	-26,553	0	0	-1,138	0	0
52.5	16.2	627	224	403	6,973	11,321	-26,553	1,395	1,724	-1,138	6,973	11,321	-26,553	1,395	1,724	-1,138	0	0
47.5	14.4	725	259	466	9,762	15,850	-26,553	4,184	5,173	-1,138	9,762	15,850	-26,553	4,184	5,173	-1,138	0	0
42.5	12.6	795	284	511	12,551	20,378	-26,553	6,973	8,621	-1,138	12,551	20,378	-26,553	6,973	8,621	-1,138	155	108
37.5	10.7	784	280	504	15,340	24,906	-26,553	9,762	12,070	-1,138	15,340	24,906	-26,553	9,762	12,070	-1,138	240	168
32.5	8.6	682	244	438	18,129	29,435	-26,553	12,551	15,518	-1,138	18,129	29,435	-26,553	12,551	15,518	-1,138	284	199
27.5	6.8	345	123	222	20,918	33,963	-26,553	15,340	18,966	-1,138	20,918	33,963	-26,553	15,340	18,966	-1,138	182	126
22.5	5.6	229	82	147	23,708	38,492	-26,553	18,129	22,415	-1,138	23,708	38,492	-26,553	18,129	22,415	-1,138	146	103
17.5	4.1	189	68	122	26,497	43,020	-26,553	20,918	25,863	-1,138	26,497	43,020	-26,553	20,918	25,863	-1,138	142	99
12.5	2.6	70	25	45	29,286	47,549	-26,553	23,708	29,312	-1,138	29,286	47,549	-26,553	23,708	29,312	-1,138	60	42
7.5	1	20	7	13	32,075	52,077	-26,553	26,497	32,760	-1,138	32,075	52,077	-26,553	26,497	32,760	-1,138	18	14
2.5	0	8	3	5	34,864	56,606	-26,553	29,286	36,209	-1,138	34,864	56,606	-26,553	29,286	36,209	-1,138	9	6
-2.5	-1.5	0	0	0	37,653	61,134	-26,553	32,075	39,657	-1,138	37,653	61,134	-26,553	32,075	39,657	-1,138	0	0
-7.5	#REF!	0	0	0	40,442	65,662	-26,553	34,864	43,106	-1,138	40,442	65,662	-26,553	34,864	43,106	-1,138	0	0
TOTALS		8,760	3,129	5,631													1,238	867

Existing Building Ventilation & Infiltration (acc)	839 cfm
Overheat Ventilation Factor	1.00
Additional ventilation to offset overheat	0 cfm
Existing Building Ventilation & Infiltration (unocc)	839 cfm

Electrical Requirements for Heating Equipment

Existing Equipment

Unit	Htng Hrs	Amps	Volts	Phase	Power Factor	Annual kWh
UH-1	1,637	5.7	115	1	0.8	858
UH-2	1,637	5.7	115	1	0.8	858
Total						1717

Proposed Equipment

Unit	Htng Hrs	Amps	Volts	Phase	Power Factor	Annual kWh
Infrared Htr	1,637	1.1	115	1	0.8	166
Infrared Htr	1,637	1.1	115	1	0.8	166
Total						331

*Electrical data based on Reznor VR Series Infrared Heaters

Avg. OA Temp °F	Heating Hrs	Assumed % Time of Operation	hrs of Operation
102.5	0	0%	0
97.5	0	0%	0
92.5	0	0%	0
87.5	0	0%	0
82.5	0	0%	0
77.5	0	0%	0
72.5	0	0%	0
67.5	0	0%	0
62.5	0	8%	0
57.5	0	15%	0
52.5	0	23%	0
47.5	0	31%	0
42.5	795	38%	305
37.5	784	46%	362
32.5	682	54%	367
27.5	345	62%	212
22.5	229	69%	158
17.5	189	77%	145
12.5	70	85%	59
7.5	20	92%	18
2.5	8	100%	8
-2.5	0	100%	0
-7.5	0	100%	0
	3,122	52%	1637

City of Linwood, NJ
CHA #22215
Public Works Building

ECM-2- Replace Unit Heater with Infrared Heaters

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
						$ -	$ -	$ -	$ -	
Unit Heater Removal	2	EA		$ 450		$ -	$ 1,089	$ -	$ 1,089	
20' NG Infrared Tube Heater 75 MBH	2	EA	$ 1,200	$ 325		$ 2,352	$ 787	$ -	$ 3,139	Includes Controls
Miscellaneous Gas Piping, Valves, etc.	2	EA	$ 200	$ 250		$ 392	$ 605	$ -	$ 997	
4" Class B Vent Piping	50	LF	$ 6.70	$ 10		$ 328	$ 605	$ -	$ 933	
4" Chimney Cap	2	EA	$ 11	$ 10		$ 22	$ 24	$ -	$ 46	
Roof Flashing	2	EA	$ 28	$ 10		$ 55	$ 24	$ -	$ 79	
Miscellaneous electrical	1	LS		$ 500		$ -	$ 605	$ -	$ 605	
						$ -	$ -	$ -	$ -	

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

$6,888	Subtotal
$1,033	15% Contingency
$1,188	15% Contractor O&P
$0	0% Engineering
$9,109	**Total**

APPENDIX D

ECM-3 Replace Electric DHW Heater

City of Linwood,NJ
CHA #22215
Building: Public Works Garage

ECM-3: Replace 30 Gallon Electric DHW Heater

Summary

* Replace Electric DHW Heater w/ Instantaneous, Condensing, Gas-Fired DHW Heater

Item	Value	Units	Formula/Comments
Occupied days per week	5	days/wk	
Water supply Temperature	50	°F	Temperature of water coming into building
Hot Water Temperature	120	°F	
Hot Water Usage per day	9	gal/day	Calculated from usage below
Annual Hot Water Energy Demand	1,421	MBTU/yr	Energy required to heat annual quantity of hot water to setpoint
Existing Tank Size	120	Gallons	Per manufacturer nameplate
Hot Water Temperature	120	°F	
Average Room Temperature	70	°F	
Standby Losses (% by Volume)	2.5%		(2.5% of stored capacity per hour, per U.S. Department of Energy)
Standby Losses (Heat Loss)	1.3	MBH	
Annual Standby Hot Water Load	10,950	MBTU/yr	
Total Annual Hot Water Demand (w/ standby losses)	12,371	Mbtu/yr	Building demand plus standby losses
Existing Water Heater Efficiency	93%		Per Manufacturer
Total Annual Energy Required	13,302	Mbtu/yr	
Total Annual Electric Required	3,898	kWh/yr	**Electrical Savings**
Average Annual Electric Demand	0.44	kW	
Peak Electric Demand	4.50	kW	**Per Manufacturer's Nameplate (Demand Savings)**
New Tank Size	0	Gallons	
Hot Water Temperature	120	°F	
Average Room Temperature	70	°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)	1,421	MBTU/yr	
Proposed Avg. Hot water heater efficiency	92%		Based on Navien instantaneous, condensing DHW Heater
Proposed Total Annual Energy Required	1,550	MBTU/yr	
Proposed Fuel Use	15	Therms/yr	Standby Losses and inefficient DHW heater eliminated
Elec Utility Demand Unit Cost	$0.00	$/kW	
Elec Utility Supply Unit Cost	$0.16	$/kWh	
NG Utility Unit Cost	$1.54	$/Therm	
Existing Operating Cost of DHW	$627	$/yr	
Proposed Operating Cost of DHW	$24	$/yr	
Annual Utility Cost Savings	$604	$/yr	

Daily Hot Water Demand

FIXTURE	*BASE WATER USE GPM	DURATION OF USE (MIN)	#USES PER DAY MALE	#USES PER DAY FEMALE	FULL TIME OCCUPANTS** MALE	FULL TIME OCCUPANTS** FEMALE	TOTAL GAL/DAY	% HOT WATER	TOTAL HW GAL/DAY
LAVATORY (Low-Flow Lavs use 0.5 GPM)	2.5	0.25	3	0	3	3	6	50%	3
SHOWER	2.5	5	0	0	3	3	0	75%	0
KITCHEN SINK	2.5	0.5	1	0	3	3	4	75%	3
MOP SINK	2.5	2	1	0	1	1	5	75%	4
Dishwasher (gal per use)	10	1	0	0	1	1	0	100%	0
						TOTAL	14		9

City of Linwood,NJ
CHA #22215

Engineer: Frank Cuttita

ECM-3: Replace 30 Gallon Electric DHW Heater

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
						$ -	$ -	$ -	$ -	
ELE DHW Heater Removal	1	LS		$ 50		$ -	$ 61	$ -	$ 61	2009 Means
Instantaneous Gas-Fired DHW Heater	1	EA	$ 1,199	$ 297		$ 1,175	$ 359	$ -	$ 1,534	Unit cost form Home Depot
Miscellaneous Electrical	1	LS	$ 500			$ 490	$ -	$ -	$ 490	2009 Means
Venting Kit	1	EA	$ 450	$ 650		$ 441	$ 787	$ -	$ 1,228	2009 Means
Miscellaneous Piping 3/4 in	10	LS	$ 6	$ 5		$ 59	$ 62	$ -	$ 121	2009 Means
Miscellaneous Valves 3/4 in	3	LS	$ 17	$ 20		$ 50	$ 73	$ -	$ 123	2009 Means
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 3,556	Subtotal	
$ 356	10%	Contingency
$ 587	15%	Contractor O&P
$ -	0%	Engineering
$ 4,498	**Total**	

APPENDIX E

ECM-4 Lighting Replacement

City of Linwood,NJ
CNA #22215
Building: Public Works Garage

ECM-4 Light Replacement

Electric Rate $ 0.161 /kWh
Demand Rate $ /kW

		EXISTING CONDITIONS											RETROFIT CONDITIONS								COST ANALYSIS		
Area Description	# Lamps	Number of Fixtures	Fixture Type	Lamp Type	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	Watts per Fixture	New Lamp Type	kW/Space	Retrofit Control	Daily Hours	Annual Hours	Annual kWh	kW Saved	Annual kWh Saved	Retrofit Cost
Tractor bay area	2	15	1x8	T-12	75	0	76.5	1.125	switch	10	2600	2925	15	59	T-8	0.885	sw	10	2600	2301	0.24	624	600
Main Bay	2	8	1x8	T-12	75	0	76.8	0.45	switch	10	2600	1170	6	59	T-8	0.354	sw	10	2600	920.4	0.096	249.6	600
Main Bay	2	8	1x8	T-8	75	0	76.5	0.45	switch	10	2600	1170	NO CHANGE										
Second Level Offices	2	7	1x8	T-8	36	0	36.72	0.252	switch	10	2600	655.2	NO CHANGE										
Second Level Offices	2	1	1x2	T-8	32	0	32.64	0.032	switch	10	2600	83.2	NO CHANGE										

APPENDIX F

New Jersey Pay For Performance Incentive Program

City of Linwood,NJ
CHA #22215
Public Works Garage

New Jersey Pay For Performance Incentive Program

Note: The following calculation is based on the New Jersey Pay For Performance Incentive Program per April, 2010.
Building must have a minimum average electric demand of 200 kW. This minimum is waived for buildings owned by local governements or non-profit organizations.
The incentive values represented below are applicable through December 31, 2010.

Total Building Area (Square Feet)	3,800
Is this audit funded by the NJ BPU (Y/N)	Yes

Bureau of Public Utilites (BPU)

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

	Annual Utilities	
	kWh	Therms
Existing Cost (from utility)	$6,540	$1,599
Existing Usage (from utility)	62,088	1,036
Proposed Savings	6,615	381
Existing Total MMBtus	316	
Proposed Savings MMBtus	61	
% Energy Reduction	19.2%	
Proposed Annual Savings	$1,661	

	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	$1.31
Incentive #3	$0.07	$0.70	$0.005	$0.05	$0.09	$1.05	$0.09	$0.91

	Incentives $		
	Elec	Gas	Total
Incentive #1	$0	$0	$190
Incentive #2	$860	$499	$1,359
Incentive #3	$595	$347	$942
Total All Incentives	$1,455	$846	$2,491

Total Project Cost	$22,608

		Allowable Incentive
% Incentives #1 of Utility Cost*	1.9%	$190
% Incentives #2 of Project Cost**	6.0%	$1,359
% Incentives #3 of Project Cost**	4.2%	$942
Total Eligible Incentives***	$2,491	
Project Cost w/ Incentives	$20,116	

Project Payback (years)	
w/o Incentives	w/ Incentives
13.6	12.1

* Maximum allowable incentive is 50% of annual utility cost if not funded by NJ BPU, and %25 if it is.

** Maximum allowable amount of incentive #2 is 30% of total project cost.

Maximum allowable amount of incentive #3 is 20% of total project cost.

*** Maximum allowable amount of incentive #1 is $50,000 if not funded by NJ BPU, and $25,000 if it is.

Maximum allowable amount of incentive #2 & #3 is $1 million per gas account and $1 million per electric account

APPENDIX G

Photovoltaic (PV) Rooftop Solar Power Generation

City of Linwood
Department of Public Works

Cost of Electricity $0.160 $/kWh

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

Budgetary Cost	Annual Utility Savings				Estimated Maintenance Savings	Total Savings	New Jersey Renewable * Energy Incentive	New Jersey Renewable ** SREC	Payback (without incentive)	Payback (with incentive)
$	kW	kWh	therms	$	$	$	$	$	Years	Years
$70,000	**0.0**	**12,503**	**0**	**$2,000**	**0**	**$2,000**	**$7,000**	**$6,100**	**35.0**	**7.8**

*Incentive based on New Jersey renewable energy program for non-residential applications(PV)= $1.00/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

PVWatts * * * AC Energy & Cost Savings

Cautions for Interpreting the Results

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

Results			
Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	3.61	895	107.40
2	4.20	932	111.84
3	4.78	1124	134.88
4	5.23	1155	138.60
5	5.44	1211	145.32
6	5.48	1133	135.96
7	5.55	1171	140.52
8	5.41	1155	138.60
9	5.23	1106	132.72
10	4.60	1034	124.08
11	3.59	821	98.52
12	3.17	766	91.92
Year	4.69	12503	1500.36

Output Hourly Performance Data

About the Hourly Performance Data

*

Output Results as Text

Saving Text from a Browser

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

Please send questions and comments regarding PVWATTS to Webmaster

Disclaimer and copyright notice

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

PVWatts Cautions for Interpreting the Results

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

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

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

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

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

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

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

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

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

APPENDIX H

Solar Thermal Domestic Hot Water Plant

NJBPU Energy Audits
CHA #22215
City of Linwood- Public Works

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

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

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

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RENEWABLE ENERGY
THE INFINITE POWER OF TEXAS

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.

Solar Water Heating Calculator

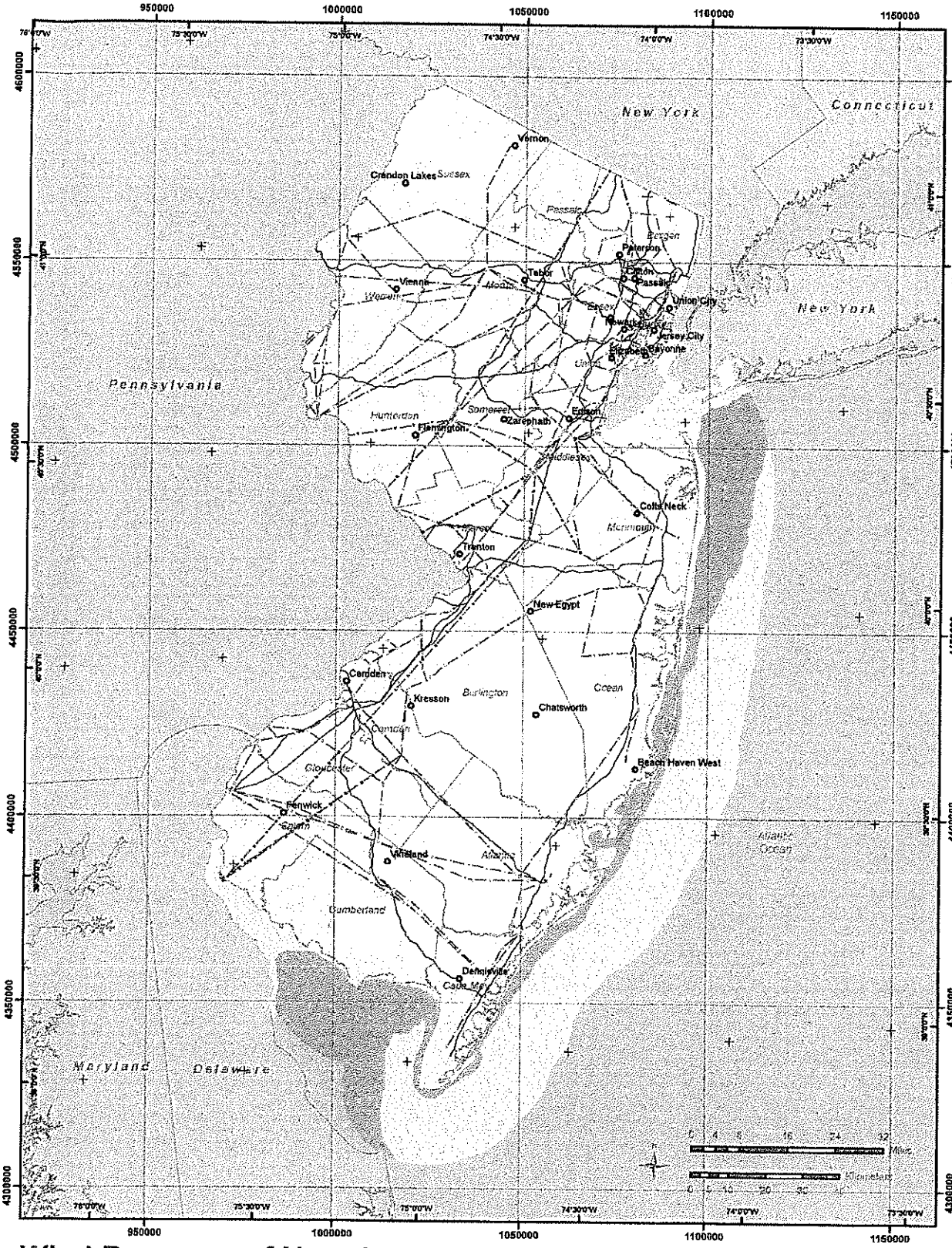
Water heating is a major energy consumer. Although the energy consumed daily is often less than for air conditioning or heating, it is required year round, making it a good application of solar energy. Use this calculator to explore the energy usage of your water heater, and to estimate whether a solar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

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

Gas vs. Electric Water Heating		
Gas		**Electric**
.8	? Overall Efficiency	.98
NaN	? Conversion Efficiency	0.98
2118 BTU/hr	? Power Into Water Heater	1729 BTU/hr
Cost		
$ 1.54 /Therm	? Utility Rates	$ 0.08.16 /kWh
$ 285.726(	? Yearly Water Heating Cost	$ 354.871
How Does Solar Compare?		
? Solar Water Heater Cost: $ 21700		? Percentage Solar: 70
108.495 years for gas	? Payback Time for Solar System	87.3555 years for electric

APPENDIX I

Wind



Wind Resource of New Jersey

Mean Annual Wind Speed at 30 Meters

Features

- City
- Interstate Highway
- County Boundary
- Water Body

Generalized Transmission Line

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

Mean Speed at 30 m		
mph	m/s	
< 10.1	< 4.5	
10.1 - 11.2	4.5 - 5.0	
11.2 - 12.3	5.0 - 5.5	
12.3 - 13.4	5.5 - 6.0	
13.4 - 14.5	6.0 - 6.5	
14.5 - 15.7	6.5 - 7.0	
15.7 - 16.8	7.0 - 7.5	
16.8 - 17.9	7.5 - 8.0	
17.9 - 19.0	8.0 - 8.5	
> 19.0	> 8.5	

AWS Truewind

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

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

APPENDIX J

EPA Portfolio Manager

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Public Works Facility

Building ID: 2549170
For 12-month Period Ending: August 31, 2010[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: January 10, 2011

Facility
Public Works Facility
550 Hamilton Ave
Linwood, NJ 08221

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

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

Year Built: 1970
Gross Floor Area (ft²): 3,800

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	215,202
Natural Gas (kBtu)[4]	112,769
Total Energy (kBtu)	327,971
Energy Intensity[5]	
Site (kBtu/ft²/yr)	86
Source (kBtu/ft²/yr)	220
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	39
Electric Distribution Utility	
Pepco - Atlantic City Electric Co	
National Average Comparison	
National Average Site EUI	77
National Average Source EUI	150
% Difference from National Average Source EUI	47%
Building Type	Service (Vehicle Repair/Service, Postal Service)

Stamp of Certifying Professional

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

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

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

Certifying Professional
Hank Kolakowski
400 Poplar Avenue
Linwood, NJ 08221

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

ENERGY STAR® Data Checklist for Commercial Buildings

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

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

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Public Works Facility	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Service (Vehicle Repair/Service, Postal Service)	Is this an accurate description of the space in question?		☐
Location	550 Hamilton Ave, Linwood, NJ 08221	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐

Main Area (Other)

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Gross Floor Area	3,800 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Number of PCs	1(Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	50Hours(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	3(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: Pepco - Atlantic City Electric Co

Fuel Type: Electricity

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

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
08/01/2010	08/31/2010	4,061.00
07/01/2010	07/31/2010	4,761.00
06/01/2010	06/30/2010	4,023.00
05/01/2010	05/31/2010	4,083.00
04/01/2010	04/30/2010	4,016.00
03/01/2010	03/31/2010	5,269.00
02/01/2010	02/28/2010	8,510.00
01/01/2010	01/31/2010	6,740.00
12/01/2009	12/31/2009	6,756.00
11/01/2009	11/30/2009	5,050.00
10/01/2009	10/31/2009	4,619.00
Electric Consumption (kWh (thousand Watt-hours))		**57,888.00**
Electric Consumption (kBtu (thousand Btu))		**197,513.86**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**197,513.86**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Natural Gas

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

Start Date	End Date	Energy Use (therms)
08/01/2010	08/31/2010	1.00
07/01/2010	07/31/2010	1.00
06/01/2010	06/30/2010	1.00
05/01/2010	05/31/2010	6.00
04/01/2010	04/30/2010	20.00
03/01/2010	03/31/2010	104.00
02/01/2010	02/28/2010	327.00
01/01/2010	01/31/2010	344.00
12/01/2009	12/31/2009	115.00
11/01/2009	11/30/2009	78.00
10/01/2009	10/31/2009	38.00

Gas Consumption (therms)	**1,035.00**
Gas Consumption (kBtu (thousand Btu))	**103,500.00**
Total Natural Gas Consumption (kBtu (thousand Btu))	**103,500.00**
Is this the total Natural Gas consumption at this building including all Natural Gas meters?	☐

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

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

Certifying Professional

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

Name: _____ Date: _____

Signature: _____

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

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

Facility
Public Works Facility
550 Hamilton Ave
Linwood, NJ 08221

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

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

General Information

Public Works Facility	
Gross Floor Area Excluding Parking: (ft²)	3,800
Year Built	1970
For 12-month Evaluation Period Ending Date:	August 31, 2010

Facility Space Use Summary

Main Area	
Space Type	Other - Service (Vehicle Repair/Service, Postal Service)
Gross Floor Area(ft²)	3,800
Number of PCs[o]	1
Weekly operating hours[o]	50
Workers on Main Shift[o]	3

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current (Ending Date 08/31/2010)**	**Baseline (Ending Date 09/30/2010)**	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft²)	86	83	0	N/A	77
Source (kBtu/ft²)	220	215	0	N/A	150
Energy Cost					
$/year	N/A	N/A	N/A	N/A	N/A
$/ft²/year	N/A	N/A	N/A	N/A	N/A
Greenhouse Gas Emissions					
$MtCO_2e$/year	39	38	0	N/A	35
$kgCO_2e$/ft²/year	10	10	0	N/A	9

More than 50% of your building is defined as Service (Vehicle Repair/Service, Postal Service). This building is currently ineligible for a rating. Please note the National Average column represents the CBECS national average data for Service (Vehicle Repair/Service, Postal Service). This building uses X% less energy per square foot than the CBECS national average for Service (Vehicle Repair/Service, Postal Service).

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

APPENDIX K

Block Load Models

HEAT GAIN/LOSS WORKSHEET

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

Building/Facility Designation: Public Works Garage

Outdoor Winter Design DB Temperature	14 *F	Indoor Winter Design DB Temperature	65 *F
Outdoor Summer Design DB Temperature	91 *F	Indoor Summer Design DB Temperature	72 *F
Outdoor Summer Design WB Temperature	73 *F	Indoor Summer Design WB Temperature	60 *F
Outdoor Summer Humidity Ratio	0.0121 #/#	Indoor Air (70*F) Humidity Ratio	0.0079 #/#

ENVELOPE DESCRIPTIONS (Descriptions are from Interior to Exterior)

Walls (Select One - Type X)

		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	7.6	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	concrete block all around
	Stucco or Gypsum, 2.5" Insul, Face Brick	14.3	10	
x	OTHER	15.0	16	
	U value calculator	15.2		

Roofs (Select One)

		R Value	Roof Type
	OTHER	25.0	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
x	Ceiling, Wood Deck, 6" Insulation, Felt & Membrane	22.7	10
	Wood Deck, 6" Insulation, Felt & Membrane	16.0	
	U value calculator	17.6	

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
x	Aluminum Frame, 1/2" DP Glazing	0.50
	Skylights	0.90
	Other	

	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	3,800 SF		
Occupied Area	3,800 SF	Return Plenum?	n

	Gross Wall Length	Average Wall Height	Ceiling Height	Window Area	Door Area	Net Wall Area
North Exposure	52 Ft	15.0 Ft	9.0 Ft	0 SF	204 SF	576 SF
East Exposure	72 Ft	15.0 Ft	9.0 Ft	0 SF	0 SF	1,080 SF
South Exposure	52 Ft	15.0 Ft	9.0 Ft	80 SF	527 SF	73 SF
West Exposure	72 Ft	15.0 Ft	9.0 Ft	8 SF	204 SF	870 SF

Occupied Forced Ventilation	200 cfm	0.2 AC/hr
Unoccupied Forced Ventilation	0 cfm	0.0 AC/hr

HEAT GAIN/LOSS WORKSHEET

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

Building/Facility Designation: Public Works Garage

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	80	225	btu/h/sf	0.8	0.58	Glass Type C	8,352 Btu/hr
West Exposure	6	216	btu/h/sf	0.8	0.29	Glass Type C	301 Btu/hr
							8,653 Btu/h

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain
North Exposure	264	0.07	20 °F	1.0	352 Btu/hr
East Exposure	648	0.07	39 °F	1.0	1,685 Btu/hr
South Exposure	-239	0.07	27 °F	1.0	-430 Btu/hr
West Exposure	438	0.07	22 °F	1.0	642 Btu/hr
Roof	3,800	0.04	79 °F	1.0	12,206 Btu/hr
Fenestration	86	0.50	19 °F		817 Btu/hr
Doors	1,035	0.14	27 °F		3,903 Btu/hr
Ceiling	3,800	0.14	0 °F		0 Btu/hr
Partition	0	0.05	0 °F		0 Btu/hr
Floor	3,800	0.04	0 °F		0 Btu/hr
					19,175 Btu/h

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

								Room Heat Gain
Lights	0.90	w/sf x	3,800	Occ Area =	3.4 kW x 3.4x	1.0 RAF =		11,672 Btu/h
Plug Load	1.00	w/sf x	3,800	Occ Area =	3.8 kW x 3.4x	1.0 RAF =		12,969 Btu/h
People	20	people x	255	btu/person x	100% time in space =			5,100 Btu/h
Computer Work Stations			20	Units x	120 W/Unit x 3414 =			8,191 Btu/h
Equipment	0.0	kW x 3.413 =						0 Btu/h
Misc.								0 Btu/h
								37,933 Btu/h

VENTILATION AND INFILTRATION

		Infiltration Factor		Perimeter Ratio		Coef	Temp. Diff.	Room Heat Gain
Walls	1,111 SF	0.20	CFM/SF			1.04	19 °F	4,759 Btu/h
Doors	1,035 SF	0.30	CFM/LF	0.30	LF/SF	1.04	19 °F	1,966 Btu/h
Windows	86 SF	0.30	CFM/LF	1.05	LF/SF	1.04	19 °F	578 Btu/h
Ventilation	200 cfm					1.04	19 °F	4,284 Btu/h
								11,588 Btu/h
Infiltration	341 cfm	0.4	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
North Exposure	312	0.07	20	1.0	416 Btu/hr
East Exposure	432	0.07	39	1.0	1,123 Btu/hr
South Exposure	312	0.07	27	1.0	562 Btu/hr
West Exposure	432	0.07	22	1.0	634 Btu/hr
Roof	3,800	0.04	73	0.0	0 Btu/hr
					2,734 Btu/h

INTERNAL HEAT GAINS

Lights	0.90 w/sf x	3,800	Occ Area =	3.4 kW x3413x	0.00 RAF =	0 Btu/h
Misc.						0 Btu/h
						0 Btu/h

SENSIBLE HEAT GAINS - TEMP. DEPENDENT		SENSIBLE HEAT GAINS - TEMP. INDEPENDENT	
Solar	8,653	Internal Gains to Room	37,933
Conduction to Room	19,175	Internal Gains to Plenum	0
Conduction to Plenum	2,734		
Ventilaton and Infiltration	11,588		
Sub Total	42,149	Sub Total	37,933

HEAT GAIN/LOSS WORKSHEET

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

Building/Facility Designation: Public Works Garage

LATENT COOLING LOADS

Infiltration

		Infiltration Factor	Air Density	Humidity Ratio Dif.	Room Heat Gain
Walls	5,288 SF	0.20 CFM/SF	4.629	0.0042 #/#	20,770 Btu/h
Doors	1,035 SF	0.30 CFM/LF	4.629	0.0042 #/#	1,803 Btu/h
Windows	86 SF	0.30 CFM/LF	4.629	0.0042 #/#	530 Btu/h
Ventilation	200 cfm		4.629	0.0042 #/#	3,926 Btu/h
People	20 people	1.00 time in space		250 Btu/hr/person	5,000 Btu/h
					32,030 Btu/h

Cooling Load Summary

	Sensible	Latent	Total	
Temperature Dependent Gains	42,149	32,030	74,179	
Temperature Indep. Gains	37,933	0	37,933	SHR= 0.71
Total	80,082	32,030	112,113	

Building Cooling Load: 9.3 Tons at 407 SF/Ton

Building Air Flow to Condition Space based on a 12°F Temp Rise is: 6,175 CFM, 1.63 CFM/sf

HEATING CALCULATION

CONDUCTION

	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.	Room Heat Gain
North Exposure	576	0.07	51	1,958 Btu/h
East Exposure	1,080	0.07	51	3,672 Btu/h
South Exposure	73	0.07	51	248 Btu/h
West Exposure	870	0.07	51	2,958 Btu/h
Fenestration	86	0.50	51	2,193 Btu/h
Roof	3,800	0.04	51	8,527 Btu/h
Doors	1,035	0.14	51	7,372 Btu/h
Ceiling	3,800	0.14	0	0 Btu/h
Partition	0	0.05	0	0 Btu/h
Floor	3,800	0.04	10	1,520 Btu/h

Ventilation and Infiltration

		Infiltration Factor	Coef	Temp. Difference	Air Flow	Room Heat Gain
Walls	2,599 SF	0.20 CFM/SF	1.04	51	520 cfm	27,671 Btu/h
Doors	1,035 SF	0.30 CFM/LF	1.04	51	92 cfm	4,887 Btu/h
Windows	86 SF	0.30 CFM/LF	1.04	51	27 cfm	1,437 Btu/h
Ventilation Load	200 cfm		1.04	51	200 cfm	11,499 Btu/h
Total Ventilation & Infiltration Load					839 cfm	45,494 Btu/h

Building Heating Load: 73,943 btu/h

19.5 btu/sf

City of Linwood,NJ
CHA #22215
Building: Public Works Garage

Reconcile Thermal Model

Building Footprint	3,500	SF	Ex Occupied Clng Temp.	72	°F	Ex Occupied Htg Temp.	65 °F
Heating Efficiency	70%		Ex Unoccupied Clng Temp.	72	°F	Ex Unoccupied Htg Temp.	55 °F
Cooling Efficiency	0.00	kW/ton	Occupied Cooling UA	(1,609)	btu/hr/°F	Occupied Heating UA	558 btu/hr/°F
Internal Gains	37,933	btu/h	Unoccupied Cooling UA	(1,153)	btu/hr/°F	Unoccupied Heating UA	558 btu/hr/°F
Unoc Internal Gain factor	0.03		Cooling Occ Enthalpy Setpoint	27.5	Btu/lb		
Ave Occ Internal Gain Factor	0.7		Cooling Unocc Enthalpy Setpoint	27.5	Btu/lb		
Economizer available (Y/N)	No						

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

					EXISTING LOADS									
					Occupied			Unoccupied						
Avg Outdoor Air Temp. Bins °F	Avg Outdoor Air Enthalpy	Total Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Available Economizer Cooling kWh	Necessary Cooling Energy kWh	Existing Cooling Energy kWh	Existing Heating Energy therms
A		B	C	D	E	F	G	H	I	J	K	L	M	M
102.5	49.1	0	0	0	-49,059	-81,512	-26,553	-35,170	-62,072	-1,138	0	0	0	0
97.5	42.5	9	3	6	-41,017	-56,606	-26,553	-29,404	-43,106	-1,138	0	0	0	0
92.5	39.5	69	25	44	-32,974	-45,284	-26,553	-23,639	-34,484	-1,138	0	0	0	0
87.5	36.6	132	47	85	-24,932	-34,341	-26,553	-17,873	-26,151	-1,138	0	0	0	0
82.5	34.0	344	123	221	-16,889	-24,529	-26,553	-12,108	-18,679	-1,138	0	0	0	0
77.5	31.6	566	202	364	-8,847	-15,472	-26,553	-6,342	-11,782	-1,138	0	0	0	0
72.5	29.2	755	270	485	-804	-6,415	-26,553	-577	-4,885	-1,138	0	0	0	0
67.5	27.0	780	279	501	0	0	-26,553	0	0	-1,138	0	0	0	0
62.5	24.5	889	318	572	1,395	2,264	-26,553	0	0	-1,138	0	0	0	0
57.5	21.4	742	265	477	4,184	6,793	-26,553	0	0	-1,138	0	0	0	0
52.5	18.7	627	224	403	6,973	11,321	-26,553	1,395	1,724	-1,138	0	0	0	0
47.5	16.2	725	259	466	9,762	15,850	-26,553	4,184	5,173	-1,138	0	0	0	0
42.5	14.4	795	284	511	12,551	20,378	-26,553	6,973	8,621	-1,138	0	0	0	131
37.5	12.6	784	280	504	15,340	24,906	-26,553	9,762	12,070	-1,138	0	0	0	204
32.5	10.7	682	244	438	18,129	29,435	-26,553	12,551	15,518	-1,138	0	0	0	242
27.5	8.6	345	123	222	20,918	33,963	-26,553	15,340	18,966	-1,138	0	0	0	155
22.5	6.8	229	82	147	23,708	38,492	-26,553	18,129	22,415	-1,138	0	0	0	125
17.5	5.5	189	68	122	26,497	43,020	-26,553	20,918	25,863	-1,138	0	0	0	121
12.5	4.1	70	25	45	29,286	47,549	-26,553	23,708	29,312	-1,138	0	0	0	51
7.5	2.6	20	7	13	32,075	52,077	-26,553	26,497	32,760	-1,138	0	0	0	17
2.5	1.0	8	3	5	34,864	56,606	-26,553	29,286	36,209	-1,138	0	0	0	7
-2.5	0.0	0	0	0	37,653	61,134	-26,553	32,075	39,657	-1,138	0	0	0	0
-7.5	-1.5	0	0	0	40,442	65,662	-26,553	34,864	43,106	-1,138	0	0	0	0
TOTALS		8,760	3,129	5,631								0	0	1,052

Existing Building Ventilation & Infiltration (occ)	839 cfm
Overheat Ventilation Factor	1.00
Additional ventilation to offset overheat	0 cfm
Existing Building Ventilation & Infiltration (unocc)	639 cfm
Economizer Ventilation (from AHU's)	cfm

Energy Use Indices (calculated)

	Base Case
Heating	1,052
Target ->	1,036
	101.6%

City of Linwood,NJ
CHA #22215
Building: Public Works Garage

Doors

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet
North	17.0	12.0	1	204.0	58.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	204.0	58.0
East				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	0.0	0.0
South	17.0	12.0	3	612.0	174.0
	3.0	5.0	1	15.0	16.0
				0.0	0.0
				0.0	0.0
			Sub-total	627.0	190.0
West	17.0	12.0	1	204.0	58.0
				0.0	0.0
			Sub-total	204.0	58.0
			Total	1035.0	306.0

LF/SF
0.30

Walls

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet		
North	52.0	15.0	1	780.0	134.0		All wall quantities must remain equal to 1
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	52.0			780.0	134.0	15.0	Average height wall automatically linked
East	72.0	15.0	1	1080.0	174.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	72.0			1080.0	174.0	15.0	Average height wall automatically linked
South	52.0	15.0	1	780.0	134.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	52.0			780.0	134.0	15.0	Average height wall automatically linked
West	72.0	15.0	1	1080.0	174.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	72.0			1080.0	174.0	15.0	Average height auto linked to bloc

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	4.0	4.0	5	80.0	80.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	80.0	80.0	
West	3.0	2.0	1	6.0	10.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	6.0	10.0	
						LF/SF
			Total	86.0	90.0	1.05

Description	QTY	Manufacturer Name	Model No.	Serial No.	Equipment Type / Utility	Capacity/Size	Location	Areas Served	Date Installed	Remaining Useful Life (years)	Other Info.
HW Unit Heater	1	Patco			Gas		Main Bay	Main Bay		10	
HW Unit Heater	1	Reznor			Gas		Tractor Bay	Tractor Bay		10	
Air Handling Unit - 1	1	Rheem	RRNA-B030JK08E	2G7285ADAAF15	Gas	80 MBH	Roof	1st & 2nd Flr Offices		20	Packaged Rooftop Unit
Condensing Unit - 1	1	In Rooftop									
Domestic HW Heater	1		GE30M06AAG		Electric	4.5 KW - 30 Gallon	Garage Bay	Offices			
Domestic HW Heater	1				Electric	1.5 KW - 5 Gallon	Mens Room	M&W restroom			