CITY OF LINWOOD
CITY HALL
ENERGY ASSESSMENT

for

NEW JERSEY
BOARD OF PUBLIC UTILITIES

CHA PROJECT NO. 22215

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1.0 INTRODUCTION AND BACKGROUND

The Linwood Municipal Building is a 13,000 square foot structure located at 400 Poplar Avenue, Linwood, NJ. The building is comprised of municipal offices and courtroom, and police wing. The municipal sector operates from 9:00 AM to 4:30 PM, Monday through Friday. The police wing is operated 24 hours per day with a separate entrance. Approximately 15 employees occupy the complex daily.

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 Linwood Municipal Building, a 13,000 square foot structure in Linwood, NJ. The building is comprised of municipal offices and courtroom, and police wing. Approximately 15 employees occupy the complex daily. The following areas were evaluated for energy conservation measures:

- Night setback
- Lighting replacement
- Boiler replacement
- Insulation upgrades

Various potential Energy Conservation Measures (ECMs) were identified for the above categories. Potential annual savings of $4,500 for the recommended ECMs may be realized with a payback of 0.7 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 Night Setback

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
1,000	0	7,000	2,570	0	4,200	0	4,200	65	NA	0.2	NA

*There is no current incentive available through the NJ Smart Start Program. 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
2,900	0	2,200	0	0	300	0	300	0.8	600	9.7	7.7

*Incentive shown is per the New Jersey Smart Start Program, 2010 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 Boiler Replacement

3.0 EXISTING CONDITIONS

3.1 Building – General

The Linwood Municipal Building is a 13,000 square foot building which was renovated in 2006, including the building envelope and HVAC systems. The building has two main areas, the office areas and police wing. The municipal area is composed of office space, storage area, courtroom, and restrooms. The public area is open from 9:00 AM to 4:30 PM Monday through Friday and is occupied by about 15 people. The police wing has a separate entrance which is accessed 24 hours per day, and is occupied by about four people.

The exterior is finished with brick and siding; the police wing is mainly brick finish. All the walls have insulation, and building interior walls are finished with sheetrock and painted. There is a suspended ceiling in both the municipal and police areas. The main entrance to the building has new double pane vinyl windows; the remainder has wood framed windows. The entire building has a pitched roof with asphalt shingles.

3.2 Utility Usage

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

From June 2009 through April 2010, electric usage was approximately 294,280 kWh at a cost of about $46,100. The May 2010 utility bills were not available. 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 summer months due to air conditioning. During the timeframe of June 2009 through April 2010, the building heating and domestic hot water produced by natural gas-fired equipment required about 14,020 therms. Based on the annual cost of about $16,800, the blended price for natural gas was $1.20 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 130,000 gallons of water over the course of a year. At a total cost of about $1,300, the unit cost for water was $9.90 per kGal. Utility data can be found in Appendix A.

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

3.3 HVAC Systems

3.3.1 Space Heating and Air Conditioning System

The municipal section has two approximately 75% efficient Burnham gas fired natural draft boilers, with gas inputs of 462 BMH each. Hot water is circulated throughout the municipal section by two 3 HP base mounted pumps. Finned tube radiators in the perimeter offices provide space heating. There are three Carrier air handling units (AHUs) with DX and heating coils. One AHU serves the courtroom, the other two serve the remainder of the building.

The police wing has a single Weil McLain boiler with input of 175 BMH, and is about 80% efficient. The hot water is circulated to an AHU with heating coil manufactured by Trane. The Trane unit is a Climate Changer with a 5 HP fan motor and DX cooling coil. The wing has no radiators.

The municipal section utilizes three AHUs with DX coils to supply conditioned air. These units and condensers are less than three years' old. The police wing uses the single Trane Climate Changer which is a constant volume system with a cooling coil. The condenser is outside and is in average condition. Each cooling coil for the entire building has a separate condenser located outside on grade.

3.3.2 Building Ventilation and Exhaust Systems

The building has ducts that supply fresh air to the AHUs. There is an exhaust fan for the municipal area restrooms. The police area has a separate restroom exhaust fan.

3.4 Lighting/Electrical Systems

Most of the fixtures in the municipal sector use two T-8 lamps with electronic ballasts. Several fixtures in the corridor had compact fluorescent bulbs. The police wing has four lamp T-12 fixtures and magnetic ballasts. Exterior lighting consists of five fixtures mounted to the sides of the building. The police area has a backup generator.

3.5 Control Systems

3.5.1 HVAC Controls

HVAC controls in the municipal portion consist of wall mounted thermostats in various rooms and a master thermostat in the hallway. Temperature setpoints vary throughout the main building area; on average, these are 70°F for heating and 72°F for cooling during occupied times. All the controls were programmable and connected to a master control panel on each AHU. The system uses a variable volume temperature (VVT) controls sequence which varies the supply temperature in the AHU.

The controls for the police wing consist of a single programmable thermostat located in the hallway; however, limited setback is performed because the wing is occupied continuously. The setpoints are 72°F cooling and 70°F heating.

3.5.2 Lighting/Electrical Controls

Lighting controls are manual switches located within each space. The exterior lights are on a timer.

3.6 Plumbing Systems

Domestic hot water is generated by a 40 gallon, AO Smith gas-fired water heater with an input of 40,000 Btuh. It is in fair condition. The plumbing fixtures in the municipal sector are low flow type, and fixtures in the police wing are standard flow.

4.0 ENERGY CONSERVATION MEASURES

4.1 ECM-1 Insulate Ceiling over Police Wing

The area above the ceiling of the police wing has minimal insulation and allows conditioned air to escape. The existing insulation in this area is insufficient and this ECM assessed adding about nine inches of batt insulation. This would raise the thermal resistance, or R-value, from about R-17 to R-36.

To calculate the savings associated with adding insulation, the existing thermal losses through the roof were calculated with the existing insulation and compared with the thermal losses with the added batt insulation. The difference between the existing conditions and proposed conditions was taken and compared with yearly temperature bin data. The calculated savings associated with adding additional insulation would be approximately 300 therms of natural gas per year. There would also be cooling savings of 320 kWh since the space is air conditioned during the summer months.

Insulation has a life expectancy of about 20 years according to ASHRAE and the total energy savings over the life of the project would be about 6,000 therms and 6,400 kWh and $8,000.

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

ECM-1 Insulate Ceiling Over Police Wing

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
5,500	0	320	300	400	0.43	NA	14	NA

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

This measure is not recommended.

4.2 ECM-2 Boiler Replacement

The municipal section has two Burnham boilers with 462 MBH input while the police wing has a single Weil McLain boiler with 175 MBH input. Although the municipal area was recently renovated, the existing boilers were not replaced.

All three boilers are beyond their useful life and should be replaced. The average existing heating efficiency is estimated to be around 68%. This ECM evaluated replacing all the boilers with newer high efficiency, condensing boilers. Based on the utility bills, gas usage was over 14,000 therms. With the improved efficiency of new condensing boilers of approximately 92%, the natural gas savings is expected to be 3,000 therms.

For implementation of this measure, one new gas-fired, condensing, hot water boiler would be installed for the police wing and two new condensing boilers for the municipal wing. A new exhaust flue system will be required for each boiler.

Condensing boilers have an expected life of 20 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 60,000 therms totaling $70,000.

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

ECM-2 Boiler Replacement

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
181,000	0	0	3,000	0	3,500	0	3,500	(0.6)	1,500	>25	>25

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

This measure is not recommended.

4.3 ECM-3 Night Setback

Heating and cooling is provided by the boilers and AHUs in the municipal section of the building. The existing controls use a constant temperature setpoint during unoccupied and occupied hours. The typical settings are 70°F in heating and 72°F in cooling mode.

To calculate the benefits of night setback, a block load building model was created to approximate the existing energy load. The block load, provided in Appendix L, models the maximum overall cooling and heating load for each space, taking into account various parameters such as roof, wall, and window construction; total envelope surface area; ventilation and infiltration loads; building occupancy; internal heat generation; and other sources of heat gains and losses. By entering this calculated maximum load into a spreadsheet containing bin temperature data, the total accumulated year-round cooling and heating energy requirements were determined. The heating and cooling loads were then combined and reconciled to building utility data and HVAC equipment energy requirements to confirm the model's accuracy. Bin data for Atlantic City, NJ was used. The bin temperature spreadsheets are included in Appendix L.

This measure will save energy by modifying the heating and cooling setpoints during the unoccupied times. It is intended to lower the heating set point to 60°F and cooling set point to 78°F during the unoccupied times.

For implementation of this measure, the existing controls will need to be reprogrammed to achieve the new schedule.

Controls equipment has an expected life of 15 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 105,000 kWh, 38,550 therms, totaling $63,000.

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

ECM-3 Night Setback

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
1,000	0	7,000	2,570	0	4,200	0	4,200	65	NA	0.2	NA

*There is no current incentive available through the NJ Smart Start Program. 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. There are a series of T-12 lamps and magnetic ballasts in the police wing which should be replaced to newer technology T-8 lamps and electronic ballasts.

Energy savings for this measure were calculated by applying the existing and proposed fixture wattages to the estimated time of operation to determine annual electricity consumptions. The difference resulted in an annual savings of about 2,200 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 33,000 kWh, totaling $4,500.

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
2,900	0	2,200	0	0	300	0	300	0.8	600	9.7	7.7

*Incentive shown is per the New Jersey Smart Start Program, 2010 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 building will be eligible for incentives from the New Jersey Office of Clean Energy. The most significant incentives will be from the New Jersey Pay for Performance (P4P) Program. The P4P program is designed for qualified energy conservation projects in facilities whose demand in any of the preceding 12 months exceeds 200 kW. However, the 200 kW/month average minimum has been waived for buildings owned by local governments or municipalities and non-profit organizations. Facilities that meet this criterion must also achieve a minimum performance target of 15% energy reduction by using the EPA Portfolio Manager benchmarking tool before and after implementation of the measure(s). If the participant is a municipal electric company customer, and a customer of a regulated gas New Jersey Utility, only gas measures will be eligible under the Program. American Recovery and Reinvestment Act (ARRA) funding, when available, may allow oil, propane and municipal electric customers to be eligible for the P4P Program. Available incentives are as follows:

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

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

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

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

5.1.2 New Jersey Smart Start Program

For this program, specific incentives for energy conservation measures are calculated on an individual basis utilizing the 2010 New Jersey Smart Start incentive program. This program provides incentives dependent upon mechanical and electrical equipment. If applicable, incentives from this program are reflected in the ECM summaries and attached appendices.

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

5.1.3 Energy Efficient and Conservation Block Grant

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

Additional funding is available to local government entities through the EECBG, a part of New Jersey's Clean Energy program (NJCEP). The grant is for local government entities only, and can offset the cost of energy reduction implementation to a maximum of $20,000 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, the Municipal Building is eligible for about $700 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 $15,700 based as discussed above in section 5.1.1. See Appendix F for further calculation.

5.2.2 New Jersey Smart Start Program

The building is eligible for several incentives available under New Jersey Smart Start Programs. The total amount of all qualified incentives is about $2,100 and includes new lighting and boilers.

5.2.3 Energy Efficient and Conservation Block Grant

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

The Municipal Building pays the Societal Benefits charge on their monthly utility bill and therefore is not eligible for this incentive.

5.2.5 Direct Install Program

The building is potentially eligible to receive funding from the Direct Install Program. This money can be in conjunction with the Energy Efficiency and Conservation Block Grant. The total implementation cost for the eligible ECMs for Direct Install funding is about $190,100. This includes new boilers and lighting fixtures. This program would pay 60% of these initial costs or $114,100. This funding has the potential to significantly affect the payback periods of Energy Conservation Measures. For the Municipal Building, the Direct Install Program brings the simple payback to approximately 18 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 3 gas-fired, hot water boilers and split system AHUs with DX cooling to meet the HVAC requirements. The air handlers would have to be replaced and significant piping changes would need to occur so this measure is not recommended.

6.2 Solar

6.2.1 Photovoltaic Rooftop Solar Power Generation

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

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

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

Installation of (PV) arrays in the state New Jersey will allow the owner to participate in the New Jersey solar renewable energy certificates program (SREC). This is a program that has been set up to allow entities with large amounts of environmentally unfriendly emissions to purchase credits from zero emission (PV) solar-producers. An alternative compliance penalty (ACP) is paid for by the high emission producers and is set each year on a declining scale of 3% per year. One SREC credit is equivalent to 1000 kilowatt hours of PV electrical production; these credits can be traded for period of 15 years from the date of installation. The cost of the ACP penalty for 2009 is $700; this is the amount that must be paid per SERC by the high emission producers. The expected dollar amount that will be paid to the PV producer for 2010 is expected to be $600/SREC credit. Payments that will be received from the PV

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

The building roof size justifies the use of a 10kW solar array. The system costs for PV installations were estimated as $7 per watt or $7,000 per kW of installed system. This has increased in the past few years due to the rise in national demand for PV power generator systems. Other cost considerations will also need to be considered. PV panels have an approximate 20 year life span; however, the inverter device that converts DC electricity to AC has a life span of 10 to 12 years and will need to be replaced multiple times during the useful life of the PV system.

The implementation cost and savings related to this ECM are presented in Appendix 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	12,503	0	1,800	1,800	10,000	6,100	>25	7.6

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

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

6.2.2 Solar Thermal Hot Water Plant

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

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

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

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

The implementation cost and savings related to this ECM are presented in Appendix 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 building may have enough wind speed to support a wind turbine. A wind speed map and aerial site photo are included in Appendix I. The location of the building outside of a dense residential area and good potential for wind speed make this an option to explore further with vendors.

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.

This measure is not recommended since the facility cannot use the waste heat in the summer months.

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

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 building has one gas meter and one electric meter for both the municipal section and police section. Since the police area is over 10% of the total size of the building, the EPA Portfolio Manager software cannot provide a score.

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 Linwood Municipal Building in Linwood, New Jersey identified potential ECMs for night setback and lighting replacement. Potential annual savings of $4,500 may be realized for the recommended ECMs, with a summary of the costs, savings, and paybacks as follows:

ECM-3 Night Setback

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
1,000	0	7,000	2,570	0	4,200	0	4,200	65	NA	0.2	NA

*There is no current incentive available through the NJ Smart Start Program. 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
2,900	0	2,200	0	0	300	0	300	0.8	600	9.7	7.7

*Incentive shown is per the New Jersey Smart Start Program, 2010 Prescriptive Lighting Application. See section 5.0 for other incentive opportunities.

APPENDICES

APPENDIX A

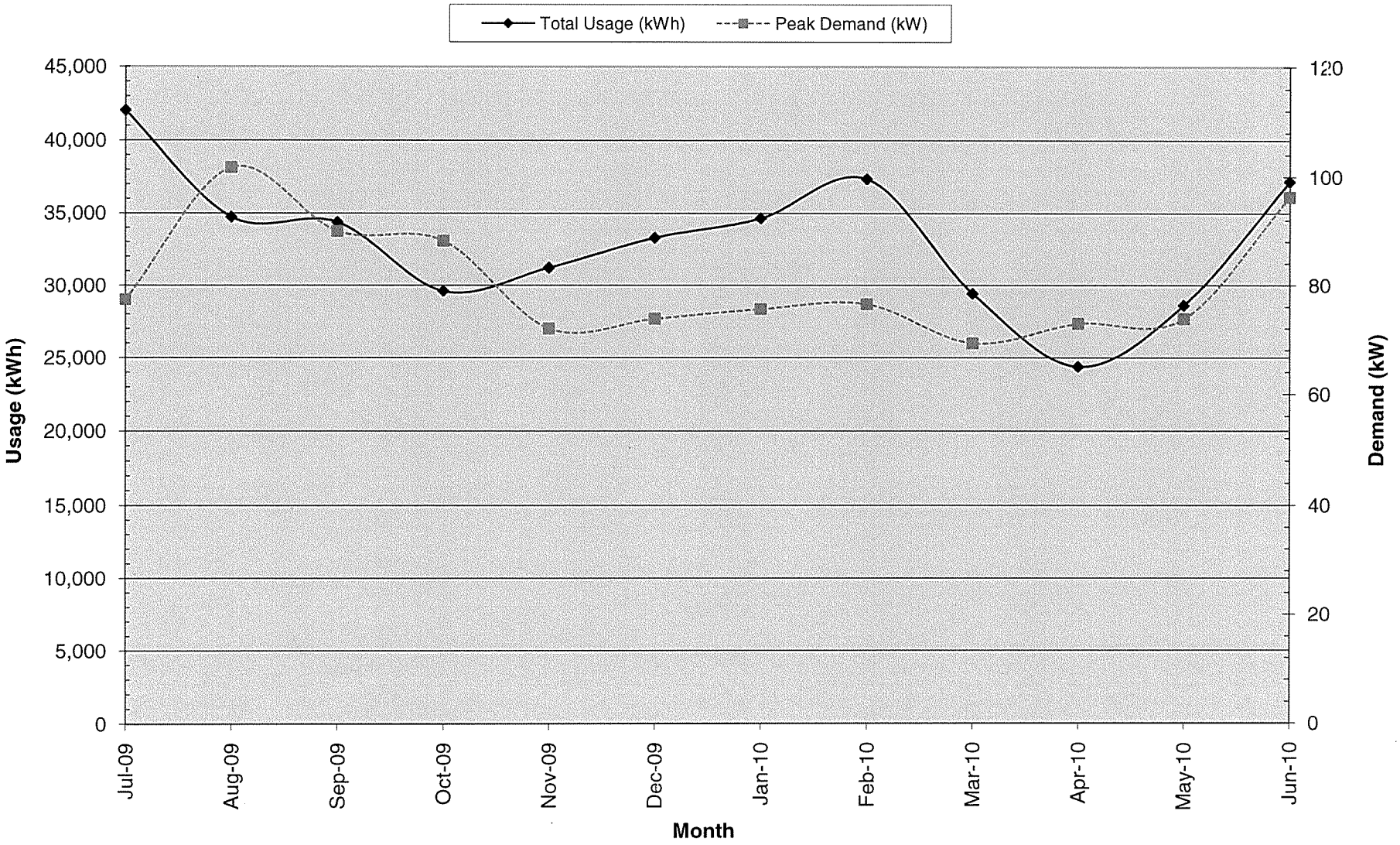
Utility Usage Analysis

City of Linwood
CHA Project Number: 22215
City Hall

Oak & Poplar Ave
Account Number: **0100 5739 9999**
Meter Number: **8084459**

			Charges					Unit Costs		
Month	Consumption (kWh)	Demand (kW)	Total ($)	Supply ($)	Delivery ($)	Demand ($)	Consumption ($)	Blended Rate ($/kWh)	Consumption ($/kWh)	Demand ($/kW)
June-09	26,320	73.2	$4,389.18	$3,522.71	$866.47	$0.00	$4,389.18	0.1668	0.1668	-
July-09	34,080	72.4	$5,503.08	$4,521.71	$981.37	$0.00	$5,503.08	0.1615	0.1615	-
August-09	34,080	72.4	$5,503.08	$3,469.02	$844.23	$0.00	$5,503.08	0.1615	0.1615	-
September-09	26,120	66.4	$4,313.25	$2,838.92	$852.28	$0.00	$4,313.25	0.1651	0.1651	-
October-09	25,560	66.4	$3,691.20	$2,943.14	$796.35	$0.00	$3,691.20	0.1444	0.1444	-
November-09	26,720	57.2	$3,739.49	$2,947.03	$850.20	$0.00	$3,739.49	0.1400	0.1400	-
December-09	26,640	57.2	$3,797.23	$2,690.54	$727.22	$0.00	$3,797.23	0.1425	0.1425	-
January-10	24,440	48.8	$3,417.76	$2,748.31	$774.98	$0.00	$3,417.76	0.1398	0.1398	-
February-10	24,920	46.0	$3,098.97	$2,387.20	$711.77	$0.00	$3,098.97	0.1244	0.1244	-
March-10	21,560	47.2	$4,288.27	$3,468.81	$819.46	$0.00	$4,288.27	0.1989	0.1989	-
April-10	23,840	64.4	$4,394.46	$3,468.81	$925.65	$0.00	$4,394.46	0.1843	0.1843	-
Total	294,280		$46,135.97	$35,006.20	$9,149.98	$0.00	$46,135.97	0.1568	0.1568	-
Most Recent Yr	294,280		$46,135.97	$35,006.20	$9,149.98	$0.00	$46,135.97	0.1568	0.1568	-

Electric Usage - City Hall - Oak & Poplar Ave



Electric Utility Data - Rev1
City Hall - Electricity Chart

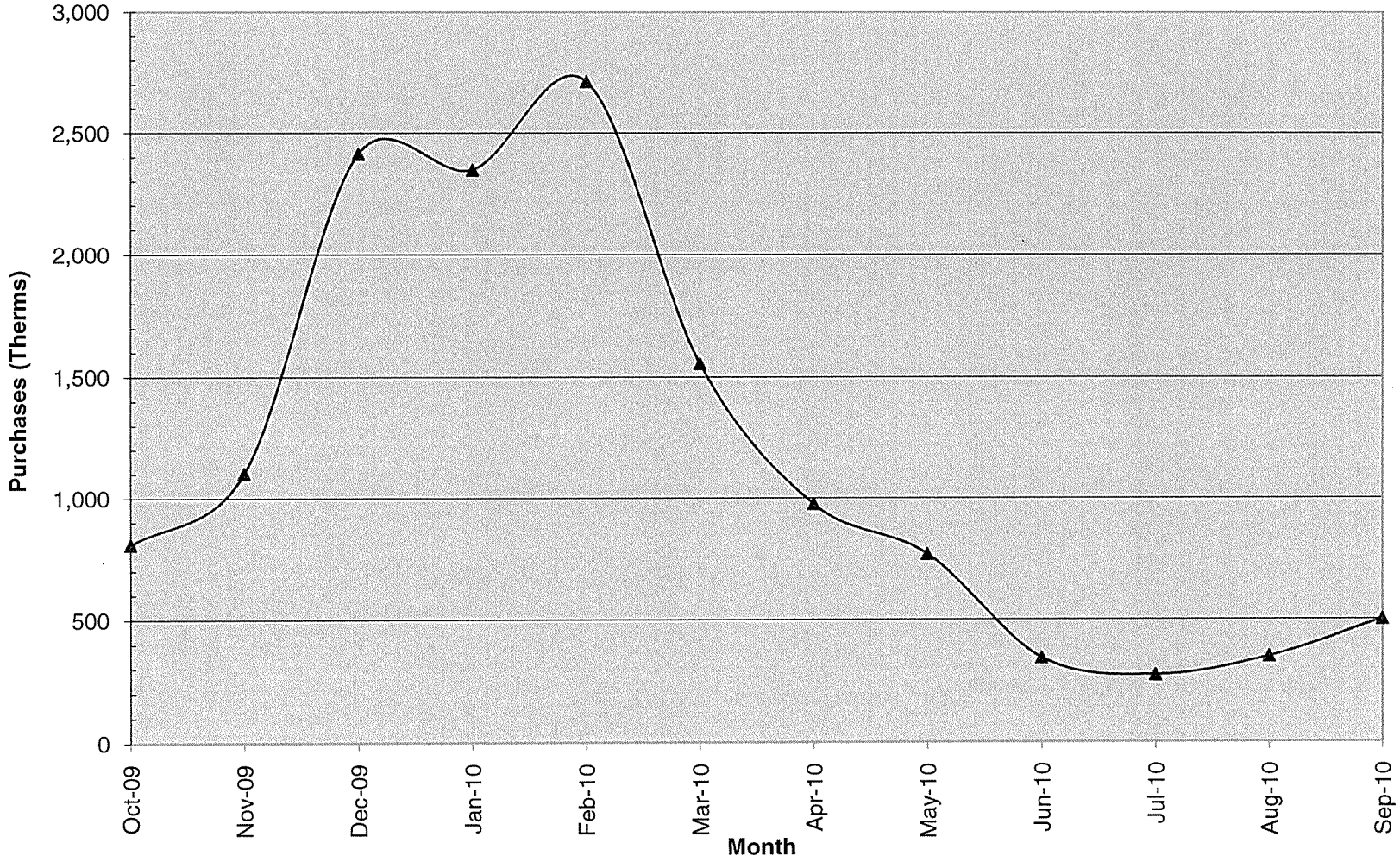
City of Linwood
CHA Project Number: 22215
City Hall

400 Poplar Ave
Account Number: 1 16 37 0042 0 8

Meter Number: 0232070

Month	Therms	Total Charges	($/therm)
June-09	401	$ 641.16	$ 1.60
July-09	236	$ 384.35	$ 1.63
August-09	203	$ 332.23	$ 1.64
September-09	500	$ 550.00	$ 1.10
October-09	807	$ 1,083.29	$ 1.34
November-09	1102	$ 1,472.67	$ 1.34
December-09	2414	$ 2,545.87	$ 1.05
January-10	2348	$ 3,009.97	$ 1.28
February-10	2713	$ 3,224.50	$ 1.19
March-10	1555	$ 1,758.56	$ 1.13
April-10	975	$ 987.93	$ 1.01
May-10	768	$ 824.03	$ 1.07
June-10	344	$ 364.06	$ 1.06
July-10	273	$ 300.30	$ 1.10
August-10	349	$ 383.90	$ 1.10
September-10	500	$ 550.00	$ 1.10
Most Recent Yr	14,022	$ 16,815	$ 1.20

Natural Gas Usage - City Hall



Gas Utility Data - Rev1
Municipal Gas Chart

ELECTRIC MARKETERS LIST

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Jan 14, 2009

GAS MARKETERS LIST

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

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

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

RPL Holdings, Inc
601 Carlson Pkwy
Minnetonka, MN 55305

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

APPENDIX B

ECM-1 Increase Ceiling Insulation

City of Linwood,NJ
CHA #22215
Building: City Hall

ECM-1: Increase Ceiling Insulation

add insulation above ceiling in Police Wing only

Existing Area	4,180	sf
Existing U-value	0.06	Btu/hr/(sf*F)
Existing R-value	17.6	
Proposed R-value	36.6	
Proposed U-value	0.03	Btu/hr/(sf*F)
Heating System Efficiency	68%	
Cooling System Efficiency	1.20	kW/ton
Heating "On" Temp	60	F

Existing Cooling

Existing Cooling Load Temp Diff.	73	F
Existing Max. Roof Cooling Load	16,541	Btu/hr

Proposed Cooling

Proposed Cooling Load	7,949	Btu/hr
Occupied Cooling Setpoint	65	F
Unoccupied Cooling Setpoint	65	F

Existing Heating

Existing Heating Load Temp Diff.	58	F
Existing Max. Roof Heating Load	13,142	Btu/hr

Proposed Heating

Proposed Heating Load	6,316	Btu/hr
Occupied Heating Setpoint	72	F
Unoccupied Heating Setpoint	72	F

Existing Heating Total	38,306,581	Btu/yr
Proposed Heating Total	18,408,789	Btu/yr
Savings	19,897,792	Btu/yr
Input	293	**therms**
Existing Cooling Total	615	kWh/yr
Proposed Cooling Total	295	kWh/yr
Savings	319	kWh/yr

				Occupied				Unoccupied							
Avg Outdoor Air Temp. Bins °F	**Existing Equipment Bin Hours**	**Occupied Equipment Bin Hours**	**Unoccupied Equipment Bin Hours**	**Existing Heat Gain**	**Proposed Heat Gain**	**Existing Heat Loss**	**Proposed Heat Loss**	**Existing Heat Gain**	**Proposed Heat Gain**	**Existing Heat Loss**	**Proposed Heat Loss**	**Existing Cooling Load**	**Existing Heating Load**	**Proposed Cooling Load**	**Proposed Heating Load**
				(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(Btu/hr)	(kWh/yr)	(Btu/yr)	(kWh/yr)	(Btu/yr)
102.5	0	0	0	8,912	4,283	-	-	8,912	4,283	-	-	-	-	-	-
97.5	9	9	0	7,724	3,712	-	-	7,724	3,712	-	-	7	-	3	-
92.5	69	69	0	6,535	3,141	-	-	6,535	3,141	-	-	45	-	22	-
87.5	132	132	0	5,347	2,570	-	-	5,347	2,570	-	-	71	-	34	-
82.5	344	344	0	4,159	1,999	-	-	4,159	1,999	-	-	143	-	69	-
77.5	566	566	0	2,971	1,428	-	-	2,971	1,428	-	-	168	-	81	-
72.5	755	755	0	1,782	857	-	-	1,782	857	-	-	135	-	65	-
67.5	780	780	0	594	286	-	-	594	286	-	-	46	-	22	-
62.5	889	889	0	-	-	-	-	-	-	-	-	-	-	-	-
57.5	742	742	0	-	-	3,446	1,656	-	-	3,446	1,656	-	2,556,909	-	1,228,760
52.5	627	627	0	-	-	4,634	2,227	-	-	4,634	2,227	-	2,905,665	-	1,396,360
47.5	725	725	0	-	-	5,822	2,798	-	-	5,822	2,798	-	4,221,312	-	2,028,613
42.5	795	795	0	-	-	7,011	3,369	-	-	7,011	3,369	-	5,573,558	-	2,678,455
37.5	784	784	0	-	-	8,199	3,940	-	-	8,199	3,940	-	6,428,039	-	3,089,089
32.5	682	682	0	-	-	9,387	4,511	-	-	9,387	4,511	-	6,402,135	-	3,076,640
27.5	345	345	0	-	-	10,576	5,082	-	-	10,576	5,082	-	3,648,568	-	1,753,373
22.5	229	229	0	-	-	11,764	5,653	-	-	11,764	5,653	-	2,693,916	-	1,294,601
17.5	189	189	0	-	-	12,952	6,224	-	-	12,952	6,224	-	2,447,945	-	1,176,396
12.5	70	70	0	-	-	14,140	6,795	-	-	14,140	6,795	-	989,825	-	475,675
7.5	20	20	0	-	-	15,329	7,366	-	-	15,329	7,366	-	306,572	-	147,328
2.5	8	8	0	-	-	16,517	7,937	-	-	16,517	7,937	-	132,135	-	63,499
-2.5	0	0	0	-	-	17,705	8,508	-	-	17,705	8,508	-	-	-	-
-7.5	0	0	0	-	-	18,893	9,080	-	-	18,893	9,080	-	-	-	-
TOTALS	**8,760**	**8,760**	**0**									**615**	**38,306,581**	**295**	**18,408,789**

City of Linwood,NJ
CHA #22215
Building: City Hall

ECM-1 Increase Ceiling 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.		
Install 6" batt insulation	4180	sqft	$ 0.48	$ 0.55		$ 1,966	$ 2,782	$ -	$ 4,748	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 4,748	Subtotal
$ 237.40	5% Contingency
$ 498.55	Contractor 10% O&P
$ -	Engineering
$ 5,484	**Total**

APPENDIX C

ECM-2 Replace Boilers

City of Linwood,NJ
CHA #22215
Building: City Hall

ECM-2 Replace Boilers

replace boilers in Municipal Section and Police Section

Existing Fuel Nat.Gas

Proposed Fuel Nat.Gas

Item	Value	Units	Formula/Comments
Baseline Fuel Cost	$ 1.20		
Proposed Fuel Cost	$ 1.20		
Baseline Fuel Use	11,316	Therms	Based on historical utility data
Existing Boiler Plant Efficiency	68%		Estimated
Baseline Boiler Load	769,488	Mbtu/yr	Baseline Fuel Use x Existing Efficiency x 100 Mbtu/Therms
Baseline Fuel Cost	$ 13,570		
Proposed Boiler Plant Efficiency	92%		New Boiler Efficiency
Proposed Fuel Use	8,364	Therms	Baseline Boiler Load / Proposed Efficiency / 100 Mbtu/Therms
Proposed Fuel Cost	$ 10,030		
Annual Savings	2,952	Therms	
Annual Savings	**$ 3,540**	**/yr**	

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

City of Linwood,NJ
CHA #22215
Building: City Hall

ECM-2 Replace Boilers

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.		
Weil McClain for Municipal(350 MBTU each)	2	ea	$ 20,000	$ 15,000		$ 39,200	$ 36,300	$ -	$ 75,500	Includes removal of old
Weil McClain for Police(175MBTU)	1	ea	$ 10,000	$ 10,000		$ 9,800	$ 12,100	$ -	$ 21,900	boilers and startup
						$ -	$ -	$ -	$ -	
Piping	1		$ 3,000	$ 3,000		$ 2,940	$ 3,630	$ -	$ 6,570	
Electrical	1		$ 1,000	$ 1,000		$ 980	$ 1,210	$ -	$ 2,190	
						$ -	$ -	$ -	$ -	
Flue	3		$ 1,250	$ 1,250		$ 3,675	$ 4,538	$ -	$ 8,213	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 114,373	Subtotal
$ 17,155.88	15% Contingency
$ 13,152.84	Contractor 10% O&P
$ 36,170	25% Engineering
$ 180,852	**Total**

APPENDIX D

ECM-3 Night Setback

City of Linwood,NJ
CHA #22215
Building: City Hall

ECM-3 Night Setback Municipal Section

Building Footprint	9,954 SF	Ex Occupied Clng Temp.	85 °F	Ex Occupied Htg Temp.	72 °F	**Heating Energy Savings**	2,568 therms
Heating Efficiency	66%	Ex Unoccupied Clng Temp.	65 °F	Ex Unoccupied Htg Temp.	72 °F	**Cooling Energy Savings**	6,985 kWh
Cooling Efficiency	1.2 kW/ton	Prop Occupied Clng Temp.	65 °F	Prop Occupied Htg Temp.	72 °F		
Building Balance Temp.	60 °F	Prop Unoccupied Clng Temp.	78 °F	Prop Unoccupied Htg Temp.	60 °F		
Internal Gains	60,976 btu/h	Occupied Cooling UA	3,586 btu/hr/°F	Occupied Heating UA	1,469 btu/hr/°F		
Unoc Internal Gain factor	0.03	Unoccupied Cooling UA	2,487 btu/hr/°F	Unoccupied Heating UA	1,102 btu/hr/°F		
Ave Occ Internal Gain Factor	0.6	Cooling Occ Enthalpy Setpoint	26.75 Btu/lb				
		Cooling Unocc Enthalpy Setpoint	26.75 Btu/lb				

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

					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 Cooling Energy kWh	Proposed Cooling Energy kWh	Existing Heating Energy therms	Proposed Heating Energy therms
A		B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	K	L	M	N
102.5	49.1	0	0	0	-134,459	-394,350	-36,587	-92,531	-253,545	-1,829	-134,459	-394,350	-36,587	-60,453	-253,545	-1,829	0	0	0	0
97.5	42.5	9	3	6	-116,531	-277,897	-36,587	-80,193	-178,672	-1,829	-116,531	-277,897	-36,587	-48,116	-178,672	-1,829	289	271	0	0
92.5	39.5	69	25	44	-98,603	-224,965	-36,587	-67,856	-144,640	-1,829	-98,603	-224,965	-36,587	-35,779	-144,640	-1,829	1,838	1,696	0	0
87.5	36.6	132	47	85	-80,676	-173,796	-36,587	-55,519	-111,741	-1,829	-80,676	-173,796	-36,587	-23,441	-111,741	-1,829	2,807	2,535	0	0
82.5	34	344	123	221	-62,748	-127,921	-36,587	-43,181	-82,246	-1,829	-62,748	-127,921	-36,587	-11,104	-82,246	-1,829	5,606	4,897	0	0
77.5	31.6	566	202	364	-44,820	-85,575	-36,587	-30,844	-55,020	-1,829	-44,820	-85,575	-36,587	0	0	-1,829	6,566	3,442	0	0
72.5	29.2	755	270	485	-26,892	-43,228	-36,587	-18,506	-27,793	-1,829	-26,892	-43,228	-36,587	0	0	-1,829	5,213	2,966	0	0
67.5	27	780	279	501	-8,964	-4,411	-36,587	-6,169	-2,836	-1,829	-8,964	-4,411	-36,587	0	0	-1,829	1,935	1,484	0	0
62.5	24.5	889	318	572	13,954	40,229	-36,587	10,465	25,865	-1,829	13,954	40,229	-36,587	0	0	-1,829	0	0	372	67
57.5	21.4	742	265	477	21,298	61,402	-36,587	15,974	39,478	-1,829	21,298	61,402	-36,587	2,754	6,807	-1,829	0	0	556	234
52.5	18.7	627	224	403	28,642	82,575	-36,587	21,482	53,091	-1,829	28,642	82,575	-36,587	8,262	20,420	-1,829	0	0	677	405
47.5	16.2	725	259	466	35,986	103,748	-36,587	26,990	66,704	-1,829	35,986	103,748	-36,587	13,770	34,033	-1,829	0	0	1,022	708
42.5	14.4	795	284	511	43,331	124,921	-36,587	32,498	80,317	-1,829	43,331	124,921	-36,587	19,278	47,646	-1,829	0	0	1,384	1,039
37.5	12.6	784	280	504	50,675	146,095	-36,587	38,006	93,931	-1,829	50,675	146,095	-36,587	24,787	61,259	-1,829	0	0	1,624	1,284
32.5	10.7	682	244	438	58,019	167,268	-36,587	43,514	107,544	-1,829	58,019	167,268	-36,587	30,295	74,872	-1,829	0	0	1,638	1,342
27.5	8.6	345	123	222	65,363	188,441	-36,587	49,022	121,157	-1,829	65,363	188,441	-36,587	35,803	88,485	-1,829	0	0	943	793
22.5	6.8	229	82	147	72,707	209,614	-36,587	54,530	134,770	-1,829	72,707	209,614	-36,587	41,311	102,098	-1,829	0	0	701	602
17.5	5.5	189	68	122	80,051	230,787	-36,587	60,038	148,383	-1,829	80,051	230,787	-36,587	46,819	115,712	-1,829	0	0	641	559
12.5	4.1	70	25	45	87,395	251,960	-36,587	65,547	161,996	-1,829	87,395	251,960	-36,587	52,327	129,325	-1,829	0	0	261	230
7.5	2.6	20	7	13	94,740	273,133	-36,587	71,055	175,609	-1,829	94,740	273,133	-36,587	57,835	142,938	-1,829	0	0	81	72
2.5	1	8	3	5	102,084	294,307	-36,587	76,563	189,223	-1,829	102,084	294,307	-36,587	63,343	156,551	-1,829	0	0	35	32
-2.5	0	0	0	0	109,428	315,480	-36,587	82,071	202,836	-1,829	109,428	315,480	-36,587	68,851	170,164	-1,829	0	0	0	0
-7.5	-1.5	0	0	0	116,772	336,653	-36,587	87,579	216,449	-1,829	116,772	336,653	-36,587	74,360	183,777	-1,829	0	0	0	0
TOTALS		8,760	3,129	5,631													24,255	17,290	9,935	7,367

Existing Building Ventilation & Infiltration (occ)	**3,921 cfm**
Overheat Ventilation Factor	**1.00**
Additional ventilation to offset overheat	**0 cfm**
Existing Building Ventilation & Infiltration (unocc)	**2,521 cfm**

City of Linwood,NJ
CHA #22215
Building: City Hall

ECM-3 Night Setback

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.		
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
Reprogram DDC system	8	hrs	$ -	$ 80	$ -	$ -	$ 774	$ -	$ 774	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 774	Subtotal
$ 77.44	10% Contingency
$ 85.18	Contractor 10% O&P
$ -	0% Engineering
$ 937	**Total**

APPENDIX E

ECM-4 Lighting Replacement

City of Linwood,NJ
CHA #22215
Building: City Hall

ECM-4 Lighting Replacement

Electric Rate $ 0.141 /kWh
Demand Rate 0 /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	Annual $ Saved	Retrofit Cost	Simple Payback
Mayors Office	2	3	2 x 4	T8	71	0	72.42	0.213	switch	10	2600	553.8													
Munc. Clerk	2	6	2 x 4	T8	71	0	72.42	0.426	switch	10	2600	1107.6													
Tax Assessor	2	6	2 x 4	T8	71	0	72.42	0.426	switch	10	2600	1107.6													
Bldg. Code Officials	2	8	2 x 4	T8	71	0	72.42	0.568	switch	10	2600	1476.8													
Staff Room	2	2	2 x 4	T8	71	0	72.42	0.142	switch	10	2600	369.2													
Storage	2	1	2 x 4	T8	71	0	72.42	0.071	switch	10	2600	184.6													
Payment Lobby	2	2	2 x 2	T8	71	0	72.42	0.142	switch	10	2600	369.2													
Copy Room	2	4	2 x 4	T8	71	0	72.42	0.284	switch	10	2600	738.4													
Storage	2	1	2 x 4	T8	71	0	72.42	0.071	switch	0.5	130	9.23													
Storage	2	1	2 x 4	T8	71	0	72.42	0.071	switch	0.5	130	9.23													
Janitors Closet	2	1	2 x 4	T8	71	0	72.42	0.071	switch	0.5	130	9.23													
Finance	2	9	2 x 4	T8	71	0	72.42	0.639	switch	10	2600	1661.4													
Closet	1	2	1 x 4	T8	43	0	43.86	0.086	switch	0.5	130	11.18													
Closet	1	1	1 x 4	T8	43	0	43.86	0.043	switch	0.5	130	5.59													
Closet	1	1	1 x 4	T8	43	0	43.86	0.043	switch	0.5	130	5.59													
City Admin.	2	6	2 x 4	T8	71	0	72.42	0.426	switch	10	2600	1107.6													
Vestibule	1	4	Wall Sconce	Inc.	75	0	76.5	0.3	switch	10	2600	780	4	36	LED PAR 38 Spot	0.144	switch	10	2600	374.4	0.156	405.6	57.22	200	3.495397251
Lobby	1	8	1x4	T8	43	0	43.86	0.344	switch	10	2600	894.4													
Display	1	6	Down Light	Inc.	75	0	76.5	0.45	switch	10	2600	1170	6	36	LED PAR 38 Spot	0.216	switch	10	2600	561.6	0.234	608.4	85.83	300	3.495397251
Corridor	2	9	2 x 2	T8	60	0	61.2	0.54	switch	10	2600	1404													
Meeting Room	2	6	2 x 4	T8	71	0	72.42	0.426	switch	4	1040	443.04													
Court Clerk	2	6	2 x 4	T8	71	0	72.42	0.426	switch	1	260	110.76													
Corridor	2	3	2 x 2	T8	60	0	61.2	0.18	switch	10	2600	468													
Women's Room	2	3	2 x 4	T8	71	0	72.42	0.213	switch	10	2600	553.8													
Men's Room	2	3	2 x 4	T8	71	0	72.42	0.213	switch	10	2600	553.8													
Judge Restroom	1	4	Down Light	Inc	75	0	76.5	0.3	switch	0.2	52	15.6	4	36	LED PAR 38 Spot	0.144	switch	0.2	52	7.488	0.156	8.112	1.14	200	174.7698625
Conference Caucus Room	1	16	Down Light	Inc.	75	0	76.5	1.2	switch	0.5	130	156	16	36	LED PAR 38 Spot	0.576	switch	0.5	130	74.88	0.624	81.12	11.44	800	69.90794502
Conference Caucus Room	1	4	Down Light	Inc.	75	0	76.5	0.3	switch	0.5	130	39	4	36	LED PAR 38 Spot	0.144	switch	0.5	130	18.72	0.156	20.28	2.86	200	69.90794502
Mail Area	2	1	2 x 2	T8	60	0	61.2	0.06	switch	10	2600	156													
Hall	1	1	1 x 4	T8	43	0	43.86	0.043	switch	10	2600	111.8													
Ramp	2	3	2 x 4	T8	71	0	72.42	0.213	switch	10	2600	553.8													
Council Room	2	14	2 x 2	T8	60	0	61.2	0.84	switch		888	745.92													
Council Room	1	19	Down Light	Inc.	75	0	76.5	1.425	switch	10	888	1265.4	19	36	LED PAR 38 Spot	0.684	switch	10	888	607.392	0.741	658.008	92.83	950	10.23427123
Vestibule	2	1	2 x 2	T8	60	0	61.2	0.06	switch	10	2600	156													
A/V	1	2	1 x 4	T8	43	0	43.86	0.086	switch	0.2	52	4.472													
Vestibule	1	1	1 x 4	T8	43	0	43.86	0.043	switch	10	2600	111.8													
Corridor	2	3	2 x 2	T8	60	0	61.2	0.18	switch	10	2600	468													
Vault	2	1	2 x 4	T8	71	0	72.42	0.071	switch	10	2600	184.6													
Cupola		4	Wall Sconce	Inc.	75	0	76.5	0.3	switch	10	2600	780	4	36	LED PAR 38 Spot	0.144	switch	10	2600	374.4	0.156	405.6	57.22	200	3.495397251
								11.9				19,852	57			2.1				2,019	2.2	2,187	$ 309	2850	9.237123263

APPENDIX F

New Jersey Pay For Performance Incentive Program

City of Linwood,NJ
CHA #22215
City Hall

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)	13,000
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)	$46,136	$16,815
Existing Usage (from utility)	294,280	14,022
Proposed Savings	2,187	5,813
Existing Total MMBtus	2,407	
Proposed Savings MMBtus	589	
% Energy Reduction	**24.5%**	
Proposed Annual Savings	$8,455	

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

	Incentives $		
	Elec	Gas	Total
Incentive #1	$0	$0	$650
Incentive #2	$284	$8,429	$8,713
Incentive #3	$197	$6,104	$6,300
Total All Incentives	**$481**	**$14,532**	**$15,663**

Total Project Cost	$190,123

		Allowable Incentive
% Incentives #1 of Utility Cost*	1.0%	$650
% Incentives #2 of Project Cost**	4.6%	$8,713
% Incentives #3 of Project Cost**	3.3%	$6,300
Total Eligible Incentives***	**$15,663**	
Project Cost w/ Incentives	$174,459	

Project Payback (years)	
w/o Incentives	w/ Incentives
22.5	20.6

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

** Maximum allowable amount of Incentive #2 is 30% of total project cost.
Maximum allowable amount of Incentive #3 is 20% of total project cost.

*** Maximum allowable amount of Incentive #1 is $50,000 if not funded by NJ BPU, and $25,000 if it is.
Maximum allowable amount of Incentive #2 & #3 is $1 million per gas account and $1 million per electric account

APPENDIX G

Photovoltaic (PV) Rooftop Solar Power Generation

City of Linwood
City Hall

Cost of Electricity $0.146 $/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**	**$1,800**	**0**	**$1,800**	**$10,000**	**$6,100**	**38.9**	**7.6**

*Incentive based on New Jersey renewable energy program for non-residential applications(PV)= $0.75/W of installed PV system

** Estimated Solar Renewable Energy Certificate Program (SREC) SREC for 15 Years= $487/1000kwh

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

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

PVWatts

AC Energy & Cost Savings

Cautions for Interpreting the Results

Municipal Building, Linwood,NJ

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:	14.6 ¢/kWh

Results			
Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	3.61	895	130.58
2	4.20	932	135.98
3	4.78	1124	163.99
4	5.23	1155	168.51
5	5.44	1211	176.68
6	5.48	1133	165.30
7	5.55	1171	170.85
8	5.41	1155	168.51
9	5.23	1106	161.37
10	4.60	1034	150.86
11	3.59	821	119.78
12	3.17	766	111.76
Year	4.69	12503	1824.19

Output Hourly Performance Data

About the Hourly Performance Data

Output Results as Text

Saving Text from a Browser

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

Please send questions and comments regarding PVWATTS to Webmaster

Disclaimer and copyright notice

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

Cautions for Interpreting the Results

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

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

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

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

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

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

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

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

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

APPENDIX H

Solar Thermal Domestic Hot Water Plant

NJBPU Energy Audits
CHA #22215
City of Linwood- City Hall

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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TX Energy - Past and Present

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About SECO

RARE

RENEWABLE ENERGY
THE INFINITE POWER OF TEXAS

Interactive Energy Calculators

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

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

Solar Water Heating Calculator

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

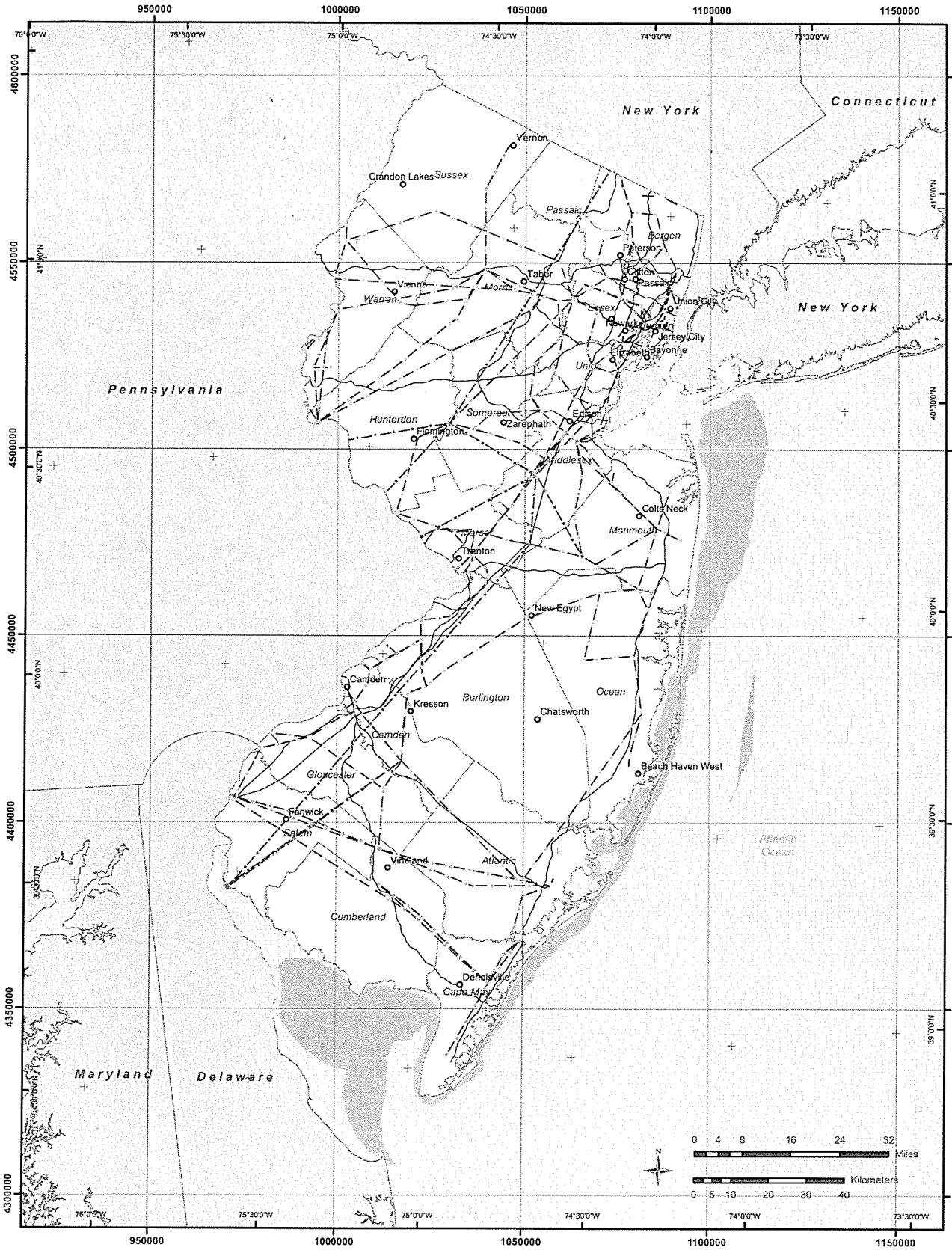
Water Heater Characteristics			
Physical		Thermal	
? Diameter (feet)	1.5	? Water Inlet Temperature (Degrees F)	58
? Capacity (gallons)	50	? Ambient Temperature (Degrees F)	70
? Surface Area (calculated - sq ft)	21.36	? Hot Water Temperature (Degrees F)	135
? Effective R-value	NaN	? Hot Water Usage (Gallons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

Gas vs. Electric Water Heating		
Gas		**Electric**
0.8	? Overall Efficiency	0.98
0.8	? Conversion Efficiency	0.98
2118 BTU/hr	? Power Into Water Heater	1729 BTU/hr
Cost		
$ .98 /Therm	? Utility Rates	$ .15 /kWh
$ 181.826(	? Yearly Water Heating Cost	$ 665.384(
How Does Solar Compare?		
? Solar Water Heater Cost: $ 21700		? Percentage Solar: 70
170.492(years for gas	? Payback Time for Solar System	46.5896(years for electric

More information on solar water heating:

APPENDIX I

Wind



Wind Resource of New Jersey

Mean Annual Wind Speed at 30 Meters

Features
- City
- Interstate Highway
- County Boundary
- Water Body

Generalized Transmission Line

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

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

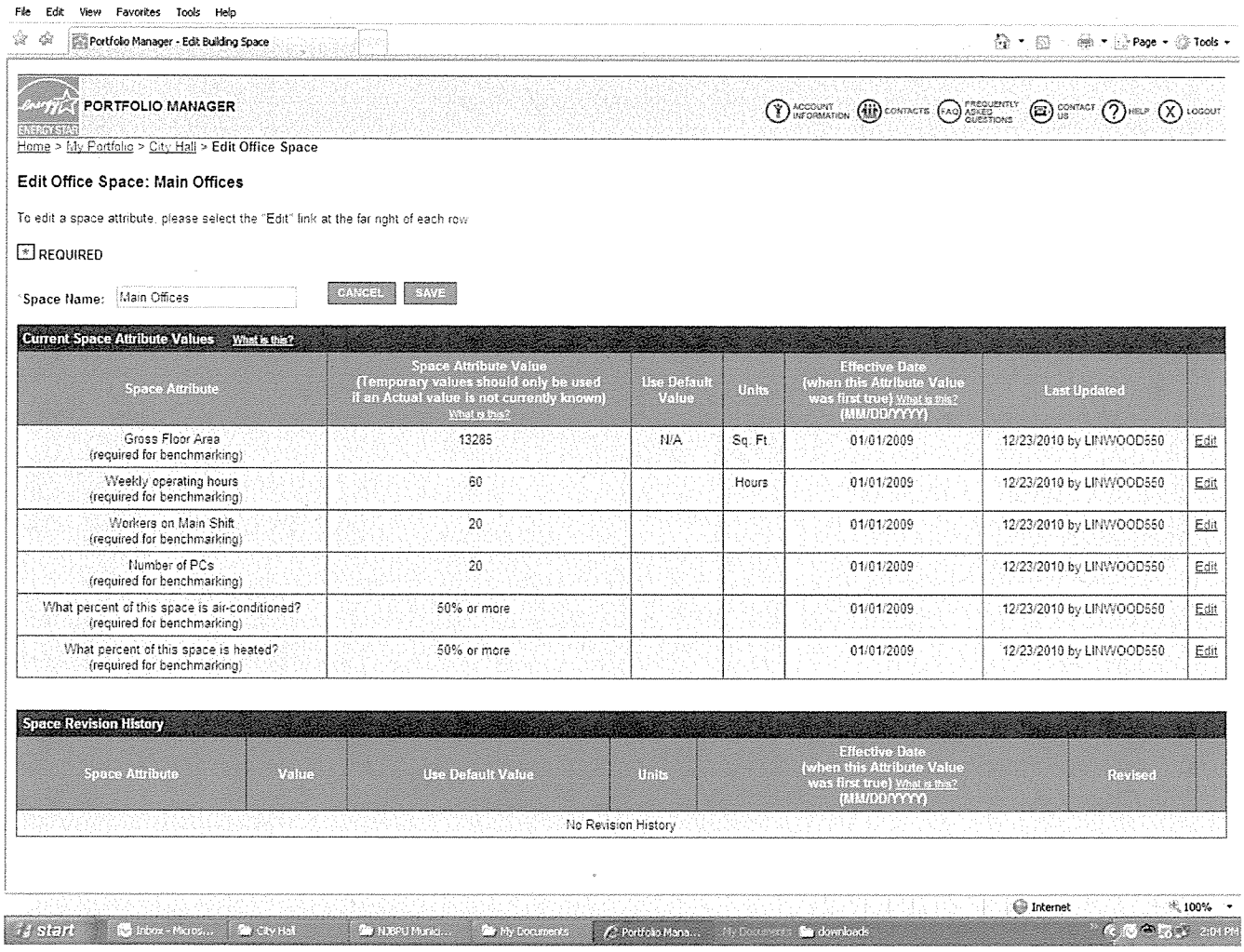
AWS Truewind

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

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

APPENDIX J

EPA Portfolio Manager



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Portfolio Manager - Edit Building Space

Page Tools

PORTFOLIO MANAGER

ACCOUNT INFORMATION CONTACTS FREQUENTLY ASKED QUESTIONS CONTACT US HELP LOGOUT

Home > My Portfolio > City Hall > Edit Office Space

Edit Office Space: Main Offices

To edit a space attribute, please select the "Edit" link at the far right of each row.

* REQUIRED

*Space Name: Main Offices CANCEL SAVE

Current Space Attribute Values What is this?

Space Attribute	Space Attribute Value (Temporary values should only be used if an Actual value is not currently known) What is this?	Use Default Value	Units	Effective Date (when this Attribute Value was first true) What is this? (MM/DD/YYYY)	Last Updated	
Gross Floor Area (required for benchmarking)	13285	N/A	Sq. Ft.	01/01/2009	12/23/2010 by LINWOOD550	Edit
Weekly operating hours (required for benchmarking)	60		Hours	01/01/2009	12/23/2010 by LINWOOD550	Edit
Workers on Main Shift (required for benchmarking)	20			01/01/2009	12/23/2010 by LINWOOD550	Edit
Number of PCs (required for benchmarking)	20			01/01/2009	12/23/2010 by LINWOOD550	Edit
What percent of this space is air-conditioned? (required for benchmarking)	50% or more			01/01/2009	12/23/2010 by LINWOOD550	Edit
What percent of this space is heated? (required for benchmarking)	50% or more			01/01/2009	12/23/2010 by LINWOOD550	Edit

Space Revision History

Space Attribute	Value	Use Default Value	Units	Effective Date (when this Attribute Value was first true) What is this? (MM/DD/YYYY)	Revised	
No Revision History						

Internet 100%

start Inbox - Micros... City Hall NJBPU Munici... My Documents Portfolio Mana... My Documents downloads 2:04 PM

APPENDIX K

Equipment Inventory

New Jersey BPU Energy Audit Program
CHA #22215
City of Linwood - Municipal Building

Description	QTY	Manufacturer Name	Model No.	Serial No.	Equipment Type / Utility	Capacity/Size	Location	Areas Served	Date Installed	Remaining Useful Life (years)	Other Info.
HW Boiler	2	Burnham	808 B-W 1	16001706		462MBH/369.6 MBH	Boiler Room	Municipal		0	
HW Pump - 1	1					3 HP	Boiler Rm	Municipal		10	
HW Pump - 2	1					3 HP	Boiler Rm	Municipal		10	
HW Boiler	1	Weil McLain	GU-6 Series 4			175 MBH	MER	Police Wing		0	
Air Handling Unit - 1	1	Carrier	40RM-024-B511YC	22003F33794				Municipal Wing		15	
Air Handling Unit - 2	1	Carrier						Court Room		15	
Air Handling Unit - 3	1	Trane	Climate Changer	K90M37381				Police Department		0	
Air Handling Unit - 4	1										
Air Handling Unit - 5	1										
Condensing Unit - 1	1	Rudd	RAWL-240CAZ	7931F23100 809				Municipal Wing	New	20	3 fans @1/3HP
Condensing Unit - 2	1	Carrier	38ARZ008-501	604050046				Court Room			1 comp 2fans
Condensing Unit - 3	1	Trane	TTA150B300EA	3335TEKAD						10	Police Department
Condensing Unit - 4	1	Sano CW2432								10	Police Dispatch
Condensing Unit - 5	1										
Exhaust Fan - 1	2	Greenheck	CSP-226			315 CFM	1st Flr Municipal	M&W Toilet			
Exhaust Fan - 2	2	Greenheck	CSP-224			272 CFM	2nd Flr Municipal	JC & Kitchen			
Exhaust Fan - 3	1	Tamarack				115 CFM	3rd Flr Municipal				
Generator	1				Fuel Oil	120 KW	Basement	Basement			Comp. 6.8 amps @115V
Dehumidifier	2	Santa Fe		-	Electric	Fan 250 CFM			-	-	
Domestic HW Heater	1	AO Smith			Electric	1.5 KW		Police			30 Gallon
Domestic HW Heater	1	Rheem		0295GG03782	Natural Gas	75 MBH		Municipal Wing			75 Gallon

APPENDIX L

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	City Hall	Date:	12/01/10		
Engineer:	Frank Cuttita				

Building/Facility Designation: City Hall

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

ENVELOPE DESCRIPTIONS (Descriptions are from Interior to Exterior)

Walls (Select One - Type X)

		R Value	Wall Type
	Steel Siding, 4" Insulation, Steel Siding	15.2	1
	Plaster or Gypsum, frame construction, 5" Insulation, 1" stucco	18.2	1
	4" WH CMU, 1" Insulation, Finished Exterior	5.2	2
	Plaster or Gypsum, frame construction, 3" Insulation, 8" LW CMU	7.8	5
	4" Face Brick, 2" Concrete, 1" Insulation, Exterior Finish	5.1	12
	4" Face Brick, 4" Concrete, 1" Insulation, Exterior Finish	4.0	11
	Interior Finish, 2" Insulation, 8" CMU, 4" Face Brick	10.9	16
	Finished Surface, 8" LW CMU (filled), Air Space, 4" Face Brick	11.1	16
	Stucco or Gypsum, 2.5" Insul, Face Brick	14.3	10
	OTHER	15.0	16
x	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
	Ceiling, Wood Deck, 6" Insulation, Felt & Membrane	22.7	10
	Wood Deck, 6" insulation, Felt & Membrane	18.0	
x	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	13,285 SF		
Occupied Area	13,285 SF	Return Plenum?	n

	Gross Wall Length	Average Wall Height	Ceiling Height	Window Area	Door Area	Net Wall Area
North Exposure	80 Ft	29.5 Ft	9.0 Ft	30 SF	0 SF	2,330 SF
East Exposure	225 Ft	17.2 Ft	9.0 Ft	215 SF	45 SF	3,605 SF
South Exposure	120 Ft	25.0 Ft	9.0 Ft	144 SF	42 SF	2,814 SF
West Exposure	210 Ft	16.6 Ft	9.0 Ft	230 SF	0 SF	3,260 SF

Occupied Forced Ventilation	2,000 cfm	0.8 AC/hr
Unoccupied Forced Ventilation	600 cfm	0.2 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	City Hall	Date:	12/01/10		
Engineer:	Frank Cuttita				

Building/Facility Designation: City Hall

COOLING HEAT GAINS TO THE ROOM - SENSIBLE

SOLAR GAINS

WINDOWS	AREA (SF)	SHGF	Shade Coef	Cooling Load Factor		Solar Heat Gain
North Exposure	30	38 btu/h/sf	0.8	0.75	Glass Type C	684 Btu/hr
East Exposure	215	216 btu/h/sf	0.8	0.31	Glass Type C	11,517 Btu/hr
South Exposure	144	225 btu/h/sf	0.8	0.58	Glass Type C	15,034 Btu/hr
West Exposure	230	216 btu/h/sf	0.8	0.29	Glass Type C	11,526 Btu/hr
						38,760 Btu/h

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain
North Exposure	690	0.07	20 °F	1.0	908 Btu/hr
East Exposure	1,765	0.07	39 °F	1.0	4,527 Btu/hr
South Exposure	894	0.07	27 °F	1.0	1,588 Btu/hr
West Exposure	1,660	0.07	22 °F	1.0	2,402 Btu/hr
Roof	13,285	0.06	73 °F	1.0	55,138 Btu/hr
Fenestration	619	0.50	26 °F		8,047 Btu/hr
Doors	87	0.14	27 °F		328 Btu/hr
Ceiling	13,285	0.14	0 °F		0 Btu/hr
Partition	0	0.05	0 °F		0 Btu/hr
Floor	13,285	0.04	0 °F		0 Btu/hr
					72,938 Btu/h

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

							Room Heat Gain
Lights	1.25 w/sf x	13,285 Occ Area =	16.6 kW x 3.4x		1.0 RAF =		56,677 Btu/h
Plug Load	0.25 w/sf x	13,285 Occ Area =	3.3 kW x 3.4x		1.0 RAF =		11,335 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
							81,304 Btu/h

VENTILATION AND INFILTRATION

		Infiltration Factor		Perimeter Ratio		Coef	Temp. Diff.	Room Heat Gain
Walls	5,009 SF	0.15	CFM/SF			1.04	26 °F	22,022 Btu/h
Doors	87 SF	0.20	CFM/LF	0.85	LF/SF	1.04	26 °F	434 Btu/h
Windows	619 SF	0.20	CFM/LF	0.85	LF/SF	1.04	26 °F	3,072 Btu/h
Ventilation	2,000 cfm					1.04	26 °F	58,620 Btu/h
								84,148 Btu/h
Infiltration	871 cfm	0.3	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	1,640	0.07	20	1.0	2,157 Btu/hr
East Exposure	1,840	0.07	39	1.0	4,720 Btu/hr
South Exposure	1,920	0.07	27	1.0	3,410 Btu/hr
West Exposure	1,600	0.07	22	1.0	2,315 Btu/hr
Roof	13,285	0.06	73	0.0	0 Btu/hr
					12,602 Btu/h

INTERNAL HEAT GAINS

					Room Heat Gain
Lights	1.25 w/sf x	13,285 Occ Area =	16.6 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	38,760	Internal Gains to Room	81,304
Conduction to Room	72,938	Internal Gains to Plenum	0
Conduction to Plenum	12,602		
Ventilaton and Infiltration	84,148		
Sub Total	208,448	Sub Total	81,304

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	City Hall	Date:	12/01/10		
Engineer:	Frank Cuttita				

Building/Facility Designation: City Hall

LATENT COOLING LOADS

Infiltration

		Infiltration Factor	Air Density	Humidity Ratio Dif.	Room Heat Gain
Walls	20,285 SF	0.15 CFM/SF	4,629	0.0042 #/#	59,755 Btu/h
Doors	87 SF	0.20 CFM/LF	4,629	0.0042 #/#	291 Btu/h
Windows	619 SF	0.20 CFM/LF	4,629	0.0042 #/#	2,058 Btu/h
Ventilation	2,000 cfm		4,629	0.0042 #/#	39,277 Btu/h
People	20 people	1.00 time in space		250 Btu/hr/person	5,000 Btu/h
					106,380 Btu/h

Cooling Load Summary

	Sensible	Latent	Total		
Temperature Dependent Gains	208,448	106,380	314,828		
Temperature Indep. Gains	81,304	0	81,304	SHR=	0.73
Total	289,752	106,380	396,132		

Building Cooling Load: 33.0 Tons at 402 SF/Ton

Building Air Flow to Condition Space based on a 12°F Temp Rise is: 22,127 CFM; 1.67 CFM/sf

HEATING CALCULATION

CONDUCTION

	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.	Room Heat Gain
North Exposure	2,330	0.07	58	8,888 Btu/h
East Exposure	3,605	0.07	58	13,752 Btu/h
South Exposure	2,814	0.07	58	10,735 Btu/h
West Exposure	3,260	0.07	58	12,436 Btu/h
Fenestration	619	0.50	58	17,951 Btu/h
Roof	13,285	0.06	58	43,808 Btu/h
Doors	87	0.14	58	705 Btu/h
Ceiling	13,285	0.14	0	0 Btu/h
Partition	0	0.05	0	0 Btu/h
Floor	13,285	0.04	10	5,314 Btu/h

Ventilation and Infiltration

		Infiltration Factor	Coef	Temp. Difference	Air Flow	Room Heat Gain
Walls	12,009 SF	0.15 CFM/SF	1.04	58	1,801 cfm	109,055 Btu/h
Doors	87 SF	0.20 CFM/LF	1.04	58	15 cfm	896 Btu/h
Windows	619 SF	0.20 CFM/LF	1.04	58	105 cfm	6,345 Btu/h
Ventilation Load	2,000 cfm		1.04	58	2,000 cfm	130,768 Btu/h
Total Ventilation & Infiltration Load					3,921 cfm	247,064 Btu/h

Building Heating Load: 360,654 btu/h

27.1 btu/sf

City of Linwood,NJ
CHA #22215
Building: City Hall

Doors

	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	3.0	5.0	3	45.0	48.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	45.0	48.0	
South	7.0	6.0	1	42.0	26.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	42.0	26.0	
West				0.0	0.0	
				0.0	0.0	
			Sub-total	0.0	0.0	
			Total	**87.0**	**74.0**	LF/SF 0.85

Walls

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet		
North	40.0	25.0	2	2000.0	260.0		All wall quantities must remain equal to 1
	40.0	9.0	1	360.0	98.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	80.0			2360.0	358.0	29.5	Average height wall automatically linked
East	115.0	25.0	1	2875.0	280.0		
	110.0	9.0	1	990.0	238.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	225.0			3865.0	518.0	17.2	Average height wall automatically linked
South	120.0	25.0	1	3000.0	290.0		
			1	0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	120.0			3000.0	290.0	25.0	Average height wall automatically linked
West	100.0	25.0	1	2500.0	250.0		
	110.0	9.0	1	990.0	238.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	210.0			3490.0	488.0	16.6	Average height auto linked to block load sheet

Windows

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet		
North	3.0	5.0	2	30.0	32.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
			Sub-total	30.0	32.0		
East	4.0	7.0	5	140.0	110.0		
	3.0	5.0	5	75.0	80.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
			Sub-total	215.0	190.0		
South	6.0	6.0	4	144.0	96.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
			Sub-total	144.0	96.0		
West	4.0	7.0	5	140.0	110.0		
	3.0	5.0	6	90.0	96.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
			Sub-total	230.0	206.0		
						LF/SF	
			Total	619.0	524.0	0.85	

Building Volume Calculator

Width(ft)	Length (ft)	Height(ft)	Count	Volume (cf)
100	40	9	1	36,000

40	60	15	1	36,000
30	60	15	1	27,000
50	70	15	1	52,500
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
			Total	151,500 CF

"% of 180
"% of 90

120.0

City of Linwood,NJ
CHA #22215
Building: City Hall

Reconcile Thermal Model

Building Footprint	13,285 SF	Ex Occupied Clng Temp.	65 °F	Ex Occupied Htg Temp.	72 °F
Heating Efficiency	68%	Ex Unoccupied Clng Temp.	65 °F	Ex Unoccupied Htg Temp.	72 °F
Cooling Efficiency	1.20 kW/ton	Occupied Cooling UA	(4,781) btu/hr/°F	Occupied Heating UA	1,958 btu/hr/°F
Internal Gains	81,304 btu/h	Unoccupied Cooling UA	(3,290) btu/hr/°F	Unoccupied Heating UA	1,958 btu/hr/°F
Unoc Internal Gain factor	0.03	Cooling Occ Enthalpy Setpoint	26.75 Btu/lb		
Ave Occ Internal Gain Factor	0.6	Cooling Unocc Enthalpy Setpoint	26.75 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	-179,279	-394,350	-48,782	-123,374	-253,545	-2,439	0	0	0	0
97.5	42.5	9	3	6	-155,375	-277,897	-48,782	-106,925	-178,672	-2,439	0	322	322	0
92.5	39.5	69	25	44	-131,471	-224,965	-48,782	-90,475	-144,640	-2,439	0	2,052	2,052	0
87.5	36.6	132	47	85	-107,567	-173,796	-48,782	-74,025	-111,741	-2,439	0	3,153	3,153	0
82.5	34.0	344	123	221	-83,664	-127,921	-48,782	-57,575	-82,246	-2,439	0	6,345	6,345	0
77.5	31.6	566	202	364	-59,760	-85,575	-48,782	-41,125	-55,020	-2,439	0	7,511	7,511	0
72.5	29.2	755	270	485	-35,856	-43,228	-48,782	-24,675	-27,793	-2,439	0	6,113	6,113	0
67.5	27.0	780	279	501	-11,952	-4,411	-48,782	-8,225	-2,836	-2,439	0	2,492	2,492	0
62.5	24.5	889	318	572	18,605	40,229	-48,782	18,605	25,865	-2,439	0	0	0	400
57.5	21.4	742	265	477	28,397	61,402	-48,782	28,397	39,478	-2,439	0	0	0	619
52.5	18.7	627	224	403	38,190	82,575	-48,782	38,190	53,091	-2,439	0	0	0	764
47.5	16.2	725	259	466	47,982	103,748	-48,782	47,982	66,704	-2,439	0	0	0	1,161
42.5	14.4	795	284	511	57,774	124,921	-48,782	57,774	80,317	-2,439	0	0	0	1,579
37.5	12.6	784	280	504	67,566	146,095	-48,782	67,566	93,931	-2,439	0	0	0	1,858
32.5	10.7	682	244	438	77,358	167,268	-48,782	77,358	107,544	-2,439	0	0	0	1,878
27.5	8.6	345	123	222	87,151	188,441	-48,782	87,151	121,157	-2,439	0	0	0	1,082
22.5	6.8	229	82	147	96,943	209,614	-48,782	96,943	134,770	-2,439	0	0	0	806
17.5	5.5	189	68	122	106,735	230,787	-48,782	106,735	148,383	-2,439	0	0	0	738
12.5	4.1	70	25	45	116,527	251,960	-48,782	116,527	161,996	-2,439	0	0	0	300
7.5	2.6	20	7	13	126,319	273,133	-48,782	126,319	175,609	-2,439	0	0	0	93
2.5	1.0	8	3	5	136,112	294,307	-48,782	136,112	189,223	-2,439	0	0	0	40
-2.5	0.0	0	0	0	145,904	315,480	-48,782	145,904	202,836	-2,439	0	0	0	0
-7.5	-1.5	0	0	0	155,696	336,653	-48,782	155,696	216,449	-2,439	0	0	0	0
TOTALS		8,760	3,129	5,631								27,988	27,988	11,320

Existing Building Ventilation & Infiltration (occ)	**3,921 cfm**
Overheat Ventilation Factor	**1.00**
Additional ventilation to offset overheat	**0 cfm**
Existing Building Ventilation & Infiltration (unocc)	**2,521 cfm**
Economizer Ventilation (from AHU's)	**cfm**

Energy Use Indices (calculated)

	Base Case
Heating	11,320
Target ->	11,316
	100.0%

	Base Case
Cooling	27,988
Target ->	27,933
	100.2%