SUSSEX BOROUGH
ADMINISTRATION BUILDING
ENERGY ASSESSMENT

for

NEW JERSEY
BOARD OF PUBLIC UTILITIES

SUSSEX BOROUGH
ADMINISTRATION BUILDING
ENERGY ASSESSMENT

for

NEW JERSEY
BOARD OF PUBLIC UTILITIES

CHA PROJECT NO. 21181

JULY 2010

Prepared by:

6 Campus Drive
Parsippany, NJ 07054

(973) 538-2120

TABLE OF CONTENTS

Page

1.0 INTRODUCTION & BACKGROUND.....1

2.0 EXECUTIVE SUMMARY.....2

3.0 EXISTING CONDITIONS.....3
- 3.1 Building General
- 3.2 Utility Usage
- 3.3 HVAC Systems
- 3.4 Lighting/Electrical Systems
- 3.5 Control Systems
- 3.6 Plumbing Systems

4.0 ENERGY CONSERVATION MEASURES.....5
- 4.1 ECM-1 Boiler Replacement with Hot Water Reset
- 4.2 ECM-2 Programmable Thermostats – Night Setback
- 4.3 ECM-3 Piping Insulation
- 4.4 ECM-4 Install Day Lighting Controls
- 4.5 ECM-5 Lighting Replacement
- 4.6 ECM-6 Installation of Occupancy Sensors
- 4.7 ECM-7 Install Roof Insulation/Seal Ductwork

5.0 INCENTIVES OVERVIEW.....12
- 5.1 Incentives Overview
- 5.2 Building Incentives

6.0 ALTERNATIVE ENERGY EVALUATION.....14
- 6.1 Geothermal
- 6.2 Solar
- 6.3 Wind
- 6.4 Combined Heat and Power Generation (CHP)
- 6.5 Biomass Power Generation
- 6.6 Demand Response Curtailment

7.0 EPA PORTFOLIO MANAGER.....19

8.0 CONCLUSIONS & RECOMMENDATIONS.....20

1.0 INTRODUCTION & BACKGROUND

The Sussex Borough administration building is about 6,000 square feet, and is located at 2 Main Street on the corner of Hamburg Avenue. Constructed in the 1920s, the building has served as the county police station, fire house, and currently serves as office space and a meeting location for the borough. When the building was changed from a fire hall to its current state, the garage doors on the east side of the building were sealed and windows added in their place.

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 Sussex Borough administration building, a 6,000 square foot facility, which serves as office space and a meeting location for the borough. The following areas were evaluated for energy conservation measures:

- Night setback
- Day lighting controls
- Lighting replacement
- Occupancy sensors
- Insulation upgrades
- Boiler replacement

Various potential Energy Conservation Measures (ECMs) were identified for the above categories. Potential annual savings of $3,400 for the recommended ECMs may be realized with a payback of 2.8 years.

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

ECM-2 Programmable Thermostats – Night Setback

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
2,000	0	1,260	940	1,300	9.1	NA	1.5	NA

* There is no incentive available through the New Jersey Smart Start program for this ECM.

ECM-4 Install Day Lighting Controls

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
700	0	630	0	100	1.8	100	7.0	6.0

* Incentive shown is per the 2010 New Jersey Smart Start Program's Lighting Controls Application.

ECM-5 Lighting Replacement

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	6,040	0	1,200	2.2	1,300	4.6	3.5

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

ECM-6 Installation of Occupancy Sensors

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
1,600	0	1,710	0	300	2.3	200	5.3	4.7

* Incentive shown is per the 2010 New Jersey Smart Start Program's Lighting Controls Application.

ECM-7 Install Roof Insulation/Seal Ductwork

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
1,200	0	100	460	500	7.4	NA	2.4	NA

* There is no incentive available through the New Jersey Smart Start program for this ECM.

It should be noted that all ECMs identified during an energy audit are evaluated as individual opportunities, and the savings and payback determined on a stand-alone basis. However, in some instances, measures have interactive properties; therefore, the savings of one measure will decrease the potential savings of other measures, if all ECMs are implemented. For the administration building, therm savings for all ECMs is approximately 2,030, or 60% of annual natural gas usage. However, if all ECMs are implemented, due to interactivity, actual therm savings would decrease slightly.

3.0 EXISTING CONDITIONS

3.1 Building General

The 6,000 square foot administration building is two stories and houses the offices of the county clerk, deputy clerk, treasurer, and mayor. The building was constructed in the 1920s and over the years has served as the county police station and fire house. Location of the previous fire hall garage doors is evident on the east side of the building. About 15 years ago, the building's roof was changed from being flat to a truss framed roof. A building employee stated that during this renovation, batt insulation was added.

The building has two large rooms on the first floor near the main entrance. One of these rooms, the meeting hall, is used for town functions and meetings, and has a raised podium. The second large room is used as an office area for the town's administrative staff. The building has a hydraulic elevator running from the first to the second floor with the hydraulic motor service closet on the first floor. There are smaller rooms toward the back of the building used for additional office space and storage.

The second floor contains the offices of the mayor, county treasurer, and the office for emergency response. However, the offices are occupied sparingly. Additionally, there is a general use office, room where the town's records are filed, and storage rooms. There is an unfinished basement where the electricity enters the building. The basement also contains two gas boilers used for heating.

3.2 Utility Usage

The Sussex Borough administration building uses natural gas, electricity, and water. Electricity is purchased from Jersey Central Power and Light (JCP&L), and natural gas is purchased from Elizabethtown Gas. The Sussex administration building does not pay for water usage.

Electrical usage was available from December 2008 through January 2010. To gain an accurate representation of yearly usage, the most recent year was analyzed. From February 2009 through January 2010, the building used about 35,890 kWh and was charged approximately $7,000 or about $0.196 per kWh. Electricity costs can fluctuate month by month causing the cost per kWh to change slightly. This is why the total average cost for all available data is slightly higher than the most recent year's average cost. Demand Usage (kW) for the Administration Building is not metered. A spike is noticeable in the summer months for electrical usage due to air conditioning. This graph can be viewed in Appendix A.

Gas usage data was available from January 2009 through December 2009. During this time period, the building used about 3,370 therms of natural gas and was charged approximately $3,900. Natural Gas is used only for heating in this building so there will be very little gas usage in the summer (See Appendix A). The cost per gallon of natural gas fluctuates throughout the year; for 2009, average cost was $1.15 per therm.

3.3 HVAC Systems

Heating is provided by two Slant/Fin Corp. gas fired boilers located in the basement. Each provides 209 Mbtus of heat and operates at a nameplate efficiency of 81%. Boilers lose efficiency with age, and since the boilers are approximately 15 years old, 80% efficiency was used for calculations. The boilers heat water to about 180°F and a small pump circulates the water through fintubed copper piping around the building.

The two boilers are staged so that one runs and the second fires when needed. A small fan blows outside air into the basement to feed the boilers. The incoming air flows through electric resistance heaters to maintain basement heat.

Air conditioning for the building is provided by two roof top units located above the back part of the first floor. A four ton Carrier unit serves the back part of the first floor; a 7.5 ton unit serves the two large rooms towards the front of the building. The second floor does not have central air conditioning.

The upstairs has three window AC units of varying sizes. There are two 2-ton GE window units, one each in the document storage room and emergency response room. Both units have a nameplate Energy Efficiency Ratio (EER) of 8.3 and appear to be about 20 years' old. The third unit, a 1-ton Fedders window AC unit operates at 9.0 EER and appears to be about five years' old. The 20 year old units are considered inefficient by today's standards, and calculations were performed to determine if it would be economically feasible to replace them with more efficient models. It was determined that due to the infrequent use of these units; replacement would not be a viable option.

3.4 Lighting/Electrical Systems

The administrative building is lit primarily with 4 lamp T12 lighting fixtures with magnetic ballasts. The building also utilizes several U-shaped T12 bulbs, mainly in the first floor's restrooms and second floor's hallway. The stairwell is lit by a combination of 4 lamp and 1 lamp fixtures. In total there are approximately (62) 4-lamp T-12 fixtures, (7) T-12 U shaped fixtures and (2) one lamp T12 fixtures. All lights in the building are controlled by switches located on the walls.

3.5 Control Systems

Building temperature is controlled by 10 mechanical thermostats that do not have the capability of automatic setback. Each thermostat is set at an average of 70°F during the heating season, and 72°F for cooling. Since the thermostats operate manually, there is no definitive setpoint temperature and any thermostat can be set to the desired temperature of the occupants.

3.6 Plumbing Systems

Domestic hot water (DHW) is provided by a Bradford-White 19 gallon electric hot water heater. The unit delivers hot water only for hand washing in the restrooms. Electric hot water heaters are generally more expensive to operate than gas fired units; however, usage is minimal, therefore replacing the hot water heater would not be viable.

There are four restrooms in the facility, two each on the first and second floors. The women's restrooms each have one toilet; the men's restrooms have one toilet and one urinal. The toilets operate at 1.6 gallons per flush and the urinals operate at 1 gallon per flush, both low flow by today's standards. Each restroom has one sink that are operated by automatic shut off push buttons. All sinks are low flow except the first floor men's restroom where the nozzle has fallen off. Calculable water savings were not performed to replace the nozzle because the building does not pay for water. However, a small amount of DHW savings would occur if this nozzle were replaced.

4.0 ENERGY CONSERVATION MEASURES

4.1 ECM-1 Boiler Replacement with Hot Water Reset

The building is heated by two natural gas fired boilers, each with a 209 Mbtu output. The boilers are staged so when the heating load is minimal only one boiler is operating; when the heating load increases, the second boiler will turn on and provide additional heating capacity. As stated previously, boilers lose efficiency as they age; therefore, an efficiency of 80% was assumed in the calculations.

Condensing boilers achieve efficiencies of up to 95%. Standard boilers operate by burning gas to heat water above the boiling point and then exhaust the combusted gas to the outside. Condensing boilers recover the waste heat from the combusted gasses that is normally expelled into the atmosphere. This is achieved by placing a large heat exchanger in the exhaust flow of the boiler. This ECM proposes replacing the two gas fired boilers with a single, more efficient 418 MBH condensing unit.

The existing boilers heat water to 180°F regardless of the required heating load. The building's heating needs fluctuate with outside air temperature. When it is warmer, it is not necessary for the boiler to heat water to 180°F. The hot water temperature could be reduced which can save on heating costs. This would be done with control systems that monitor the outdoor air temperature and modulate the temperature of the hot water. In addition to a new condensing boiler, this ECM proposes adding temperature controls to reset the hot water temperature depending on building needs.

To calculate the savings associated with replacing the boiler and adding temperature reset, a block load model of the building was generated to determine necessary building heating loads. The block loads is provided in appendix O and takes into account various parameters such as roof and wall infiltration, internal heat gains, building occupancy, and other sources of heat gain and loss. After establishing a building heating load, the existing and proposed boilers were analyzed using temperature bin data from Newark, NJ. The difference was about 410 therms.

Water temperature setback saving was determined by creating a second spreadsheet that compared building heating needs to temperature bin data from Newark, NJ. It was assumed for the calculations that when a minimal amount of building heating was required, the temperature of the water produced by the boiler can be set to 140°F. This temperature was increased linearly up to 180°F as the outdoor air temperature decreased. The natural gas required for this staging was compared with maintaining the circulating water at a constant 180°F. The savings associated with this hot water reset is about 190 therms per year. A new boiler and reset would realize annual savings of approximately 600 therms.

This measure is not recommended due to the long payback. However, when a new boiler is needed, a natural gas fired condensing unit should be considered.

Condensing boilers have a life expectancy of about 24 years, according to ASHRAE. The total energy savings over the life of the project is 14,400 therms and $16,800.

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

ECM-1 Boiler Replacement with Hot Water Reset

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
21,000	0	0	600	700	(.2)	700	>25	>25

* Incentive shown is per the 2010 New Jersey Smart Start Program's Gas Heating Application.

This measure is not recommended.

4.2 ECM-2 Programmable Thermostats – Night Setback

Ten manual thermostats, which control heating and cooling, are set at approximately 70°F in the winter, and are set at 72°F in summer. The temperatures remain constant regardless of building occupancy. Installing programmable thermostats to control heating and cooling would allow the building temperature to set back during unoccupied times, and save energy. During unoccupied periods, this ECM proposes that the building be set to 60°F in heating mode, and in cooling mode, the temperature would be enabled to reach 78°F.

To calculate the proposed savings associated with installing programmable thermostats, two block loads were created. One block load modeled the second floor of the building, and the other modeled the first. It was necessary to create two block loads for the space because the first floor is centrally heated and cooled, but the second floor is only centrally heated. Window units are used to cool the second floor. The model considered parameters such as building infiltration loads, internal heat gains and losses, occupancy, wall and roof insulation amounts, and other parameters that affect the heating and cooling needs of the building. Using temperature bin data for Newark, NJ in conjunction with the block load provided an accurate representation of the building heating and cooling needs. The block load model is provided in Appendix O.

The savings associated with installing new programmable thermostats was determined by simulating temperature setback and observing the effects on the block load model. The difference between the current state of the building and proposed setback resulted in kWh and therm savings. The calculated savings of the building with setback is expected to be about 1,260 kWh and 940 therms of natural gas per year.

Programmable thermostats have a life expectancy of 15 years, according to ASHRAE. The savings over the life of the project is 14,100 therms, 18,900 kWh, and $19,500.

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

ECM-2 Programmable Thermostats – Night Setback

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
2,000	0	1,260	940	1,300	9.1	NA	1.5	NA

* There is no incentive available through the New Jersey Smart Start program for this ECM.

This measure is recommended.

4.3 ECM-3 Piping Insulation

Hot water from the boilers is circulated through the building in copper piping. The water is set at 180°F and the ambient temperature of the building is approximately 70°F. The temperature difference causes heat to be transferred from the hot water in the pipe to the building. The majority of copper piping in the basement is insulated. However, there is a section of about 10 feet of uninsulated 1" copper pipe located just beyond the outlet of the boiler in the basement.

This ECM proposes insulating the 10 feet of copper piping to save energy used by the boiler to heat the water in the pipes. To calculate the savings, heat loss was determined with the existing conditions of the uninsulated piping and after insulation. The difference is the savings.

This measure was evaluated and the savings were less than $100; therefore, it is not recommended as part of the study. However, it is a low cost measure with an attractive payback, and implementation may be desired for occupant comfort. See Appendix D for calculations.

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

This measure was evaluated and the savings were less than $100; therefore, it is not recommended as part of the study. However, it is a low cost measure with an attractive payback, and implementation may be desired See Appendix D for calculations.

4.4 ECM-4 Install Day Lighting Controls

The stairwell in the building has four T12 lighting fixtures that are on, consisting of two 4-lamp fixtures, and two 1-lamp fixtures. The stairwell also has sufficient sunlight coming in through south and east facing windows. During the portions of the day when the sun lights the stairwell, the lights are unnecessary, and could be turned off to save energy. Day lighting controls have an automatic sensor that can be installed to dim and turn the lights off when there is sufficient day light.

Day lighting data was not available for Sussex County; therefore, data from New York City was used to determine how many hours a day the stairwell lights could be turned off. Sunlight occurs and average of 4.04 hours per day in this region, and a conservative estimate of 4 hours per day was the assumed time the lights could be turned off. This would result in a savings of about 630 kWh annually.

Day lighting controls have an expected life of about 15 years according to the manufacturer. The energy savings over the life of the project would be about 9,450 kWh and $1,500.

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

ECM-4 Install Day Lighting Controls

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
700	0	630	0	100	1.8	100	7.0	6.0

* Incentive shown is per the 2010 New Jersey Smart Start Program's Lighting Controls Application.

This measure is recommended.

4.5 ECM-5 Lighting Replacement

The administration building is lit with primarily magnetic ballast T12 fixtures. Approximately 62 fixtures use 4 lamp linear bulbs; there are also (7) U-shaped T12 fixtures as well as (2) 1 lamp fixtures. All of these lights are considered inefficient by today's standards and could be replaced by more efficient T-8 bulbs and electronic ballasts.

The total hours of usage of the lights determines if it is economically feasible to replace them. Lighting replacement was analyzed for the entire building; however, it was determined that only the first floor and stairwell lighting are utilized for sufficient length of time to justify replacement.

This ECM proposes replacing the following first floor and stairwell lighting fixtures, with more efficient, electronic ballast T8s:

Location	# fixtures	Current Fixture Type
Main Offices	6	4-lamp T12
Clerk's Office	4	4-lamp T12
Downstairs Restrooms	2	U shaped T12 Bulbs
Stairwell	2	4 lamp T12
Stairwell	2	1 lamp T12
First Floor Hallway	7	4 lamp T12
Back Rooms/Offices	2	4 lamp T12
Large Conference Room	18	4 lamp T12
Large Conference Room	1	U shaped T12 Bulbs

The total cost savings for replacing the above lights was calculated by determining the kW usage of the existing lights, and then subtracting the proposed kW usage of the new fixtures. This number was then multiplied by the approximate yearly operating hours for the fixtures to get a kWh savings of about 6,040 per year.

T8 fixtures have an expected life of 15 years according to lighting manufacturers. The total energy savings over the life of the project would be 90,600 kWh and $18,000.

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

ECM-5 Lighting Replacement

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	6,040	0	1,200	2.2	1,300	4.6	3.5

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

This measure is recommended.

4.6 ECM-6 Installation of Occupancy Sensors

A lighting survey was conducted for the administration building to determine the potential for occupancy sensors. This survey consisted of a lighting count, analysis of bulbs and ballasts, and operating hours. Some of the second floor offices, and the storage areas/offices in the back of the first floor were found to be good candidates for occupancy sensors. Also, the first floor restrooms would work well with sensors due to sporadic traffic. Many portions of the second floor are unoccupied for significant amounts of time; however, during the energy audit the lights in those areas were turned off. Assuming it is standard practice to turn the lights off, occupancy sensors would not add to any current savings but would guarantee minimized lighting usage during unoccupied times.

To determine the cost savings associated with occupancy sensors, the existing amount of time the lights are on was compared to the approximate amount of time the lights would be on with occupancy sensors. Occupancy sensors generally remain on for 10 to 15 minutes after an occupant has left the room, and then automatically shut off. It was determined that if occupancy sensors were implemented in the previously noted rooms, the administration building could save about 1,710 kWh per year.

Occupancy sensors have an expected life of 15 years according to lighting manufacturers. The total energy savings over the life of the project would be 25,650 kWh and $4,500.

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

ECM-6 Installation of Occupancy Sensors

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
1,600	0	1,710	0	300	2.3	200	5.3	4.7

* Incentive shown is per the 2010 New Jersey Smart Start Program's Lighting Controls Application.

This measure is recommended.

4.7 ECM-7 Install Roof Insulation/Seal Ductwork

During the energy audit of the administration building a large hole in the roofing insulation was found in the back office above the ceiling tiles. The approximate location is under the 4 ton air conditioning unit. This hole is approximately nine square feet in area and was cut into the ceiling most likely for the supply air duct of the a/c system. The air duct enters the plenum space in a different location, but the hole was never sealed. On the day of the audit, this hole was allowing a significant amount of outside air into the dropped ceiling space rendering the insulation in the roof ineffective. It was also noticed when looking at the hole in the ceiling, that the roof in that particular area of the building was not well insulated. This ECM proposes re-sealing the hole around the air conditioner ducting, and adding 6" of blown-in insulation to increase the roof's thermal resistance.

To calculate the savings that could be achieved by insulating the roof and sealing the area around the ductwork, a block load of the first floor was created. This block load (the same as in the night setback ECM) takes into account parameters such as: roof and wall insulation values, building infiltrations, internal gains, occupancy, and other details that add to the heating and cooling loads of the building. To account for the hole in the air plenum, an estimated 100 cubic feet per minute (cfm) was added to the infiltration section of the block load model.

The two issues that this ECM addresses, infiltration and adding insulation, were split up for analysis. Then the savings of each was added together to get a total savings of the ECM. For sealing the ductwork, the existing condition of an extra 100 cfm of outside air entering the building was compared with the proposed scenario of 0 excess cfm of air entering the building. It was determined that if the hole was completely sealed, the administration building could be expected to save about 50 therms of natural gas, and 80 kWh of electricity. Additionally, if 6" of insulation were added to the entire roof area above the back offices, the thermal resistance of the roof, or R-value would rise by 13 to R-29. This would save approximately 410 therms of natural gas, and about 20 kWh of electricity.

In total, this ECM has the potential to save about 100 kWh of electricity, and 460 therms of natural gas per year. This would constitute a savings of about $500 per year.

Insulating and resealing the duct work in the air plenum has an estimated lifespan of about 20 according to ASHRAE and manufacturer data. The total savings over the life of this project would be about 2,000 kWh and 9,200 therms, or about $10,000.

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

ECM-7 Install Roof Insulation/Seal Ductwork

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
1,200	0	100	460	500	7.4	NA	2.4	NA

* There is no incentive available through the New Jersey Smart Start program for this ECM.

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.

5.2 Building Incentives

5.2.1 New Jersey Pay For Performance Program

The building is eligible for all three incentives available from the New Jersey P4P program. Incentive #1 is for the development of an energy reduction plan and will pay $.05/ square foot of the building footprint, which equates to about $300. Implementation of the energy conservation measures discussed in this report is expected to reduce the building's energy usage by over 15% which qualifies it for both incentives #2 and #3. Combining incentives #2 and #3 will provide maximum savings of $0.18/ kWh and $1.80/ therm not to exceed 50% of the total project cost. The building is projected to save about 8,380 kWh which amounts to about $1,500 in incentives. The building is also projected to save about 2,030 therms of natural gas. With New Jersey's current incentive structure, this would qualify for about $3,700 in incentive money. Combining all incentives in the P4P program would amount to approximately $5,500, reducing the overall payback of the project from 7.5 years to 6.2 years. See appendix I for calculations.

5.2.2 New Jersey Smart Start Program

The Sussex Borough administration building is eligible for multiple incentives from the New Jersey Smart Start Program.

The boiler replacement ECM is eligible for about $700 in incentive money for being at least 85% efficient. The lighting replacement measure is eligible for $1,300 in savings if all fixtures are replaced. An additional $100 would be available if day lighting controls were implemented on the stairwell lights. There would also be $150 available for the installation of occupancy sensors. Totaling all these incentives would produce a savings of about $2,250.

5.2.3 Energy Efficient and Conservation Block Grant

The Sussex Borough administration 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"

Based on the utility information that was provided by the borough for the administration building, it could not be determined whether the building pays for the societal benefits charge. Jersey Central Power and light should be contacted to determine if this charge is being paid. If not, then the administration building could be eligible for additional funding through this program.

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 gas-fired, hot water boilers and packaged rooftop AC units to meet the HVAC requirements. With exception to the hydronic heating system, most of the existing equipment is not compatible with a geothermal energy source. Therefore, to take advantage of a GHP system, the existing mechanical equipment would have to be removed or overhauled; and either a low temperature closed loop water source heat pump system or a water to water heat pump system would have to be installed to realize the benefit of the consistent temperature of the ground.

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

6.2 Solar

6.2.1 Photovoltaic Rooftop Solar Power Generation

The administration building was evaluated for the potential to install rooftop photovoltaic (PV) solar panels for power generation. Present technology incorporates the use of solar cell arrays that produce direct current (DC) electricity. This DC current is converted to alternating current (AC) with the use of an electrical device known as an inverter. The building's roof has sufficient room to install a large solar cell array but it would need to be angled south for maximum efficiency. A structural analysis would be required to determine if the roof framing could support a cell array. There is also an abundance of open land available around the building which could potentially house a solar array.

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

The State of New Jersey incentives for non-residential PV applications is $1.00/watt up to 50 kW of installed PV array. Federal tax credits are also available for renewable energy projects up to 30% of installation cost. Municipalities do not pay federal taxes; therefore, would not be able to utilize the federal tax credit incentive.

Installation of (PV) arrays in the state New Jersey will allow the owner to participate in the New Jersey solar renewable energy certificates program (SREC). This is a program that has been set up to allow entities with large amounts of environmentally unfriendly emissions to purchase credits from zero emission (PV) solar-producers. An alternative compliance penalty (ACP) is paid for by the high emission producers and is set each year on a declining scale of 3% per year. One SREC credit is equivalent to 1000 kilowatt hours of PV electrical production; these credits can be traded for periods of 15 years from the date of installation. The cost of the ACP penalty for 2009 was $700; this is the amount that must be paid per SERC by the high emission producers. The expected dollar amount that will be paid to the PV producer for 2010 is expected to be $600/SREC credit. Payments that will be received from the PV producer will change from year to year dependent upon supply and demand. Renewable Energy Consultants is a third party SREC broker that has been approved by the New Jersey Clean Energy Program. As stated above there is no definitive way to calculate an exact price that will be received by the PV producer per SREC over the next 15 years. Renewable Energy Consultants estimated an average of $487/ SERC per year and this number was utilized in the cash flow for this report.

The building had a maximum electricity demand of 21.1 kW and a minimum of 7.7 kW, over the previous 12 months. The monthly average over the observed 12 month period was 11.9 kW. The existing load does not justify the use of the maximum incentive cap of 50 kW of installed PV solar array; therefore, a 12 kW system size was selected for the calculations. The system costs for PV installations were derived from the most recent NYSERDA (New York State Energy Research and Development Agency) estimates of total cost of system installation. It should be noted that the cost of installation is currently $8 per watt or $8,000 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 J and summarized below:

Photovoltaic (PV) Rooftop Solar Power Generation – 12 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
96,000	0	14,200	0	2,800	2,800	12,000	2,900	>25	8.6

*Incentive based on New Jersey Renewable Energy Program for non-residential applications of $1.00 per Watt of installed capacity
** Estimated Solar Renewable Energy Certificate Program (SREC) for 15 years at $487/1000 kWh

The administration building has a small amount of south facing roof that could potentially be turned into an area for solar cells. Solar cells work best when they are south facing, with no surrounding obstructions (mostly trees and other buildings) that could cast shadows over the panels. South facing roofs are ideal for solar power. For the other sections of roof there are mounts that can be used to orient the solar cells south but this adds to the implementation costs.

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

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

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

Currently, an incentive is not available for installation of thermal solar systems. A Federal tax credit of 30% of installation cost for the thermal applications is available; however, the Borough of Sussex 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 K 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	870	0	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 are not eligible for the tax credit incentive.

The most important part of any small wind generation project is the mean annual wind speed at the height of which the turbine will be installed. In the Sussex Borough area, the map shown in the appendices indicates a mean annual wind speed of under 10 miles per hour. For the building, there are site restrictions, such as parking lots, trees and surrounding structures would greatly affect a tower location.

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

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

6.4 Combined Heat and Power Generation (CHP)

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

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

This measure is not recommended.

6.5 Biomass Power Generation

Biomass power generation is a process in which waste organic materials are used to produce electricity or thermal energy. These materials would otherwise be sent to the landfill or expelled to the atmosphere. To participate in NJCEP's Customer On-Site Renewable Energy program, participants must install an on-site

sustainable biomass or fuel cell energy generation system. Incentives for bio-power installations are available to support up to 1MW-dc of rated capacity.

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

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

The NJDEP evaluates biomass resources not identified in the RPS.

Examples of eligible facilities for a CORE incentive include:

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

* from NJOCE Website

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

6.6 Demand Response Curtailment

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

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

7.0 EPA PORTFOLIO MANAGER

The United State 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 administration building is considered a high energy consumer by the Portfolio Manager with a Site Energy Usage Index (EUI) of 74 kBTU/ft^2/year. Several factors contribute to the unfavorable EUI, including, but not limited to, wasted energy from poor wall insulation, lack of heating controls, and inefficient lighting. By implementing the measures discussed in this report, it is expected that the EUI can be reduced to approximately 37 kBTU/ft^2/year; the national average for this building type is 59 kBTU/ft^2/year. The EPA Portfolio Manager generated an energy rating score for this building of about 29. This number represents how energy efficient a building is on a scale from 1 to 100 with 100 being the best. In order for a building to receive and energy star label, this energy benchmark rating must be at least 75. As energy use decreases from the implementation of the proposed ECMs, this rating will increase.

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

The user name and password for the EPA Portfolio Manager Account has been provided to Cathy Gleason, the Sussex Borough Clerk.

8.0 CONCLUSIONS & RECOMMENDATIONS

The energy audit conducted by CHA at the Hillsborough Municipal Building in Hillsborough, New Jersey identified potential ECMs for night setback, day lighting controls, lighting replacement, occupancy sensors, and insulation upgrades. Potential annual savings of $3,400 may be realized for the recommended ECMs, with a summary of the costs, savings, and paybacks as follows:

This report details the results of the Sussex Borough administration building, a 6,000 square foot facility, which serves as office space and a meeting location for the borough. The following areas were evaluated for energy conservation measures:

- Night setback
- Day lighting controls
- Lighting replacement
- Occupancy sensors
- Insulation upgrades
- Boiler replacement

Various potential Energy Conservation Measures (ECMs) were identified for the above categories. Potential annual savings of $3,400 for the recommended ECMs may be realized with a payback of 2.8 years.

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

ECM-2 Programmable Thermostats – Night Setback

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
2,000	0	1,260	940	1,300	9.1	NA	1.5	NA

* There is no incentive available through the New Jersey Smart Start program for this ECM.

ECM-4 Install Day Lighting Controls

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
700	0	630	0	100	1.8	100	7.0	6.0

* Incentive shown is per the 2010 New Jersey Smart Start Program's Lighting Controls Application.

ECM-5 Lighting Replacement

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	6,040	0	1,200	2.2	1,300	4.6	3.5

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

ECM-6 Installation of Occupancy Sensors

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
1,600	0	1,710	0	300	2.3	150 200	5.3	4.7

* Incentive shown is per the 2010 New Jersey Smart Start Program's Lighting Controls Application.

ECM-7 Install Roof Insulation/Seal Ductwork

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Therms	Total				
$	kW	kWh	Natural Gas	$		$	Years	Years
1,200	0	100	460	500	7.4	NA	2.4	NA

* There is no incentive available through the New Jersey Smart Start program for this ECM.

As previously noted, all ECMs identified during an energy audit are evaluated as individual opportunities, and the savings and payback determined on a stand-alone basis. However, in some instances, measures have interactive properties; therefore, the savings of one measure will decrease the potential savings of other measures, if all ECMs are implemented. For the administration building, therm savings for all ECMs is approximately 2,030, or 60% of annual natural gas usage. However, if all ECMs are implemented, due to interactivity, actual therm savings would decrease slightly.

APPENDIX A

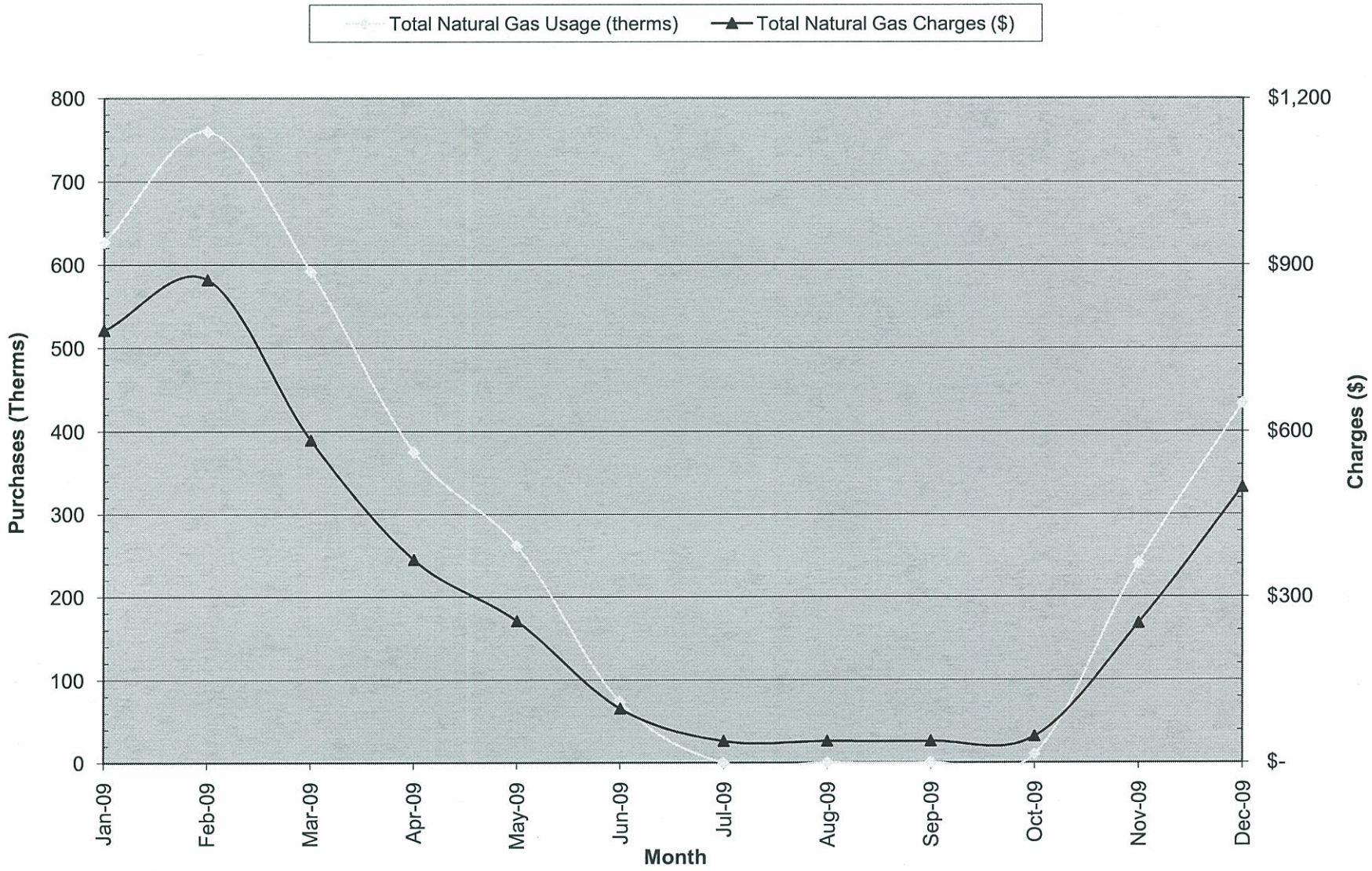
Utility Usage Analysis

New Jersey BPU Energy Audit Program
CHA Project Number: 21181
Borough of Sussex Administrative Building
Elizabethtown Gas

2 Main Street Sussex NJ
Account Number: 6245572601

Month	Therms	Charges ($)	($/therm)
January-09	627	$ 781.51	$ 1.25
February-09	760	$ 872.82	$ 1.15
March-09	592	$ 584.13	$ 0.99
April-09	375	$ 367.83	$ 0.98
May-09	262	$ 256.06	$ 0.98
June-09	74	$ 98.45	$ 1.34
July-09	0	$ 39.64	
August-09	0	$ 39.64	
September-09	0	$ 39.64	
October-09	10	$ 48.11	$ 4.63
November-09	241	$ 252.12	$ 1.05
December-09	434	$ 499.10	$ 1.15

Natural Gas Usage - Sussex Administrative Building



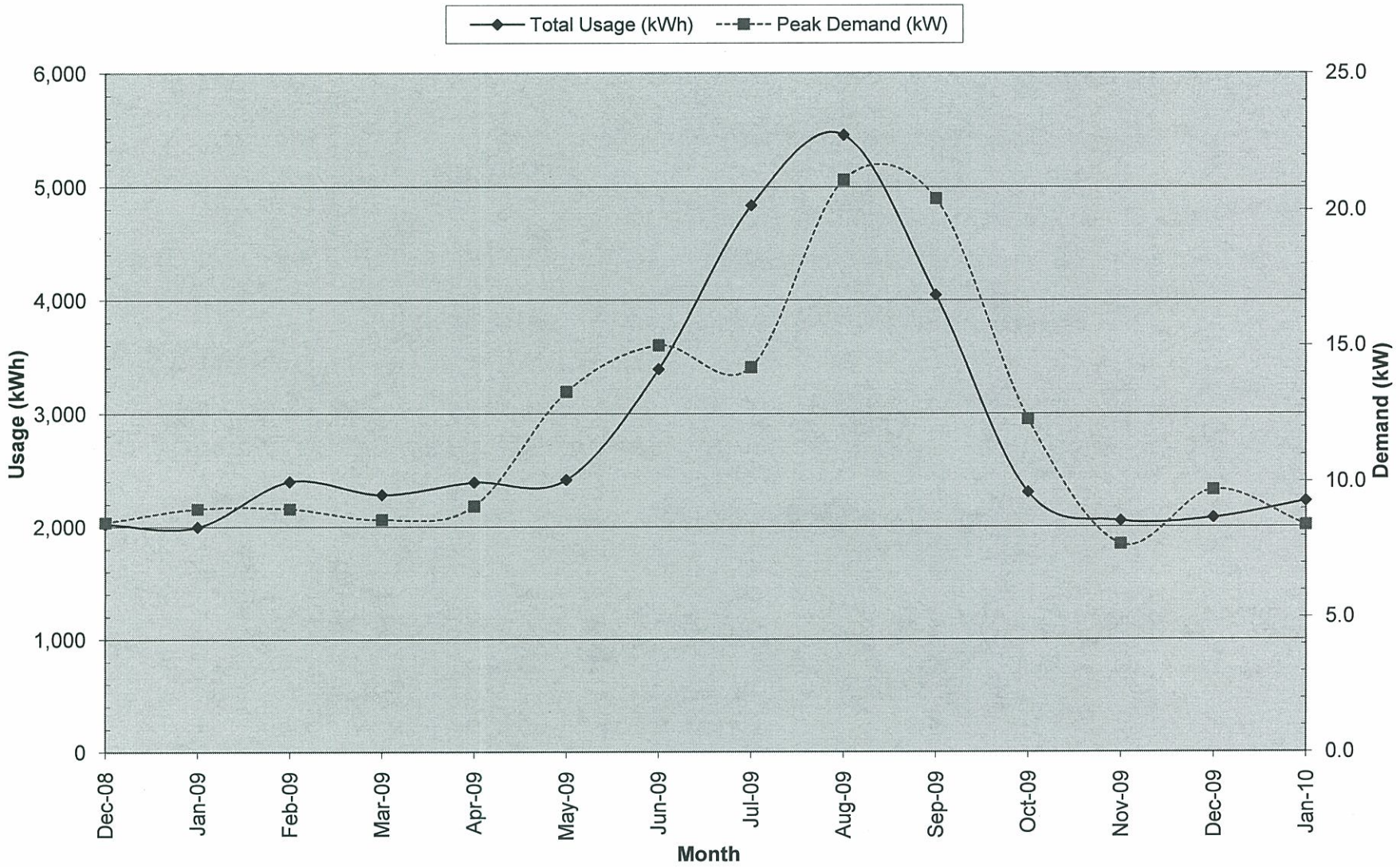
Utility Data - Sussex Admin Building
Chart5

New Jersey BPU Energy Audit Program
CHA Project Number: 21181
Borough of Sussex Administrative Building
JCP&L - Electric Service

2 Main Street Sussex NJ
Account Numbers: 100001999281
100001933389

			Charges			Unit Costs		
Month	Consumption (kWh)	Demand (kW)	Total ($)	Demand ($)	Consumption ($)	Blended Rate ($/kWh)	Consumption ($/kWh)	Demand ($/kW)
December-08	2,024	8.5	$410.72	$0.00	$410.72	0.2029	0.2029	-
January-09	1,999	9.0	$415.73	$0.00	$415.73	0.2080	0.2080	-
February-09	2,400	9.0	$472.13	$0.00	$472.13	0.1967	0.1967	-
March-09	2,284	8.6	$452.84	$0.00	$452.84	0.1983	0.1983	-
April-09	2,394	9.1	$464.41	$0.00	$464.41	0.1940	0.1940	-
May-09	2,416	13.3	$467.50	$0.00	$467.50	0.1935	0.1935	-
June-09	3,390	15.0	$680.03	$0.00	$680.03	0.2006	0.2006	-
July-09	4,838	14.2	$897.47	$0.00	$897.47	0.1855	0.1855	-
August-09	5,455	21.1	$1,042.11	$0.00	$1,042.11	0.1910	0.1910	-
September-09	4,044	20.4	$802.71	$0.00	$802.71	0.1985	0.1985	-
October-09	2,304	12.3	$461.47	$0.00	$461.47	0.2003	0.2003	-
November-09	2,054	7.7	$425.97	$0.00	$425.97	0.2074	0.2074	-
December-09	2,080	9.7	$390.09	$0.00	$390.09	0.1875	0.1875	-
January-10	2,228	8.4	$462.82	$0.00	$462.82	0.2077	0.2077	-
Total	39,910	21.1	$7,846.00	$0.00	$7,846.00	0.1966	0.1966	-
Most Recent Yr	35,887	21.1	$7,019.55	$0.00	$7,019.55	0.1956	0.1956	-

Electric Usage - Sussex Borough Administration Building



Utility Data - Sussex Admin Building
Chart4

APPENDIX B

ECM-1 Boiler Replacement with Hot Water Reset

Borough of Sussex
CHA #21181
Building: Administration Building

ECM-1 Boiler Replacement with Hot Water Temperature Reset

Existing Fuel	Nat.Gas
Proposed Fuel	Nat.Gas

Item	Value	Units	Formula/Comments
Baseline Fuel Cost	$ 1.15		
Proposed Fuel Cost	$ 1.15		
Baseline Fuel Use	3,374	Therms	Based on historical utility data
Existing Boiler Plant Efficiency	80%		Estimated or Measured
Baseline Boiler Load	269,920	Mbtu/yr	Baseline Fuel Use x Existing Efficiency x 100 Mbtu/Therms
Baseline Fuel Cost	$ 3,880		
Proposed Boiler Plant Efficiency	91%		New Boiler Efficiency, based on manufacturers data and operating hours
Proposed Fuel Use	2,961	Therms	Baseline Boiler Load / Proposed Efficiency / 100 Mbtu/Therms
Proposed Fuel Cost	$ 3,405		
Annual Savings	413	Therms	
Annual Savings	$ 475	/yr	

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

Fuel Table

	Fuel Type	HHV	Units
1	Nat.Gas	100	Therms
2	Propane	91	Gals LPG
3	#2 Oil	138.7	Gals #2
4	#4 Oil	148.1	Gals # 4
5	#6 Oil	155.9	Gals # 6
6	Electric	3.413	kWh

Existing	Proposed
1	1

Borough of Sussex
CHA #21181
Building: Borough Hall Municipal Building

ECM-1 Boiler Replacement with Hot Water Temperature Reset

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

A	B	C	D	E	F	G	H	I	J
					Proposed Usage			Utility Usage	
Amb. Bin Temp °F	Avg. DB Bin Temp °F	Bin Hours	Heating Bin HOURS	Existing Heat Loss In Piping MBH	Avg. HHW Temp @ OA Temp °F	Proposed Heat Loss In Piping MBH	Proposed Boiler Efficiency	Existing Utility Use Therms/Yr	Proposed Utility Use Therms/Yr
100-104	102.0	0	0	0	0	0	0.0%	0	0
95-99	97.0	3	0	0	0	0	0.0%	0	0
90-94	92.0	34	0	0	0	0	0.0%	0	0
85-89	87.0	131	0	0	0	0	0.0%	0	0
80-84	82.0	500	0	0	0	0	0.0%	0	0
75-79	77.0	620	0	0	0	0	0.0%	0	0
70-74	72.0	664	0	0	0	0	0.0%	0	0
65-69	67.0	854	0	0	0	0	0.0%	0	0
60-64	62.0	927	0	0	0	0	96.0%	0	0
55-59	57.0	600	0	0	0	0	95.0%	0	0
50-54	52.0	610	610	5,551	80	3,117	94.0%	59	33
45-49	47.0	611	611	5,560	90	3,122	93.4%	60	33
40-44	42.0	656	656	5,970	100	3,352	92.0%	65	36
35-39	37.0	1,023	1,023	9,309	110	5,228	90.6%	103	58
30-34	32.0	734	734	6,679	120	3,751	89.8%	74	42
25-29	27.0	334	334	3,039	130	1,707	89.0%	34	19
20-24	22.0	252	252	2,293	140	1,288	88.5%	26	15
15-19	17.0	125	125	1,138	150	639	88.0%	13	7
10-14	12.0	47	47	428	160	240	87.6%	5	3
5-9	7.0	22	22	200	170	112	87.2%	2	1
0-4	2.0	13	13	118	180	66	86.8%	1	1
(5) - (1)	-3.0	0	0	0	180	0	86.8%	0	0
(10) - (6)	-8.0	0	0	0	180	0	86.8%	0	0
Totals		**8,760**	**4,427**	**40,286**		**22,622**		**442**	**248**

Annual Energy Savings	**194**	**Therms/yr**
Annual Cost Savings	**$ 223**	**/yr**

Existing Boiler Efficiency	80%	
Avg. Proposed Boiler Efficiency	91%	

Building HHW Piping System		
Heating On Temperature	55	°F
Total Length of Pipe	700	LF
Existing HHW Setpoint High	180	°F
Existing HHW Setpoint Low	180	°F
Avg HHW Temp	180	°F
Avg Pipe Size	1	Inches
Avg Insul Thickness	1	Inches
Existing Heat Loss	13.0	Btu/Hr/LF
Percent in Uncond. Space	100%	
Existing System Heat Loss	9,100	Btu/Hr
Proposed Min HHW Return*	80	°F
Avg Prop HHW Supply Temp	109	°F
Proposed Heat Loss	7.3	Btu/Hr/LF
Proposed System Heat Loss	5,110	Btu/Hr

*Refer to proposed boiler capabilities

Size (in)	Length (ft)
1 1/2	200
1	250
3/4	250
1	**Average**

Total Pipe Length is estimated based on building size, height, and perimeter

Comments:

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

Borough of Sussex
CHA #21181
Building: Administration Building

ECM-1 Boiler Replacement with Hot Water Temperature Reset

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.		
						$ -	$ -	$ -	$ -	
Aerco Modulex 454 (418 Mbtu Output)	1	Boiler	$ 13,000	$ 500		$ 12,740	$ 605	$ -	$ 13,345	
BMS II Boiler Control System	1	Controller	$ 1,500	$ 300		$ 1,470	$ 363	$ -	$ 1,833	With HW Reset
6" PVC Exhaust Piping	15	LF	$ 22	$ 19		$ 316	$ 348	$ -	$ 665	From RS Means
Old Boiler Removal	2	Boiler		$ 250		$ -	$ 605	$ -	$ 605	
Miscellaneous Electrical	1	LS	$ 100	$ 250		$ 98	$ 303	$ -	$ 401	
Miscellaneous Piping Modifications	1	LS	$ 200	$ 250		$ 196	$ 303	$ -	$ 499	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 17,347	Subtotal
$ 1,735	10% Contingency
$ 1,908	10% Contractor O&P
$ -	Engineering
$ 20,989	**Total**

APPENDIX C

ECM-2 Programmable Thermostats – Night Setback

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 2 Night Setback

Building Footprint	3,330	SF	Ex Occupied Clng Temp.	72	°F	Ex Occupied Htg Temp.	70	°F	**Heating Energy Savings**	423	**therms**
Heating Efficiency	80%		Ex Unoccupied Clng Temp.	72	°F	Ex Unoccupied Htg Temp.	70	°F	**Cooling Energy Savings**	1,261	**kWh**
Cooling Efficiency	1.07	kW/ton	Prop Occupied Clng Temp.	72	°F	Prop Occupied Htg Temp.	70	°F			
Building Balance Temp.	60	°F	Prop Unoccupied Clng Temp.	78	°F	Prop Unoccupied Htg Temp.	60	°F			
Internal Gains	18,677	btu/h	Occupied Cooling UA	-1,248	btu/hr/°F	Occupied Heating UA	417	btu/hr/°F			
Unoc Internal Gain factor	0.05		Unoccupied Cooling UA	-642	btu/hr/°F	Unoccupied Heating UA	417	btu/hr/°F			
Ave Occ Internal Gain Factor	0.8		Cooling Occ Enthalpy Setpoint	25.5	Btu/lb						
			Cooling Unocc Enthalpy Setpoint	25.5	Btu/lb						

					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	-37,973	-57,698	-14,941	-19,566	-57,698	-934	-37,973	-57,698	-14,941	-15,717	-57,698	-934	0	0	0	0
97.5	42.5	3	1	2	-31,748	-41,562	-14,941	-16,359	-41,562	-934	-31,748	-41,562	-14,941	-12,509	-41,562	-934	18	17	0	0
92.5	39.5	34	8	26	-25,523	-34,228	-14,941	-13,151	-34,228	-934	-25,523	-34,228	-14,941	-9,302	-34,228	-934	166	157	0	0
87.5	36.6	131	31	100	-19,298	-27,138	-14,941	-9,943	-27,138	-934	-19,298	-27,138	-14,941	-6,094	-27,138	-934	509	475	0	0
82.5	34	500	119	381	-13,073	-20,781	-14,941	-6,736	-20,781	-934	-13,073	-20,781	-14,941	-2,887	-20,781	-934	1,484	1,354	0	0
77.5	31.6	620	148	472	-6,848	-14,914	-14,941	-3,528	-14,914	-934	-6,848	-14,914	-14,941	0	0	-934	1,299	522	0	0
72.5	29.2	664	158	506	-623	-9,046	-14,941	-321	-9,046	-934	-623	-9,046	-14,941	0	0	-934	812	389	0	0
67.5	27	854	203	651	1,043	1,467	-14,941	1,043	1,467	-934	1,043	1,467	-14,941	0	0	-934	225	280	0	0
62.5	24.5	927	221	706	3,128	4,401	-14,941	3,128	4,401	-934	3,128	4,401	-14,941	0	0	-934	146	205	0	0
57.5	21.4	600	143	457	5,214	7,335	-14,941	5,214	7,335	-934	5,214	7,335	-14,941	1,043	1,467	-934	30	30	0	0
52.5	18.7	610	145	465	7,299	10,268	-14,941	7,299	10,268	-934	7,299	10,268	-14,941	3,128	4,401	-934	0	0	101	43
47.5	16.2	611	145	466	9,384	13,202	-14,941	9,384	13,202	-934	9,384	13,202	-14,941	5,214	7,335	-934	0	0	140	81
42.5	14.4	656	156	500	11,470	16,136	-14,941	11,470	16,136	-934	11,470	16,136	-14,941	7,299	10,268	-934	0	0	191	129
37.5	12.6	1,023	244	779	13,555	19,070	-14,941	13,555	19,070	-934	13,555	19,070	-14,941	9,384	13,202	-934	0	0	363	265
32.5	10.7	734	175	559	15,641	22,004	-14,941	15,641	22,004	-934	15,641	22,004	-14,941	11,470	16,136	-934	0	0	306	236
27.5	8.6	334	80	254	17,726	24,937	-14,941	17,726	24,937	-934	17,726	24,937	-14,941	13,555	19,070	-934	0	0	160	128
22.5	6.8	252	60	192	19,812	27,871	-14,941	19,812	27,871	-934	19,812	27,871	-14,941	15,641	22,004	-934	0	0	137	113
17.5	5.5	125	30	95	21,897	30,805	-14,941	21,897	30,805	-934	21,897	30,805	-14,941	17,726	24,937	-934	0	0	76	64
12.5	4.1	47	11	36	23,982	33,739	-14,941	23,982	33,739	-934	23,982	33,739	-14,941	19,812	27,871	-934	0	0	31	27
7.5	2.6	22	5	17	26,068	36,673	-14,941	26,068	36,673	-934	26,068	36,673	-14,941	21,897	30,805	-934	0	0	16	14
2.5	1	13	3	10	28,153	39,607	-14,941	28,153	39,607	-934	28,153	39,607	-14,941	23,982	33,739	-934	0	0	10	9
-2.5	0	0	0	0	30,239	42,540	-14,941	30,239	42,540	-934	30,239	42,540	-14,941	26,068	36,673	-934	0	0	0	0
-7.5	-1.5	0	0	0	32,324	45,474	-14,941	32,324	45,474	-934	32,324	45,474	-14,941	28,153	39,607	-934	0	0	0	0
TOTALS		8,760	2,086	6,674													4,689	3,428	1,532	1,109

Existing Building Ventilation & Infiltration (occ)	**543**	**cfm**
Overheat Ventilation Factor	**1.00**	
Additional ventilation to offset overheat	**0**	**cfm**
Existing Building Ventilation & Infiltration (unocc)	**543**	**cfm**

4,777 **1,581**

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 2 Night Setback

Building Footprint	2,610	SF	Ex Occupied Clng Temp.	74	°F	Ex Occupied Htg Temp.	70	°F	**Heating Energy Savings**	517	therms
Heating Efficiency	80%		Ex Unoccupied Clng Temp.	74	°F	Ex Unoccupied Htg Temp.	70	°F	**Cooling Energy Savings**	0	kWh
Cooling Efficiency	0	kW/ton	Prop Occupied Clng Temp.	74	°F	Prop Occupied Htg Temp.	70	°F			
Building Balance Temp.	60	°F	Prop Unoccupied Clng Temp.	74	°F	Prop Unoccupied Htg Temp.	60	°F			
Internal Gains	14,952	btu/h	Occupied Cooling UA	-1,595	btu/hr/°F	Occupied Heating UA	438	btu/hr/°F			
Unoc Internal Gain factor	0.05		Unoccupied Cooling UA	-973	btu/hr/°F	Unoccupied Heating UA	438	btu/hr/°F			
Ave Occ Internal Gain Factor	0.3		Cooling Occ Enthalpy Setpoint	27.5	Btu/lb						
			Cooling Unocc Enthalpy Setpoint	27.5	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	-45,461	-45,992	-4,486	-27,726	-45,992	-748	-45,461	-45,992	-4,486	-27,726	-45,992	-748	0	0	0	0
97.5	42.5	3	1	2	-37,485	-31,939	-4,486	-22,862	-31,939	-748	-37,485	-31,939	-4,486	-22,862	-31,939	-748	0	0	0	0
92.5	39.5	34	8	26	-29,510	-25,551	-4,486	-17,998	-25,551	-748	-29,510	-25,551	-4,486	-17,998	-25,551	-748	0	0	0	0
87.5	36.6	131	31	100	-21,534	-19,376	-4,486	-13,134	-19,376	-748	-21,534	-19,376	-4,486	-13,134	-19,376	-748	0	0	0	0
82.5	34	500	119	381	-13,558	-13,840	-4,486	-8,269	-13,840	-748	-13,558	-13,840	-4,486	-8,269	-13,840	-748	0	0	0	0
77.5	31.6	620	148	472	-5,583	-8,730	-4,486	-3,405	-8,730	-748	-5,583	-8,730	-4,486	-3,405	-8,730	-748	0	0	0	0
72.5	29.2	664	158	506	0	0	-4,486	0	0	-748	0	0	-4,486	0	0	-748	0	0	0	0
67.5	27	854	203	651	1,095	1,278	-4,486	1,095	1,278	-748	1,095	1,278	-4,486	0	0	-748	0	0	0	0
62.5	24.5	927	221	706	3,284	3,833	-4,486	3,284	3,833	-748	3,284	3,833	-4,486	0	0	-748	0	0	63	1
57.5	21.4	600	143	457	5,474	6,388	-4,486	5,474	6,388	-748	5,474	6,388	-4,486	1,095	1,278	-748	0	0	77	22
52.5	18.7	610	145	465	7,663	8,943	-4,486	7,663	8,943	-748	7,663	8,943	-4,486	3,284	3,833	-748	0	0	114	59
47.5	16.2	611	145	466	9,853	11,498	-4,486	9,853	11,498	-748	9,853	11,498	-4,486	5,474	6,388	-748	0	0	151	95
42.5	14.4	656	156	500	12,042	14,053	-4,486	12,042	14,053	-748	12,042	14,053	-4,486	7,663	8,943	-748	0	0	201	141
37.5	12.6	1,023	244	779	14,232	16,608	-4,486	14,232	16,608	-748	14,232	16,608	-4,486	9,853	11,498	-748	0	0	373	281
32.5	10.7	734	175	559	16,422	19,163	-4,486	16,422	19,163	-748	16,422	19,163	-4,486	12,042	14,053	-748	0	0	311	245
27.5	8.6	334	80	254	18,611	21,718	-4,486	18,611	21,718	-748	18,611	21,718	-4,486	14,232	16,608	-748	0	0	162	131
22.5	6.8	252	60	192	20,801	24,273	-4,486	20,801	24,273	-748	20,801	24,273	-4,486	16,422	19,163	-748	0	0	137	114
17.5	5.5	125	30	95	22,990	26,829	-4,486	22,990	26,829	-748	22,990	26,829	-4,486	18,611	21,718	-748	0	0	75	64
12.5	4.1	47	11	36	25,180	29,384	-4,486	25,180	29,384	-748	25,180	29,384	-4,486	20,801	24,273	-748	0	0	31	27
7.5	2.6	22	5	17	27,369	31,939	-4,486	27,369	31,939	-748	27,369	31,939	-4,486	22,990	26,829	-748	0	0	16	14
2.5	1	13	3	10	29,559	34,494	-4,486	29,559	34,494	-748	29,559	34,494	-4,486	25,180	29,384	-748	0	0	10	9
-2.5	0	0	0	0	31,748	37,049	-4,486	31,748	37,049	-748	31,748	37,049	-4,486	27,369	31,939	-748	0	0	0	0
-7.5	-1.5	0	0	0	33,938	39,604	-4,486	33,938	39,604	-748	33,938	39,604	-4,486	29,559	34,494	-748	0	0	0	0
TOTALS		8,760	2,086	6,674													0	0	1,721	1,204

Existing Building Ventilation & Infiltration (occ)	**473**	**cfm**
Overheat Ventilation Factor	**1.00**	
Additional ventilation to offset overheat	**0**	**cfm**
Existing Building Ventilation & Infiltration (unocc)	**473**	**cfm**

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 2 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.		
						$ -	$ -	$ -	$ -	
Programmable thermostat	8	ea	$ 100	$ 50	$ -	$ 784	$ 484	$ -	$ 1,268	
Miscellaneous Wiring	200	LF	$ 1.00	$ 1.00		$ 196	$ 242	$ -	$ 438	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 1,706	Subtotal
$ 85	5% Contingency
$ 179	Contractor 10% O&P
$ -	0% Engineering
$ 1,970	**Total**

APPENDIX D

ECM-3 Piping Insulation

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 3 Piping Insulation

Description Insulate heating system piping which are not currently insulated to reduce heat loss from piping and heat gain to the spaces.

Given	Fuel Energy Cost	=				$ 1.15 $/Therm (Nat'l Gas)
	Operation (Hours/Week)	=				168 Hours/Week
	Operation (Heating Weeks/Year)	=				Weeks/Year
	Operation (Hours/Year)	=				2,214 Hours/Year
	Heating Media	=				Water
	Piping Material	=				Copper
	Ambient Temperature	=				60 °F
			Pipe #1	Pipe #2	Pipe #3	Pipe #4
	Pipe Diameter	=	1.00 inches	2.00 inches	4.00 inches	2.00 inches
	Pipe Length	=	10.00 feet	0.00 feet	0.00 feet	0.00 feet
Assumption	Min. Pipe Insulation Recommended	=	1.00 inches	1.50 inches	1.50 inches	1.50 inches
	Circulating Temperature	=				180 °F
	Heating Efficiency	=				80%
	Pipe Insulation Conductivity	=				0.29 Btu*in./(h*ft2*F)

Formula

Piping Correction Factor = (Current Transmission Coefficient / Reference Transmission Coefficient)
Temperature Correction Factor = (Circulating Temperature - Ambient Temperature) / (Circulating Temperature - Reference Temperature)
Hourly Heat Loss per pipe size and length = (Heat loss per foot [from chart]) x (Piping Correction Factor) x (Temperature Correction Factor) x (Pipe Length)
Seasonal Heat Loss = (Hourly Heat Loss Total) x (Operating hours) / (Heating Efficiency) / (1,000 btu/Mbtu)

Energy Loss = (Seasonal Heat Loss) / (Conversion Factor [MBtu/Unit])
Energy Loss Cost = (Energy Loss) x (cost/unit)

Calculation

Existing

Piping Correction Factor = (Current Transmission Coefficient 2.25 / Reference Transmission Coefficient 2.00) = **1.13**

Temperature Correction Factor = (Circulating Temp. 180 - Ambient Temp. 60) / (Circulating Temp. 180 - Reference Temp. 80) = **1.20**

	Heat Loss per foot	Piping CF	Temperature CF	Pipe Length		
Heat Loss Pipe #1 (Hourly)	= 88.80	1.13	1.20	10.00	=	1,199 Btuh
Heat Loss Pipe #2 (Hourly)	= (151.80	1.13	1.20	0.00	=	- Btuh
Heat Loss Pipe #3 (Hourly)	= (271.60	1.13	1.20	0.00	=	- Btuh
Heat Loss Pipe #4 (Hourly)	= (151.80	1.13	1.20	0.00	=	- Btuh
						1,199 Btuh

Seasonal Heat Loss = Hourly Heat Loss 1,199 x operating Hours 2,214 / Heating Efficiency 80% / Factor 1,000 = **3,317 Mbtu**

Existing Energy Loss = Seasonal Heat Loss 3,317 / Btu/unit 100 = **33 Therm**

Existing Energy Loss Cost = 33 x Unit $ Cost per Unit 1.15 = **$ 38**

New

	Heat Loss per foot	Piping CF	Temperature CF	Pipe Length		
Heat Loss Pipe #1 (Hourly)	= 16.00	1.13	1.20	10.00	=	216 Btuh
Heat Loss Pipe #2 (Hourly)	= (17.00	1.13	1.20	0.00	=	- Btuh
Heat Loss Pipe #3 (Hourly)	= (22.00	1.13	1.20	0.00	=	- Btuh
Heat Loss Pipe #4 (Hourly)	= (17.00	1.13	1.20	0.00	=	- Btuh
						216 Btuh

Seasonal Heat Loss = Hourly Heat Loss 216 x operating Hours 2,214 / Heating Efficiency 80% / Factor 1,000 = **598 Mbtu**

New Energy Loss = Seasonal Heat Loss 598 / Btu/unit 100 = **6 Therm**

New Energy Loss Cost = 6 x Unit $ Cost per Unit 1.15 = **$ 7**

Result

Existing Heat Loss		**33**	**Therm**	**$**	**38**
New Heat Loss		**6**	**Therm**	**$**	**7**
Savings	**100%**	**27**	**Therm**	**$**	**31** **82.0%**

Conversion Factors

$/MCF (Nat'l Gas)	1	1,030,000	btu/MCF	MCF	Mbh/MCF	1,030	MMbh/MCF	1.030
$/CCF (Nat'l Gas)	2	103,000	btu/CCF	CCF	Mbh/CCF	103	MMbh/CCF	0.103
$/CF (Nat'l Gas)	3	1,030	btu/CF	CF	Mbh/CF	1.030	MMbh/CF	0.001
$/Therm (Nat'l Gas)	4	100,000	btu/Therm	Therm	Mbh/Therm	100	MMbh/Therm	0.100
$/gal (LP Gas)	5	91,500	btu/gallon	gallons	Mbh/gallon	91.5	MMbh/gallon	0.092
$/gal (Fuel Oil #2)	6	139,000	btu/gallon	gallons	Mbh/gallon	139	MMbh/gallon	0.139
$/lb Steam	7	975	btu/lb Steam	lb Steam	Mbh/lb Steam	0.975	MMbh/lb Steam	0.001
$/1000 lbs Steam	8	975,000	btu/1000 lbs Stea	1000 lbs Steam	Mbh/1000 lbs Steam	975	MMbh/1000 lbs Stea	0.975

This chart is not used but is left for future reference

Pipe Diameter (I.d.)	Initial Bare BTU/hr/ft/°F	Final (1) R=2 BTU/hr/ft/°F	Final (2) ASHRAE standard BTU/hr/ft/°F	ASHRAE standard 40-80 Relative thickness in inches	Final (2) ASHRAE stnd x pipe length Btu/hr/°F	Initial Bare x pipe length	
1/2	0.27	0.18	0.15	0.75	30.0	54.0	44%
3/4	0.61	0.27	0.21	0.75	42.0	122.0	66%
1	0.77	0.30	0.23	0.75	46.0	154.0	70%
1 1/2	1.06	0.34	0.20	1.00	40.0	212.0	81%
2	1.30	0.36	0.21	1.00	42.0	260.0	84%
3	1.86	0.39	0.22	1.00	44.0	372.0	88%
4	2.30	0.41	0.22	1.00	44.0	460.0	90%
6	3.35	0.44	0.23	1.00	46.0	670.0	93%

Select one pipe length from below:
25 ft
50 ft
100 ft
150 ft
200 ft

Heat Transmission Coefficients					Water		Steam
	Cast Iron	Mild Steel	Copper	Cast Iron	1.40		2.00
Water	1.40	2.00	2.25	Mild Steel	2.00		2.50
Steam	2.00	2.50	3.00	Copper	2.25		3.00

Bare Heat Loss Chart							Temperatures	
2.00	120	150	180	210	240	280	1	120
1/2	14.9	29.4	59.3	85.7	112.0	147.2	2	150

3/4	19.8	39.3	72.5	104.8	137.1	180.1	3	180
1	24.7	48.9	88.8	128.4	168.0	220.8	4	210
1 1/2	34.0	67.2	123.9	179.3	234.7	308.5	5	240
2	42.9	84.9	151.8	219.7	287.6	378.1	6	280
2 1/2	51.7	102.1	180.5	261.4	342.2	450.0		
3	60.2	118.9	215.9	312.8	409.6	538.8		
4	77.0	151.6	271.6	393.7	515.8	678.6		
5	93.2	183.5	329.8	478.3	626.7	824.7		
6	108.9	214.7	387.1	561.6	736.1	968.7		
8	140.0	275.5	493.3	716.0	938.7	#####		

Minimum Insulation Chart							Insulation Thickness	
	120	150	180	210	240	280	1	0.5
1/2	1.0	1.0	1.0	1.5	1.5	1.5	2	1.0
3/4	1.0	1.0	1.0	1.5	1.5	1.5	3	1.5
1	1.0	1.0	1.0	1.5	1.5	2.0	4	2.0
1 1/2	1.0	1.0	1.0	2.0	2.0	2.5	5	2.5
2	1.0	1.5	1.5	2.0	2.0	3.0	6	3.0
2 1/2	1.0	1.5	1.5	2.0	2.0	3.0		
3	1.5	1.5	1.5	2.0	2.5	3.0		
4	1.5	1.5	1.5	2.0	3.0	3.0		
5	1.5	1.5	1.5	2.0	3.0	3.0		
6	1.5	2.0	2.0	3.0	3.0	3.0		
8	2.0	2.0	3.0	3.0	3.0	3.0		

Insulated Pipe Heat Loss Chart							Temperatures	
	120	150	180	210	240	280	1	120
1/2	7.5	8.0	10.0	12.6	16.0	18.5	2	150
3/4	8.5	10.0	14.0	16.1	19.0	21.0	3	180
1	10.0	11.0	16.0	18.3	21.0	23.7	4	210
1 1/2	11.5	14.0	18.0	20.2	22.0	25.3	5	240
2	13.0	13.0	17.0	20.0	25.0	27.0	6	280
2 1/2	15.0	14.5	20.0	22.4	27.0	28.0		
3	15.0	16.0	21.0	23.7	28.0	30.0		
4	16.0	19.0	22.0	25.6	29.0	34.0		
5	17.0	20.0	23.0	27.8	35.0	39.0		
6	18.0	21.0	24.0	29.4	38.0	42.0		
8	16.5	26.0	26.0	32.6	40.0	48.0		

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 3 Piping 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.		
1" pipe insulation (1" wall)	10	LF	$ 5.72	$ 1.00		$ 56	$ 12	$ -	$ 68	Mild Steel Pipe
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 68	Subtotal
$ 7	10% Contingency
$ -	Contractor O&P
$ -	Engineering
$ 75	**Total**

APPENDIX E

ECM-4 Install Day Lighting Controls

Borough of Sussex
CHA #21181
Administration Building

ECM 4 - Install Daylighting Controls

Notes:
This measure is for turning off lights in the main stairwell when natural daylighting is sufficient
Based on data from New York City, sunlight occurs 4.04 hours per day in this region.
This stairwell has south facing windows, and it was assumed the lights could be turned off 4 hours per day based on sunlight hour data.

Cost of Electricity $ 0.20 $/kWh

					Existing Conditions			Proposed conditions		
Area Description	**Number of Fixtures**	**Fixture Code or Tag**	**Watts per Fixture**	**kW/Space**	**Hrs/Day**	**Annual Hrs**	**Annual kWh**	**Annual Hrs of Sunlight**	**Annual kWh Savings**	**Annual Savings**
Stairwell	2	F44SS	188	0.376	8	2920	1,098	1460	549	$108
Stairwell	2	F41EE	26	0.052	8	2920	152	1460	76	$15
TOTALS -	**4.0**			**0.4**			**1,250**		**625**	**$123**

Borough of Sussex
CHA #21181
Administration Building

ECM 4 - Install Daylighting Controls

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.		
Photoelectric Control	2	controllers	$ 25	$ 47		$ 49	$ 114	$ -	$ 163	
Misc. Electrical, wiring	2	LS	$ 50	$ 100		$ 98	$ 242	$ -	$ 340	
						$ -	$ -	$ -	$ -	

$ 503	Subtotal
$ 101	20% Contingency
$ 50	10% Contractor O&P
$ -	0% Engineering
$ 654	**Total**

APPENDIX F

ECM-5 Lighting Replacements

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 5 Replacement of T-12 lights

Building Schedule:

Hours Per Week	40	hours/week
Blended Electric Rate	$ 0.197	/kWh
Demand Rate	$ -	/kW

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

	EXISTING CONDITIONS										RETROFIT CONDITIONS								COST ANALYSIS				
Area Description	**Number of Fixtures**	**Fixture Code**	**Watts per Fixture**	**Number of Non-Operational Fixtures**	**Watts per Non-Operational Fixtures**	**kW/Space**	**Exist Control**	**Daily Hours**	**Annual Hours**	**Annual kWh**	**Number of Fixtures**	**Fixture Code**	**Watts per Fixture**	**kW/Space**	**Retrofit Control**	**Daily Hours**	**Annual Hours**	**Annual kWh**	**kW Saved**	**Annual kWh Saved**	**Annual $ Saved**	**Retrofit Cost**	**Simple Payback**
Main Offices	6	F44SS	188	0	191.76	1.128	switch	8	2,080	2,346	6	F44ILL	118	0.708	switch	8	2,080	1,473	0	874	$ 172	$ 753	4.4
Clerks Office	4	F44SS	188	0	191.76	0.752	switch	8	2,080	1,564	4	F44ILL	118	0.472	switch	8	2,080	982	0	582	$ 114	$ 502	4.4
Downstairs Bathrooms	2	F44SS	188	0	191.76	0.376	switch	8	2,080	782	2	F44ILL	118	0.236	switch	8	2,080	491	0	291	$ 57	$ 251	4.4
Stairwell	2	F41EE	43	0	43.86	0.086	switch	8	2,080	179	2	F41ILL	31	0.062	switch	8	2,080	129	0	50	$ 10	$ 251	25.6
Stairwell	2	F44SS	188	0	191.76	0.376	switch	8	2,080	782	2	F44ILL	118	0.236	switch	8	2,080	491	0	291	$ 57	$ 251	4.4
First Floor Hallway	7	F44SS	188	0	191.76	1.316	switch	8	2,080	2,737	7	F44ILL	118	0.826	switch	8	2,080	1,718	0	1,019	$ 200	$ 878	4.4
Back Rooms/Offices	2	F44SS	188	0	191.76	0.376	switch	8	2,080	782	2	F44ILL	118	0.236	switch	8	2,080	491	0	291	$ 57	$ 251	4.4
Large Conference Room	18	F44SS	188	0	191.76	3.384	switch	8	2,080	7,039	18	F44ILL	118	2.124	switch	8	2,080	4,418	1	2,621	$ 515	$ 2,259	4.4
Large Conference Room	1	FU1EE	43	0	43.86	0.043	switch	8	2,080	89	1	FU1ILL	32	0.032	switch	8	2,080	67	0	23	$ 4	$ 125	27.9
TOTALS -	**44**			**0**		**7.8**				**16,301**	**44**			**4.9**				**10,259**	**2.9**	**6,042**	**$ 1,188**	**$ 5,521**	**4.6**

APPENDIX G

ECM-6 Installation of Occupancy Sensors

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 6 Installation of Occupancy Sensors

Building Schedule:
Existing conditions (master switch): hrs/week
Retrofit conditions (motion sensors): 5 hrs/week

Cost of Electricity: 0.197 $/kWh

Instructions and notes:
Input all applicable fixture codes from Light Table. In retrofit conditions indicate "Yes" if motion sensor is applicable
Use weekly hours if all fixtures on this sheet can be retrofitted with motion sensors, else use daily hours
*Motion sensor = Evaluate operating hours (location, traffic, etc.)
Tip: Motion sensors stays On for approx. 10 minutes when activated. It may save operating hours by 25%,30% or more.
Make sure that security or safety does not prevent installation of motion sensors
Make judgment when using Cost Tables

	EXISTING CONDITIONS									RETROFIT CONDITION				COST ANALYSIS			
Area Description	Number of Fixtures	Fixture Code	Watts per Fixture	Number of Non-Operational Fixtures	Watts per Non-Operational Fixtures	kW/Space	Daily Hours	Annual Hours	Annual kWh	Motion sensor Yes or No	Number of Sensors Required	Annual Hours	Annual kWh	Annual kWh Saved	Annual $ Saved	Retrofit Cost	Simple Payback
Downstairs Restrooms	2	FU2ES	72	0	73.44	0.1	6	2,190	315	Yes	2	260	37	278	$ 55	$ 517	9.5
Downstairs Back Rooms	2	F44SS	188	0	191.76	0.376	6	2,190	823	yes	2	260	98	726	$ 143	$ 517	3.6
Mayor's Office	4	F44SS	188	0	191.76	0.752	2	730	549	yes	1	260	196	353	$ 69	$ 259	3.7
Upstairs Office	4	F44SS	188	0	191.76	0.752	2	730	549	yes	1	260	196	353	$ 69	$ 259	3.7
TOTALS -	12			0		2.0			2,237			1,040	526.2	1,710	$ 336	$ 1,551	4.6

APPENDIX H

ECM-7 Install Roof Insulation/Seal Ductwork

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 7 Install Roof Insulation/ Seal Duct Work

Existing R-Value Calculation		
Area	ft^2	R-Value
Roof	860	17.36
Opening	10	0
	Combined R Value	17.16

Notes:

A 3'x3' opening was found where the air conditioner ducting came through the ceiling.
This ECM suggests adding insulation to the entire roof area, and properly sealing the hole where the a/c ducts enter the building

Existing Roof Area	870	sf
Existing U-value	0.06	Btu/hr/(sf*F)
Proposed R-value	29	
Proposed U-value	0.03	Btu/hr/(sf*F)
Heating System Efficiency	80%	
Cooling System Efficiency	1.07	kW/ton

Existing Cooling			Existing Heating		
Existing Cooling Load Temp Diff.	73	F	Existing Heating Load Temp Diff.	68	F
Existing Max. Roof Cooling Load	3,658	Btu/hr	Existing Max. Roof Heating Load	3,383	Btu/hr
Proposed Cooling			Proposed Heating		
Proposed Cooling Load	2,165	Btu/hr	Proposed Heating Load	2,002	Btu/hr
Occupied Cooling Setpoint	72	F	Occupied Heating Setpoint	70	F
Unoccupied Cooling Setpoint	72	F	Unoccupied Heating Setpoint	70	F

Heating Savings		
Existing Heating Total	7,985,179	Btu/yr
Proposed Heating Total	4,725,150	Btu/yr
Savings	3,260,029	Btu/yr
Input	408	therms
Fuel Cost	1.15	$/therm
Total Saved	469	$/year

Cooling Savings	
Existing Cooling Load	53
Proposed Cooling Load	32
Savings (KWh)	22
Savings ($)	4

				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	1,546	915	-	-	1,546	915	-	-	-	-	-	-
97.5	3	1	2	1,293	765	-	-	1,293	765	-	-	0	-	0	-
92.5	34	8	26	1,039	615	-	-	1,039	615	-	-	3	-	2	-
87.5	131	31	100	786	465	-	-	786	465	-	-	9	-	5	-
82.5	500	119	381	532	315	-	-	532	315	-	-	24	-	14	-
77.5	620	148	472	279	165	-	-	279	165	-	-	15	-	9	-
72.5	664	158	506	25	15	-	-	25	15	-	-	2	-	1	-
67.5	854	203	651	-	-	127	75	-	-	127	75	-	108,240	-	64,050
62.5	927	221	706	-	-	380	225	-	-	380	225	-	352,477	-	208,575
57.5	600	143	457	-	-	634	375	-	-	634	375	-	380,235	-	225,000
52.5	610	145	465	-	-	887	525	-	-	887	525	-	541,201	-	320,250
47.5	611	145	466	-	-	1,141	675	-	-	1,141	675	-	696,970	-	412,425
42.5	656	156	500	-	-	1,394	825	-	-	1,394	825	-	914,591	-	541,200
37.5	1,023	244	779	-	-	1,648	975	-	-	1,648	975	-	1,685,580	-	997,425
32.5	734	175	559	-	-	1,901	1,125	-	-	1,901	1,125	-	1,395,461	-	825,750
27.5	334	80	254	-	-	2,155	1,275	-	-	2,155	1,275	-	719,657	-	425,850
22.5	252	60	192	-	-	2,408	1,425	-	-	2,408	1,425	-	606,854	-	359,100
17.5	125	30	95	-	-	2,662	1,575	-	-	2,662	1,575	-	332,705	-	196,875
12.5	47	11	36	-	-	2,915	1,725	-	-	2,915	1,725	-	137,011	-	81,075
7.5	22	5	17	-	-	3,169	1,875	-	-	3,169	1,875	-	69,710	-	41,250
2.5	13	3	10	-	-	3,422	2,025	-	-	3,422	2,025	-	44,487	-	26,325
-2.5	0	0	0	-	-	3,676	2,175	-	-	3,676	2,175	-	-	-	-
-7.5	0	0	0	-	-	3,929	2,325	-	-	3,929	2,325	-	-	-	-
TOTALS	**8,760**	**2,086**	**6,674**									**53**	**7,985,179**	**32**	**4,725,150**

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 7 Install Roof Insulation/ Seal Duct Work

Building Footprint	3,330 SF	Ex Occupied Clng Temp.	72 *F	Ex Occupied Htg Temp.	70 *F
Heating Efficiency	80%	Ex Unoccupied Clng Temp.	72 *F	Ex Unoccupied Htg Temp.	70 *F
Cooling Efficiency	1.07 kW/ton	Occupied Cooling UA	(1,245) btu/hr/°F	Occupied Heating UA	417 btu/hr/°F
Internal Gains	18,677 btu/h	Unoccupied Cooling UA	(642) btu/hr/°F	Unoccupied Heating UA	417 btu/hr/°F
Unoc Internal Gain factor	0.05	Cooling Occ Enthalpy Setpoint	26 Btu/lb		
Ave Occ Internal Gain Factor	0.8	Cooling Unocc Enthalpy Setpoint	26 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	-37,973	-67,771	-14,941	-19,566	-56,476	-934	0	0	0	0
97.5	42.5	3	1	2	-31,748	-48,408	-14,941	-16,359	-40,340	-934	0	18	18	0
92.5	39.5	34	8	26	-25,523	-39,607	-14,941	-13,151	-33,005	-934	0	167	167	0
87.5	36.6	131	31	100	-19,298	-31,098	-14,941	-9,943	-25,915	-934	0	509	509	0
82.5	34.0	500	119	381	-13,073	-23,471	-14,941	-6,736	-19,559	-934	0	1,471	1,471	0
77.5	31.6	620	148	472	-6,848	-16,429	-14,941	-3,528	-13,691	-934	0	1,268	1,268	0
72.5	29.2	664	158	506	-623	-9,388	-14,941	-321	-7,824	-934	0	761	761	0
67.5	27.0	854	203	651	1,043	1,760	-14,941	1,043	1,467	-934	0	220	220	0
62.5	24.5	927	221	706	3,128	5,281	-14,941	3,128	4,401	-934	0	129	129	0
57.5	21.4	600	143	457	5,214	8,801	-14,941	5,214	7,335	-934	0	12	12	0
52.5	18.7	610	145	465	7,299	12,322	-14,941	7,299	10,268	-934	0	0	0	105
47.5	16.2	611	145	466	9,384	15,843	-14,941	9,384	13,202	-934	0	0	0	145
42.5	14.4	656	156	500	11,470	19,363	-14,941	11,470	16,136	-934	0	0	0	198
37.5	12.6	1,023	244	779	13,555	22,884	-14,941	13,555	19,070	-934	0	0	0	374
32.5	10.7	734	175	559	15,641	26,404	-14,941	15,641	22,004	-934	0	0	0	316
27.5	8.6	334	80	254	17,726	29,925	-14,941	17,726	24,937	-934	0	0	0	165
22.5	6.8	252	60	192	19,812	33,446	-14,941	19,812	27,871	-934	0	0	0	141
17.5	5.5	125	30	95	21,897	36,966	-14,941	21,897	30,805	-934	0	0	0	78
12.5	4.1	47	11	36	23,982	40,487	-14,941	23,982	33,739	-934	0	0	0	32
7.5	2.6	22	5	17	26,068	44,007	-14,941	26,068	36,673	-934	0	0	0	17
2.5	1.0	13	3	10	28,153	47,528	-14,941	28,153	39,607	-934	0	0	0	11
-2.5	0.0	0	0	0	30,239	51,048	-14,941	30,239	42,540	-934	0	0	0	0
-7.5	-1.5	0	0	0	32,324	54,569	-14,941	32,324	45,474	-934	0	0	0	0
TOTALS		8,760	2,086	6,674								4,554	4,554	1,581

Existing Building Ventilation & Infiltration (occ)	543	cfm
Overheat Ventilation Factor	1.20	
Additional ventilation to offset overheat	109	cfm
Existing Building Ventilation & Infiltration (unocc)	543	cfm

Unit	Clng Hrs	Amps	Volts	Phase	Power Factor	% Runtime	Annual kWh
AC 1	1,952	15.3	208	3	0.8	20%	1719
AC 2	1,952	27.2	208	3	0.8	20%	3057
Total							4776

Energy Use Indices (calculated)

Heating

Upstairs	1,756
Downstairs	1,581
Total	3,337

Cooling	4,554
Target ->	4,776

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 7 Install Roof Insulation/ Seal Duct Work

Building Footprint	3,330 SF	Ex Occupied Clng Temp.	72 *F	Ex Occupied Htg Temp.	70 *F
Heating Efficiency	80%	Ex Unoccupied Clng Temp.	72 *F	Ex Unoccupied Htg Temp.	70 *F
Cooling Efficiency	1.07 kW/ton	Occupied Cooling UA	(1,245) btu/hr/°F	Occupied Heating UA	417 btu/hr/°F
Internal Gains	18,677 btu/h	Unoccupied Cooling UA	(642) btu/hr/°F	Unoccupied Heating UA	417 btu/hr/°F
Unoc Internal Gain factor	0.05	Cooling Occ Enthalpy Setpoint	26 Btu/lb		
Ave Occ Internal Gain Factor	0.8	Cooling Unocc Enthalpy Setpoint	26 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	-37,973	-56,476	-14,941	-19,566	-56,476	-934	0	0	0	0
97.5	42.5	3	1	2	-31,748	-40,340	-14,941	-16,359	-40,340	-934	0	17	17	0
92.5	39.5	34	8	26	-25,523	-33,005	-14,941	-13,151	-33,005	-934	0	162	162	0
87.5	36.6	131	31	100	-19,298	-25,915	-14,941	-9,943	-25,915	-934	0	495	495	0
82.5	34.0	500	119	381	-13,073	-19,559	-14,941	-6,736	-19,559	-934	0	1,430	1,430	0
77.5	31.6	620	148	472	-6,848	-13,691	-14,941	-3,528	-13,691	-934	0	1,232	1,232	0
72.5	29.2	664	158	506	-623	-7,824	-14,941	-321	-7,824	-934	0	739	739	0
67.5	27.0	854	203	651	1,043	1,467	-14,941	1,043	1,467	-934	0	225	225	0
62.5	24.5	927	221	706	3,128	4,401	-14,941	3,128	4,401	-934	0	146	146	0
57.5	21.4	600	143	457	5,214	7,335	-14,941	5,214	7,335	-934	0	30	30	0
52.5	18.7	610	145	465	7,299	10,268	-14,941	7,299	10,268	-934	0	0	0	101
47.5	16.2	611	145	466	9,384	13,202	-14,941	9,384	13,202	-934	0	0	0	140
42.5	14.4	656	156	500	11,470	16,136	-14,941	11,470	16,136	-934	0	0	0	191
37.5	12.6	1,023	244	779	13,555	19,070	-14,941	13,555	19,070	-934	0	0	0	363
32.5	10.7	734	175	559	15,641	22,004	-14,941	15,641	22,004	-934	0	0	0	306
27.5	8.6	334	80	254	17,726	24,937	-14,941	17,726	24,937	-934	0	0	0	160
22.5	6.8	252	60	192	19,812	27,871	-14,941	19,812	27,871	-934	0	0	0	137
17.5	5.5	125	30	95	21,897	30,805	-14,941	21,897	30,805	-934	0	0	0	76
12.5	4.1	47	11	36	23,982	33,739	-14,941	23,982	33,739	-934	0	0	0	31
7.5	2.6	22	5	17	26,068	36,673	-14,941	26,068	36,673	-934	0	0	0	16
2.5	1.0	13	3	10	28,153	39,607	-14,941	28,153	39,607	-934	0	0	0	10
-2.5	0.0	0	0	0	30,239	42,540	-14,941	30,239	42,540	-934	0	0	0	0
-7.5	-1.5	0	0	0	32,324	45,474	-14,941	32,324	45,474	-934	0	0	0	0
TOTALS		8,760	2,086	6,674								4,476	4,476	1,532

Existing Building Ventilation & Infiltration (occ)	**543**	**cfm**
Overheat Ventilation Factor	**1.00**	
Additional ventilation to offset overheat	**0**	**cfm**
Existing Building Ventilation & Infiltration (unocc)	**543**	**cfm**

Unit	Clng Hrs	Amps	Volts	Phase	Power Factor	% Runtime	Annual kWh
AC 1	1,952	15.3	208	3	0.8	20%	1719
AC 2	1,952	27.2	208	3	0.8	20%	3057
Total							4776

Energy Use Indices (calculated)

	Heating
Upstairs	1,756
Downstairs	1,532
Total	3,288

Therm Savings	49	**Therms**
kWh Savings	78	

Borough of Sussex
CHA #21181
Building: Administration Building

ECM 7 Install Roof Insulation/ Seal Duct Work

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.		
						$ -	$ -	$ -	$ -	
R-13 Blown In Fiberglass insulation (6")	870	ft^2	$ 0.23	$ 0.27	$ 0.1	$ 196	$ 284	$ 123	$ 604	Accessible through large hole in
Sealing Ducts and Drywall	1	LS	$ 100	$ 200		$ 98	$ 242	$ -	$ 340	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 944	Subtotal
$ 142	15% Contingency
$ 163	15% Contractor O&P
$ -	Engineering
$ 1,248	**Total**

APPENDIX I

New Jersey Pay for Performance Incentive Program

Borough of Sussex
CHA #21181
Administration Building

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)	6,000
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)	$7,020	$3,879
Existing Usage (from utility)	35,887	3,374
Proposed Savings	8,373	2,031
Existing Total MMBtus	460	
Proposed Savings MMBtus	232	
% Energy Reduction	**50.4%**	
Proposed Annual Savings	$4,250	

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

	Incentives $		
	Elec	Gas	Total
Incentive #1	$0	$0	$300
Incentive #2	$921	$2,234	$3,155
Incentive #3	$586	$1,422	$2,008
Total All Incentives	**$1,507**	**$3,656**	**$5,463**

Total Project Cost	$32,000

		Allowable Incentive
% Incentives #1 of Utility Cost*	2.8%	$300
% Incentives #2 of Project Cost**	9.9%	$3,155
% Incentives #3 of Project Cost**	6.3%	$2,008
Total Eligible Incentives***	**$5,463**	
Project Cost w/ Incentives	$26,537	

Project Payback (years)	
w/o Incentives	w/ Incentives
7.5	6.2

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

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

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

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

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

APPENDIX J

Photovoltaic (PV) Rooftop Solar Power Generation

PVWatts *** AC Energy & Cost Savings

Cautions for Interpreting the Results

Station Identification	
City:	Newark
State:	New_Jersey
Latitude:	40.70° N
Longitude:	74.17° W
Elevation:	9 m
PV System Specifications	
DC Rating:	12.0 kW
DC to AC Derate Factor:	0.770
AC Rating:	9.2 kW
Array Type:	Fixed Tilt
Array Tilt:	40.7°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	19.6 ¢/kWh

Results			
Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	3.36	993	194.23
2	4.05	1073	209.88
3	4.58	1301	254.48
4	4.84	1272	248.80
5	5.30	1401	274.04
6	5.33	1321	258.39
7	5.27	1335	261.13
8	5.25	1321	258.39
9	5.06	1281	250.56
10	4.46	1207	236.09
11	3.15	861	168.41
12	2.87	830	162.35
Year	4.46	14196	2776.74

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*)

Sussex Borough
Administration Building

Cost of Electricity $0.196 $/kWh

Photovoltaic (PV) Rooftop Solar Power Generation-6kW 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
$96,000	**0.0**	**14,200**	**0**	**$2,800**	**0**	**$2,800**	**$12,000**	**$6,900**	**34.3**	**8.7**

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

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

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

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

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

Cautions for Interpreting the Resul

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.

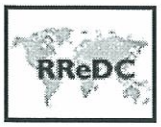
The cost savings are determined as the product of the number of kilowatt hours (kWh) and the cost of electricity per kWh. These cost savings occur if the owner uses all the electricity produced by the PV system, or if the owner has a net-metering agreement with the utility. With net-metering, the utility 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.

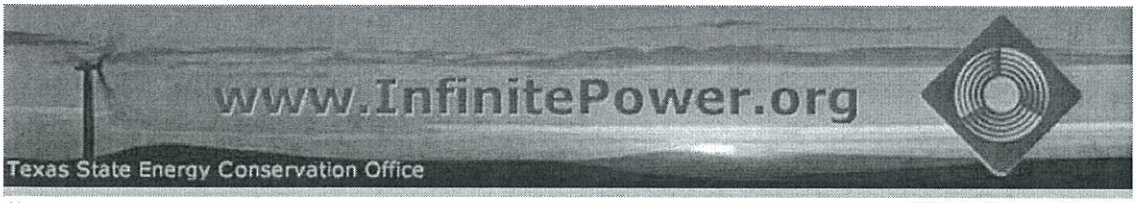
Please send questions and comments to Webmaster Disclaimer and copyright notice.



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

APPENDIX K

Solar Thermal Domestic Hot Water Plant



Home

What Can I Do?

Electric Choice

Home Energy

FAQs

LEARN
Fact Sheets
Lesson Plans

PLAY
Calculators

NETWORK
Organizations
Businesses
Events Calendar

BROWSE
Resources
Solar
Wind
Biomass
Geothermal
Water

Projects

TX Energy - Past and Present

Financial Help

About Us

About SECO

RARE

Interactive Energy Calculators

RENEWABLE ENERGY
THE INFINITE POWER
OF TEXAS

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

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

Solar Water Heating Calculator

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

Water Heater Characteristics			
Physical		**Thermal**	
? Diameter (feet)	1.5	? Water Inlet Temperature (Degrees F)	55
? Capacity (gallons)	19	? Ambient Temperature (Degrees F)	65
? Surface Area (calculated - sq ft)	10.31	? Hot Water Temperature (Degrees F)	120
? Effective R-value	NaN	? Hot Water Usage (Gallons per Day)	15
Energy Use			
333.5		? Heat Delivered in Hot Water (BTU/hr)	
0		? Heat loss through insulation (BTU/hr)	

Gas vs. Electric Water Heating		
Gas		**Electric**
0	? Overall Efficiency	0.98
0	? Conversion Efficiency	0.98
NaN BTU/hr	? Power Into Water Heater	340.3 BTU/hr
Cost		
$ 1.15 /Therm	? Utility Rates	$ .1956 /kWh
$ NaN	? Yearly Water Heating Cost	$ 170.772
How Does Solar Compare?		
? Solar Water Heater Cost: $ 27100		? Percentage Solar: 70
NaN years for gas	? Payback Time for Solar System	226.701 years for electric

More information on solar water heating:

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

NJBPU Energy Audits
CHA #21181
Building: Borough of Sussex Administration Building

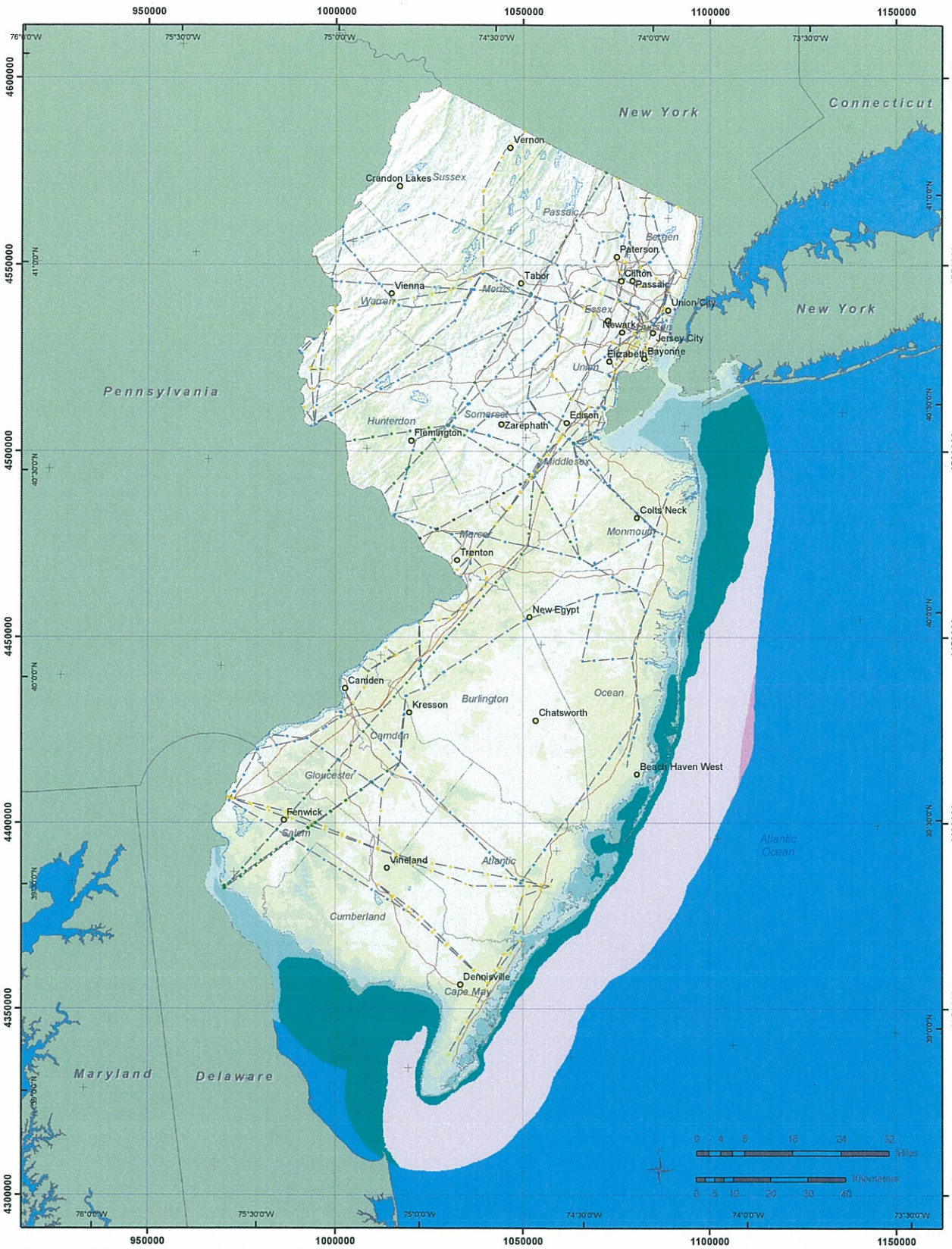
Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

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

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

APPENDIX L

Wind



Wind Resource of New Jersey

Mean Annual Wind Speed at 30 Meters

Features

- City
- Interstate Highway
- County Boundary
- Water Body

Generalized Transmission Line

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

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

AWS Truewind

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

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

AWS Truewind, LCC


Harrison St
E Main
284
E Main St
639
Ave
Hamburg Ave
23
St
bing
© GlobeXplorer © 2010 Navteq © 2010 Microsoft

APPENDIX M

EPA Portfolio Manager

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Administrative Building

Building ID: 2270627
For 12-month Period Ending: November 30, 2009[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: April 22, 2010

Facility	**Facility Owner**	**Primary Contact for this Facility**
Administrative Building 2 Main Street Sussex, NJ 07461	Sussex Borough 2 Main Street Sussex, NJ 07461	Cathy Gleason 2 Main Street Sussex, NJ 07461

Year Built: 1960
Gross Floor Area (ft²): 6,000

Energy Performance Rating[2] (1-100) 29

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	121,436
Natural Gas (kBtu)[4]	321,397
Total Energy (kBtu)	442,833

Energy Intensity[5]	
Site (kBtu/ft²/yr)	74
Source (kBtu/ft²/yr)	124

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	36

Electric Distribution Utility
FirstEnergy - Jersey Central Power & Lt Co

National Average Comparison	
National Average Site EUI	59
National Average Source EUI	98
% Difference from National Average Source EUI	26%
Building Type	Office

Stamp of Certifying Professional

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

Certifying Professional
N/A

Meets Industry Standards[6] **for Indoor Environmental Conditions:**	
Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

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

The government estimates the average time needed to fill out this form is 6 hours (includes the time for entering energy data, PE facility inspection, and notarizing the SEP) and welcomes suggestions for reducing this level of effort. Send comments (referencing OMB control number) to the Director, Collection Strategies Division, U.S., EPA (2822T), 1200 Pennsylvania Ave., NW, Washington, D.C. 20460.

ENERGY STAR® Data Checklist for Commercial Buildings

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

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

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Administrative Building	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Office	Is this an accurate description of the space in question?		☐
Location	2 Main Street, Sussex, NJ 07461	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐
Administration Building (Office)				
CRITERION	**VALUE AS ENTERED IN PORTFOLIO MANAGER**	**VERIFICATION QUESTIONS**	**NOTES**	☑
Gross Floor Area	6,000 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Weekly operating hours	40 Hours	Is this the total number of hours per week that the Office space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	3	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100. The normal worker density ranges between 0.3 and 10 workers per 1000 square feet (92.8 square meters)		☐
Number of PCs	5	Is this the number of personal computers in the Office?		☐
Percent Cooled	50% or more	Is this the percentage of the total floor space within the facility that is served by mechanical cooling equipment?		☐
Percent Heated	50% or more	Is this the percentage of the total floor space within the facility that is served by mechanical heating equipment?		☐

ENERGY STAR® Data Checklist for Commercial Buildings

Energy Consumption

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

Fuel Type: Electricity		
Meter: Admin Building Account 100001999281 (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
10/14/2009	11/10/2009	134.00
09/14/2009	10/13/2009	144.00
08/11/2009	09/13/2009	164.00
07/14/2009	08/10/2009	135.00
06/11/2009	07/13/2009	158.00
05/11/2009	06/10/2009	150.00
04/13/2009	05/10/2009	136.00
03/12/2009	04/12/2009	154.00
02/06/2009	03/11/2009	164.00
01/12/2009	02/05/2009	120.00
12/10/2008	01/11/2009	159.00
Admin Building Account 100001999281 Consumption (kWh (thousand Watt-hours))		**1,618.00**
Admin Building Account 100001999281 Consumption (kBtu (thousand Btu))		**5,520.62**
Meter: Administration Building 1000019333389 (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
10/20/2009	11/17/2009	1,920.00
09/18/2009	10/19/2009	2,160.00
08/19/2009	09/17/2009	3,880.00
07/20/2009	08/18/2009	5,320.00
06/17/2009	07/19/2009	4,680.00
05/18/2009	06/16/2009	3,240.00
04/20/2009	05/17/2009	2,280.00
03/18/2009	04/19/2009	2,240.00
02/16/2009	03/17/2009	2,120.00
01/16/2009	02/15/2009	2,280.00
12/16/2008	01/15/2009	1,840.00
Administration Building 1000019333389 Consumption (kWh (thousand Watt-hours))		**31,960.00**
Administration Building 1000019333389 Consumption (kBtu (thousand Btu))		**109,047.52**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**114,568.14**

Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?	☐

Fuel Type: Natural Gas		
Meter: Administration Building Gas Meter (therms) **Space(s):** Entire Facility		
Start Date	**End Date**	**Energy Use (therms)**
11/01/2009	11/30/2009	241.00
10/01/2009	10/31/2009	10.00
09/01/2009	09/30/2009	0.00
08/01/2009	08/31/2009	0.00
07/01/2009	07/31/2009	0.00
06/01/2009	06/30/2009	74.00
05/01/2009	05/31/2009	262.00
04/01/2009	04/30/2009	375.00
03/01/2009	03/31/2009	592.00
02/01/2009	02/28/2009	760.00
01/01/2009	01/31/2009	627.00
Administration Building Gas Meter Consumption (therms)		**2,941.00**
Administration Building Gas Meter Consumption (kBtu (thousand Btu))		**294,100.00**
Total Natural Gas Consumption (kBtu (thousand Btu))		**294,100.00**
Is this the total Natural Gas consumption at this building including all Natural Gas meters?		☐

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

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

Certifying Professional

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

Name: _____ Date: _____

Signature: _____

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

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

Facility
Administrative Building
2 Main Street
Sussex, NJ 07461

Facility Owner
Sussex Borough
2 Main Street
Sussex, NJ 07461

Primary Contact for this Facility
Cathy Gleason
2 Main Street
Sussex, NJ 07461

General Information

Administrative Building	
Gross Floor Area Excluding Parking: (ft²)	6,000
Year Built	1960
For 12-month Evaluation Period Ending Date:	November 30, 2009

Facility Space Use Summary

Administration Building	
Space Type	Office
Gross Floor Area(ft²)	6,000
Weekly operating hours	40
Workers on Main Shift	3
Number of PCs	5
Percent Cooled	50% or more
Percent Heated	50% or more

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 11/30/2009)	**Baseline** (Ending Date 11/30/2009)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	29	29	75	N/A	50
Energy Intensity					
Site (kBtu/ft²)	74	74	43	N/A	59
Source (kBtu/ft²)	124	124	73	N/A	98
Energy Cost					
$/year	$ 10,350.93	$ 10,350.93	$ 6,089.11	N/A	$ 8,233.34
$/ft²/year	$ 1.73	$ 1.73	$ 1.02	N/A	$ 1.38
Greenhouse Gas Emissions					
$MtCO_2e$/year	36	36	21	N/A	29
$kgCO_2e/ft^2$/year	6	6	4	N/A	5

More than 50% of your building is defined as Office. Please note that your rating accounts for all of the spaces listed. The National Average column presents energy performance data your building would have if your building had an average rating of 50.

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

APPENDIX N

Equipment Inventory

New Jersey BPU Energy Audit Program
CHA #21181
Sussex
Administration Building

Description	Manufacturer Name	Model No.	Serial No.	Equipment Type	Capacity/Size	Operating Hours	Location	Areas Served	Date Installed	Useable Life Expectancy (years)
Air Conditioner #2	Carrier	500TJ-008---501GA	0895G30189	Electric Cooled	7.5 tons	Summer	Rear Roof	Main Conference Room and Admin offices on first floor		
Air Conditioner #1	Carrier	500TJ-005---501GA	1295G20184	Electric Cooled	4 tons	Summer	Rear Roof	Rear Offices and back of Main Conference Room first floor		
DHW Heater	Bradford-White	M126U65513	MM5823279	Electric	19 gallons 1500W	year round	Basement	First and Second Floor Bathrooms		
Sump Pump	Smith Electric	F48K32Z01		Electric	1/3 HP	year round	Basement	Basement		
Boiler	Stant Fin Corp	GG-250	599830	Natural Gas Boiler	250 Mbtu	winter	Basement	Entire Building		
Boiler	Stant Fin Corp	GG-250	599826	Natural Gas Boiler	250 Mbtu	winter	Basement	Entire Building		
Hydraulic Lift	Unity Manufacturing	AAU-36461		Electro-Hydraulic Elevator Lift	60 GPM and 25 HP	year round	First Floor Elevator Utility closet	Elevator		
HHW Circulating Pump	Bell and Gosset-ITT Industries	Aqn56A17057E		electric pump	1/4 HP at 1440 RPM	winter	Basement	Entire Building		
OA Supply Heating Fan				electric heated supply fan	3000W heating coil	winter	Basment	Boilers		

APPENDIX O

Block Load Models

Borough of Sussex
CHA #21181
Building: Administration Building

Downstairs Reconcile Thermal Model

Building Footprint	3,330 SF	Ex Occupied Clng Temp.	72 °F	Ex Occupied Htg Temp.	70 °F
Heating Efficiency	80%	Ex Unoccupied Clng Temp.	72 °F	Ex Unoccupied Htg Temp.	70 °F
Cooling Efficiency	1.07 kW/ton	Occupied Cooling UA	(1,245) btu/hr/°F	Occupied Heating UA	417 btu/hr/°F
Internal Gains	18,677 btu/h	Unoccupied Cooling UA	(642) btu/hr/°F	Unoccupied Heating UA	417 btu/hr/°F
Unoc Internal Gain factor	0.05	Cooling Occ Enthalpy Setpoint	25.5 Btu/lb		
Ave Occ Internal Gain Factor	0.8	Cooling Unocc Enthalpy Setpoint	25.5 Btu/lb		
Economizer available (Y/N)	No				

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

					EXISTING LOADS									
					Occupied			Unoccupied						
Avg Outdoor Air Temp. Bins °F	Avg Outdoor Air Enthalpy	Total Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Available Economizer Cooling kWh	Necessary Cooling Energy kWh	Existing Cooling Energy kWh	Existing Heating Energy therms
A		B	C	D	E	F	G	H	I	J	K	L	M	M
102.5	49.1	0	0	0	-37,973	-69,238	-14,941	-19,566	-57,698	-934	0	0	0	0
97.5	42.5	3	1	2	-31,748	-49,875	-14,941	-16,359	-41,562	-934	0	18	18	0
92.5	39.5	34	8	26	-25,523	-41,073	-14,941	-13,151	-34,228	-934	0	170	170	0
87.5	36.6	131	31	100	-19,298	-32,565	-14,941	-9,943	-27,138	-934	0	524	524	0
82.5	34.0	500	119	381	-13,073	-24,937	-14,941	-6,736	-20,781	-934	0	1,529	1,529	0
77.5	31.6	620	148	472	-6,848	-17,896	-14,941	-3,528	-14,914	-934	0	1,338	1,338	0
72.5	29.2	664	158	506	-623	-10,855	-14,941	-321	-9,046	-934	0	837	837	0
67.5	27.0	854	203	651	1,043	1,760	-14,941	1,043	1,467	-934	0	220	220	0
62.5	24.5	927	221	706	3,128	5,281	-14,941	3,128	4,401	-934	0	129	129	0
57.5	21.4	600	143	457	5,214	8,801	-14,941	5,214	7,335	-934	0	12	12	0
52.5	18.7	610	145	465	7,299	12,322	-14,941	7,299	10,268	-934	0	0	0	105
47.5	16.2	611	145	466	9,384	15,843	-14,941	9,384	13,202	-934	0	0	0	145
42.5	14.4	656	156	500	11,470	19,363	-14,941	11,470	16,136	-934	0	0	0	198
37.5	12.6	1,023	244	779	13,555	22,884	-14,941	13,555	19,070	-934	0	0	0	374
32.5	10.7	734	175	559	15,641	26,404	-14,941	15,641	22,004	-934	0	0	0	316
27.5	8.6	334	80	254	17,726	29,925	-14,941	17,726	24,937	-934	0	0	0	165
22.5	6.8	252	60	192	19,812	33,446	-14,941	19,812	27,871	-934	0	0	0	141
17.5	5.5	125	30	95	21,897	36,966	-14,941	21,897	30,805	-934	0	0	0	78
12.5	4.1	47	11	36	23,982	40,487	-14,941	23,982	33,739	-934	0	0	0	32
7.5	2.6	22	5	17	26,068	44,007	-14,941	26,068	36,673	-934	0	0	0	17
2.5	1.0	13	3	10	28,153	47,528	-14,941	28,153	39,607	-934	0	0	0	11
-2.5	0.0	0	0	0	30,239	51,048	-14,941	30,239	42,540	-934	0	0	0	0
-7.5	-1.5	0	0	0	32,324	54,569	-14,941	32,324	45,474	-934	0	0	0	0
TOTALS		8,760	2,086	6,674								4,777	4,777	1,581

Existing Building Ventilation & Infiltration (occ)	543 cfm
Overheat Ventilation Factor	1.20
Additional ventilation to offset overheat	109 cfm
Existing Building Ventilation & Infiltration (unocc)	543 cfm

Unit	Clng Hrs	Amps	Volts	Phase	Power Factor	% Runtime	Annual kWh
AC 1	1,952	15.3	208	3	0.8	20%	1719
AC 2	1,952	27.2	208	3	0.8	20%	3057
Total							4776

Energy Use Indices (calculated)

Heating	
Upstairs	1,756
Downstairs	1,581
Total	3,337
Target ->	3,374

Cooling	4,777
Target ->	4,776
	100.0%

Borough of Sussex
CHA #21181
Building: Administration Building

Upstairs Reconcile Thermal Model

Upstairs Footprint	2,610 SF	Ex Occupied Clng Temp.	74 °F	Ex Occupied Htg Temp.	70 °F
Heating Efficiency	80%	Ex Unoccupied Clng Temp.	74 °F	Ex Unoccupied Htg Temp.	70 °F
Cooling Efficiency	0.00 kW/ton	Occupied Cooling UA	(1,595) btu/hr/°F	Occupied Heating UA	438 btu/hr/°F
Internal Gains	14,952 btu/h	Unoccupied Cooling UA	(973) btu/hr/°F	Unoccupied Heating UA	438 btu/hr/°F
Unoc Internal Gain factor	0.05	Cooling Occ Enthalpy Setpoint	27.5 Btu/lb		
Ave Occ Internal Gain Factor	0.3	Cooling Unocc Enthalpy Setpoint	27.5 Btu/lb		
Economizer available (Y/N)	No				

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

					EXISTING LOADS									
					Occupied			Unoccupied						
Avg Outdoor Air Temp. Bins °F	Avg Outdoor Air Enthalpy	Total Bin Hours	Occupied Equipment Bin Hours	Unoccupied Equipment Bin Hours	Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Unoccupied Envelope Load BTUH	Ventilation Load BTUH	Internal Gain BTUH	Available Economizer Cooling kWh	Necessary Cooling Energy kWh	Existing Cooling Energy kWh	Existing Heating Energy therms
A		B	C	D	E	F	G	H	I	J	K	L	M	M
102.5	49.1	0	0	0	-45,461	-52,796	-4,486	-27,726	-45,992	-748	0	0	0	0
97.5	42.5	3	1	2	-37,485	-36,664	-4,486	-22,862	-31,939	-748	0	0	0	0
92.5	39.5	34	8	26	-29,510	-29,331	-4,486	-17,998	-25,551	-748	0	0	0	0
87.5	36.6	131	31	100	-21,534	-22,243	-4,486	-13,134	-19,376	-748	0	0	0	0
82.5	34.0	500	119	381	-13,558	-15,888	-4,486	-8,269	-13,840	-748	0	0	0	0
77.5	31.6	620	148	472	-5,583	-10,021	-4,486	-3,405	-8,730	-748	0	0	0	0
72.5	29.2	664	158	506	0	0	-4,486	0	0	-748	0	0	0	0
67.5	27.0	854	203	651	1,095	1,467	-4,486	1,095	1,278	-748	0	0	0	0
62.5	24.5	927	221	706	3,284	4,400	-4,486	3,284	3,833	-748	0	0	0	65
57.5	21.4	600	143	457	5,474	7,333	-4,486	5,474	6,388	-748	0	0	0	78
52.5	18.7	610	145	465	7,663	10,266	-4,486	7,663	8,943	-748	0	0	0	117
47.5	16.2	611	145	466	9,853	13,199	-4,486	9,853	11,498	-748	0	0	0	154
42.5	14.4	656	156	500	12,042	16,132	-4,486	12,042	14,053	-748	0	0	0	205
37.5	12.6	1,023	244	779	14,232	19,065	-4,486	14,232	16,608	-748	0	0	0	381
32.5	10.7	734	175	559	16,422	21,998	-4,486	16,422	19,163	-748	0	0	0	318
27.5	8.6	334	80	254	18,611	24,931	-4,486	18,611	21,718	-748	0	0	0	165
22.5	6.8	252	60	192	20,801	27,864	-4,486	20,801	24,273	-748	0	0	0	140
17.5	5.5	125	30	95	22,990	30,798	-4,486	22,990	26,829	-748	0	0	0	77
12.5	4.1	47	11	36	25,180	33,731	-4,486	25,180	29,384	-748	0	0	0	32
7.5	2.6	22	5	17	27,369	36,664	-4,486	27,369	31,939	-748	0	0	0	16
2.5	1.0	13	3	10	29,559	39,597	-4,486	29,559	34,494	-748	0	0	0	10
-2.5	0.0	0	0	0	31,748	42,530	-4,486	31,748	37,049	-748	0	0	0	0
-7.5	-1.5	0	0	0	33,938	45,463	-4,486	33,938	39,604	-748	0	0	0	0
TOTALS		8,760	2,086	6,674								0	0	1,756

Existing Building Ventilation & Infiltration (occ)	**473 cfm**
Overheat Ventilation Factor	**1.00**
Additional ventilation to offset overheat	**70 cfm**
Existing Building Ventilation & Infiltration (unocc)	**473 cfm**

Energy Use Indices (calculated)

Upstairs	1,756
Downstairs	1,581
Heating	3,337
Target ->	3,374
	98.9%

	Base Case
Cooling	0
Target ->	300
	0.0%

HEAT GAIN/LOSS WORKSHEET

Project Name:	Borough of Sussex	**Project No.:**	CHA #21181		
Location	Sussex, NJ	**Site Elevation:**	0 Feet	**Specific Volume**	14.00 CF/#
Building Name	Administration Building	**Date:**	03/24/10		
Engineer:	Matt Pittinger				

Building/Facility Designation Downstairs Administration Building

Outdoor Winter Design DB Temperature	2.5 *F	**Indoor Winter Design DB Temperature**	70 *F
Outdoor Summer Design DB Temperature	91 *F	**Indoor Summer Design DB Temperature**	72 *F
Outdoor Summer Design WB Temperature	73 *F	**Indoor Summer Design WB Temperature**	60 *F
Outdoor Summer Humidity Ratio	0.0121 #/#	**Indoor Air (70*F) Humidity Ratio**	0.0079 #/#

ENVELOPE DESCRIPTIONS (Descriptions are from Interior to Exterior)

Walls (Select One - Type X)

		R Value	Wall Type
	Steel Siding, 4" Insulation, Steel Siding	15.2	1
	Plaster or Gypsum, frame construction, 5" Insulation, 1" stucco	18.2	1
	4" WH CMU, 1" Insulation, Finished Exterior	5.2	2
	Plaster or Gypsum, frame construction, 3" Insulation, 8" LW CMU	7.8	5
	4" Face Brick, 2" Concrete, 1" Insulation, Exterior Finish	5.1	12
	4" Face Brick, 4" Concrete, 1" Insulation, Exterior Finish	4.0	11
	Interior Finish, 2" Insulation, 8" CMU, 4" Face Brick	10.9	16
	Finished Surface, 8" LW CMU (filled), Air Space, 4" Face Brick	11.1	16
	Stucco or Gypsum, 2.5" Insul, Face Brick	14.3	10
	4" Block, 1" insulation, 8" Block	19.9	16
x	Gypsum, Stucco, Face Brick	12.0	

Roofs (Select One)

		R Value	Roof Type
	Tectum Deck, 3.3" Insul., BU Roof	13.0	1
	Steel Deck, 5" Insul., BU Roof	18.2	1
	Attic Roof with 6" Insul.	25.0	4
	4" HW Concrete Deck, BU Roof	2.7	2
	Ceiling, 3" Insulation, 4" Concrete Deck, BU Roof	14.9	4
	Ceiling, 4" Concrete Deck, 3" Insulation, BU Roof	18.5	13
	Ceiling, 4" Concrete Deck, 6" Insulation, BU Roof	21.7	14
	Ceiling, Wood Deck, 6" Insulation, Felt & Membrane	22.7	10
	Wood Deck, 6" insulation, Felt & Membrane	18.0	
x	Shingles, OSB, Insulation, air space, Ceiling Tiles	17.36	

Windows (Select One)

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

	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	870 SF		
Occupied Area	3,330 SF	**Return Plenum?**	y

	Gross Wall Length	Average Wall Height	Ceiling Height	Window Area	Door Area	Net Wall Area
North Exposure	60 Ft	11.0 Ft	10.0 Ft	90 SF	21 SF	549 SF
East Exposure	58 Ft	11.0 Ft	10.0 Ft	0 SF	0 SF	638 SF
South Exposure	60 Ft	11.0 Ft	10.0 Ft	94 SF	21 SF	546 SF
West Exposure	58 Ft	11.0 Ft	10.0 Ft	94 SF	0 SF	545 SF

Forced Ventilation 0 cfm

HEAT GAIN/LOSS WORKSHEET

Project Name:	Borough of Sussex	Project No.:	CHA #21181		
Location	Sussex, NJ	Site Elevation:	0 Feet	Specific Volume	14.00 CF/#
Building Name	Administration Building	Date:	03/24/10		
Engineer:	Matt Pittinger				

Building/Facility Designation: Downstairs Administration Building

COOLING HEAT GAINS TO THE ROOM - SENSIBLE

SOLAR GAINS

WINDOWS	AREA (SF)	SHGF	Shade Coef	Cooling Load Factor		Solar Heat Gain
North Exposure	90	38 btu/h/sf	0.8	0.75	Glass Type C	2,052 Btu/hr
East Exposure	0	216 btu/h/sf	0.8	0.31	Glass Type C	0 Btu/hr
South Exposure	94	109 btu/h/sf	0.8	0.58	Glass Type C	4,729 Btu/hr
West Exposure	94	216 btu/h/sf	0.8	0.29	Glass Type C	4,685 Btu/hr
						11,466 Btu/h

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain
North Exposure	489	0.08	20 *F	1.0	815 Btu/hr
East Exposure	580	0.08	39 *F	1.0	1,885 Btu/hr
South Exposure	486	0.08	27 *F	1.0	1,092 Btu/hr
West Exposure	487	0.08	22 *F	1.0	892 Btu/hr
Roof	870	0.06	73 *F	1.0	3,658 Btu/hr
Fenestration	277	0.60	19 *F		3,158 Btu/hr
Doors	42	0.14	27 *F		158 Btu/hr
Ceiling	3,330	0.14	0 *F		0 Btu/hr
Partition		0.05	0 *F		0 Btu/hr
Floor	3,330	0.04	0 *F		0 Btu/hr
					11,659 Btu/h

INTERNAL HEAT GAINS

								Room Heat Gain
Lights	0.80 w/sf x	3,330	Occ Area =	2.7	kW x 3.4x	1.0	RAF =	9,092 Btu/h
Plug Load	0.30 w/sf x	3,330	Occ Area =	1.0	kW x 3.4x	1.0	RAF =	3,410 Btu/h
People	4 people x	255	btu/person x	70%	time in space =			714 Btu/h
Computer Work Stations		5	Units x	120	W/Unit x 3414 =			2,048 Btu/h
Equipment	1.0	kW x 3.413 =						3,413 Btu/h
Misc.								0 Btu/h
								18,677 Btu/h

VENTILATION AND INFILTRATION

		Infiltration Factor	Perimeter Ratio	Coef	Temp. Diff.	Room Heat Gain
Walls	2,041 SF	0.20 CFM/SF		1.04	19 *F	8,743 Btu/h
Doors	42 SF	0.21 CFM/LF	0.95 LF/SF	1.04	19 *F	180 Btu/h
Windows	277 SF	0.25 CFM/LF	1.15 LF/SF	1.04	19 *F	1,703 Btu/h
Ventilation	0 cfm			1.04	19 *F	0 Btu/h
						10,626 Btu/h

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	60	0.08	20	1.0	100 Btu/hr
East Exposure	58	0.08	39	1.0	189 Btu/hr
South Exposure	60	0.08	27	1.0	135 Btu/hr
West Exposure	58	0.08	22	1.0	106 Btu/hr
Roof	870	0.06	73	0.0	0 Btu/hr
					530 Btu/h

INTERNAL HEAT GAINS

							Room Heat Gain
Lights	0.80 w/sf x	3,330	Occ Area =	2.7	kW x3413x	0.00 RAF =	0 Btu/h
Misc.							0 Btu/h
							0 Btu/h

SENSIBLE HEAT GAINS - TEMP. DEPENDENT

Solar	11,466
Conduction to Room	11,659
Conduction to Plenum	530
Ventilaton and Infiltration	10,626
Sub Total	34,281

SENSIBLE HEAT GAINS - TEMP. INDEPENDENT

Internal Gains to Room	18,677
Internal Gains to Plenum	0
Sub Total	18,677

HEAT GAIN/LOSS WORKSHEET

Project Name:	Borough of Sussex	**Project No.:**	CHA #21181		
Location	Sussex, NJ	**Site Elevation:**	0 Feet	**Specific Volume**	14.00 CF/#
Building Name	Administration Building	**Date:**	03/24/10		
Engineer:	Matt Pittinger				

Building/Facility Designation Downstairs Administration Building

LATENT COOLING LOADS

Infiltration

		Infiltration Factor	Air Density	Humidity Ratio Dif.	Room Heat Gain	
Walls	1,106 SF	0.20 CFM/SF	4,629	0.0042 ##/##	4,344	Btu/h
Doors	42 SF	0.21 CFM/LF	4,629	0.0042 ##/##	165	Btu/h
Windows	277 SF	0.25 CFM/LF	4,629	0.0042 ##/##	1,561	Btu/h
Ventilation	0 cfm		4,629	0.0042 ##/##	0	Btu/h
People	4 people	0.70 time in space		250 Btu/hr/person	700	Btu/h
					6,770	**Btu/h**

Cooling Load Summary

	Sensible	Latent	Total		
Temperature Dependent Gains	34,281	6,770	41,051		
Temperature Indep. Gains	18,677		18,677	SHR=	0.89
Total	52,958	6,770	59,728		

Building Cooling Load 5.0 Tons at 669 SF/Ton

Building Air Flow to Condition Space based on a 12*F Temp Rise is **4,186 CFM** / **1.26 CFM/sf**

HEATING CALCULATION

CONDUCTION

	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.	Room Heat Gain	
North Exposure	549	0.08	68	3,088	Btu/h
East Exposure	638	0.08	68	3,589	Btu/h
South Exposure	546	0.08	68	3,068	Btu/h
West Exposure	545	0.08	68	3,063	Btu/h
Fenestration	277	0.60	68	11,219	Btu/h
Roof	870	0.06	68	3,383	Btu/h
Doors	42	0.14	68	396	Btu/h
Ceiling	3,330	0.14	0	0	Btu/h
Partition	0	0.05	0	0	Btu/h
Floor	870	0.04	10	348	Btu/h

Ventilation and Infiltration

		Infiltration Factor	Coef	Temp. Difference	Air Flow	Room Heat Gain	
Walls	2,277 SF	0.20 CFM/SF	1.04	68	455 cfm	32,086	Btu/h
Doors	42 SF	0.21 CFM/LF	1.04	68	8 cfm	592	Btu/h
Windows	277 SF	0.25 CFM/LF	1.04	68	80 cfm	5,601	Btu/h
Ventilation Load	0 cfm		1.04	68	0 cfm	0	Btu/h
Total Ventilation & Infiltration Load					543 cfm	38,279	Btu/h

Building Heating Load 66,433 **btu/h**

19.9 btu/sf

HEAT GAIN/LOSS WORKSHEET

Project Name:	Borough of Sussex	**Project No.:**	CHA #21181		
Location	Sussex, NJ	**Site Elevation:**	0 Feet	**Specific Volume**	14.00 CF/#
Building Name	Administration Building	**Date:**	03/24/10		
Engineer:	Matt Pittinger				

Building/Facility Designation Upstairs Administration Building

Outdoor Winter Design DB Temperature	2.5 *F	**Indoor Winter Design DB Temperature**	68 *F
Outdoor Summer Design DB Temperature	91 *F	**Indoor Summer Design DB Temperature**	74 *F
Outdoor Summer Design WB Temperature	73 *F	**Indoor Summer Design WB Temperature**	60 *F
Outdoor Summer Humidity Ratio	0.0121 #/#	**Indoor Air (70*F) Humidity Ratio**	0.0079 #/#

ENVELOPE DESCRIPTIONS (Descriptions are from Interior to Exterior)

Walls (Select One - Type X)

		R Value	Wall Type
	Steel Siding, 4" Insulation, Steel Siding	15.2	1
	Plaster or Gypsum, frame construction, 5" Insulation, 1" stucco	18.2	1
	4" WH CMU, 1" Insulation, Finished Exterior	5.2	2
	Plaster or Gypsum, frame construction, 3" Insulation, 8" LW CMU	7.8	5
	4" Face Brick, 2" Concrete, 1" Insulation, Exterior Finish	5.1	12
	4" Face Brick, 4" Concrete, 1" Insulation, Exterior Finish	4.0	11
	Interior Finish, 2" Insulation, 8" CMU, 4" Face Brick	10.9	16
	Finished Surface, 8" LW CMU (filled), Air Space, 4" Face Brick	11.1	16
	Stucco or Gypsum, 2.5" Insul, Face Brick	14.3	10
	4" Block, 1" insulation, 8" Block	19.9	16
x	Gypsum, insulation, air space, Face Brick	12.0	

Roofs (Select One)

		R Value	Roof Type
	Tectum Deck, 3.3" Insul., BU Roof	13.0	1
	Steel Deck, 5" Insul., BU Roof	18.2	1
	Attic Roof with 6" Insul.	25.0	4
	4" HW Concrete Deck, BU Roof	2.7	2
	Ceiling, 3" Insulation, 4" Concrete Deck, BU Roof	14.9	4
	Ceiling, 4" Concrete Deck, 3" Insulation, BU Roof	18.5	13
	Ceiling, 4" Concrete Deck, 6" Insulation, BU Roof	21.7	14
	Ceiling, Wood Deck, 6" Insulation, Felt & Membrane	22.7	10
	Wood Deck, 6" insulation, Felt & Membrane	18.0	
x	Attic with Batt Insulation	20.00	

15

Windows (Select One)

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

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

BUILDING CHARACTERISTICS

Roof Area	2,610 SF		
Occupied Area	2,610 SF	**Return Plenum?**	n

	Gross Wall Length	Average Wall Height	Ceiling Height	Window Area	Door Area	Net Wall Area
North Exposure	45 Ft	11.0 Ft	10.0 Ft	41 SF	0 SF	455 SF
East Exposure	58 Ft	11.0 Ft	10.0 Ft	41 SF	0 SF	598 SF
South Exposure	45 Ft	11.0 Ft	10.0 Ft	95 SF	0 SF	401 SF
West Exposure	58 Ft	11.0 Ft	10.0 Ft	54 SF	0 SF	584 SF

Forced Ventilation 0 cfm

HEAT GAIN/LOSS WORKSHEET

Project Name:	Borough of Sussex	Project No.:	CHA #21181		
Location	Sussex, NJ	Site Elevation:	0 Feet	Specific Volume	14.00 CF/#
Building Name	Administration Building	Date:	03/24/10		
Engineer:	Matt Pittinger				

Building/Facility Designation: Upstairs Administration Building

COOLING HEAT GAINS TO THE ROOM - SENSIBLE

SOLAR GAINS

WINDOWS	AREA (SF)	SHGF	Shade Coef	Cooling Load Factor		Solar Heat Gain
North Exposure	41	38 btu/h/sf	0.8	0.75	Glass Type C	923 Btu/hr
East Exposure	41	216 btu/h/sf	0.8	0.31	Glass Type C	2,170 Btu/hr
South Exposure	95	109 btu/h/sf	0.8	0.58	Glass Type C	4,779 Btu/hr
West Exposure	54	216 btu/h/sf	0.8	0.29	Glass Type C	2,706 Btu/hr
						10,578 Btu/h

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain
North Exposure	410	0.08	20 *F	1.0	683 Btu/hr
East Exposure	540	0.08	39 *F	1.0	1,753 Btu/hr
South Exposure	356	0.08	27 *F	1.0	800 Btu/hr
West Exposure	526	0.08	22 *F	1.0	964 Btu/hr
Roof	2,610	0.05	73 *F	1.0	9,527 Btu/hr
Fenestration	230	0.60	17 *F		2,341 Btu/hr
Doors	0	0.14	27 *F		0 Btu/hr
Ceiling	2,610	0.14	0 *F		0 Btu/hr
Partition		0.05	0 *F		0 Btu/hr
Floor	2,610	0.04	0 *F		0 Btu/hr
					16,067 Btu/h

INTERNAL HEAT GAINS

							Room Heat Gain
Lights	0.80 w/sf x	2,610 Occ Area =	2.1 kW x 3.4x		1.0 RAF =		7,126 Btu/h
Plug Load	0.30 w/sf x	2,610 Occ Area =	0.8 kW x 3.4x		1.0 RAF =		2,672 Btu/h
People	4 people x	255 btu/person x	10% time in space =				102 Btu/h
Computer Work Stations		4 Units x	120 W/Unit x	3414 =			1,638 Btu/h
Equipment	1.0 kW x 3.413 =						3,413 Btu/h
Misc.							0 Btu/h
							14,952 Btu/h

VENTILATION AND INFILTRATION

		Infiltration Factor	Perimeter Ratio	Coef	Temp. Diff.	Room Heat Gain
Walls	1,831 SF	0.20 CFM/SF		1.04	17 *F	7,016 Btu/h
Doors	0 SF	0.21 CFM/LF	0.95 LF/SF	1.04	17 *F	0 Btu/h
Windows	230 SF	0.25 CFM/LF	1.15 LF/SF	1.04	17 *F	1,262 Btu/h
Ventilation	0 cfm			1.04	17 *F	0 Btu/h
						8,278 Btu/h

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	45	0.08	20	1.0	75 Btu/hr
East Exposure	58	0.08	39	1.0	189 Btu/hr
South Exposure	45	0.08	27	1.0	101 Btu/hr
West Exposure	58	0.08	22	1.0	106 Btu/hr
Roof	2,610	0.05	73	0.0	0 Btu/hr
					471 Btu/h

INTERNAL HEAT GAINS

					Room Heat Gain
Lights	0.80 w/sf x	2,610 Occ Area =	2.1 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	10,578	Internal Gains to Room	14,952
Conduction to Room	16,067	Internal Gains to Plenum	0
Conduction to Plenum	471		
Ventilaton and Infiltration	8,278		
Sub Total	35,395	Sub Total	14,952

HEAT GAIN/LOSS WORKSHEET

Project Name:	Borough of Sussex	Project No.:	CHA #21181		
Location	Sussex, NJ	Site Elevation:	0 Feet	Specific Volume	14.00 CF/#
Building Name	Administration Building	Date:	03/24/10		
Engineer:	Matt Pittinger				

Building/Facility Designation: Upstairs Administration Building

LATENT COOLING LOADS

Infiltration

		Infiltration Factor	Air Density	Humidity Ratio Dif.	Room Heat Gain
Walls	2,816 SF	0.20 CFM/SF	4,629	0.0042 ##	11,060 Btu/h
Doors	0 SF	0.21 CFM/LF	4,629	0.0042 ##	0 Btu/h
Windows	230 SF	0.25 CFM/LF	4,629	0.0042 ##	1,294 Btu/h
Ventilation	0 cfm		4,629	0.0042 ##	0 Btu/h
People	4 people	0.10 time in space		250 Btu/hr/person	100 Btu/h
					12,454 Btu/h

Cooling Load Summary

	Sensible	Latent	Total	
Temperature Dependent Gains	35,395	12,454	47,849	
Temperature Indep. Gains	14,952		14,952	SHR= 0.80
Total	50,347	12,454	62,801	

Building Cooling Load: 5.2 Tons at 499 SF/Ton

Building Air Flow to Condition Space based on a 12*F Temp Rise is: 3,982 CFM (1.53 CFM/sf)

HEATING CALCULATION

CONDUCTION

	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.	Room Heat Gain
North Exposure	455	0.08	66	2,481 Btu/h
East Exposure	598	0.08	66	3,261 Btu/h
South Exposure	401	0.08	66	2,186 Btu/h
West Exposure	584	0.08	66	3,188 Btu/h
Fenestration	230	0.60	66	9,019 Btu/h
Roof	2,610	0.05	66	8,548 Btu/h
Doors	0	0.14	66	0 Btu/h
Ceiling	2,610	0.14	0	0 Btu/h
Partition	0	0.05	0	0 Btu/h
Floor	2,610	0.04	0	0 Btu/h

Ventilation and Infiltration

		Infiltration Factor	Coef	Temp. Difference	Air Flow	Room Heat Gain
Walls	2,037 SF	0.20 CFM/SF	1.04	66	407 cfm	27,847 Btu/h
Doors	0 SF	0.21 CFM/LF	1.04	66	0 cfm	0 Btu/h
Windows	230 SF	0.25 CFM/LF	1.04	66	66 cfm	4,503 Btu/h
Ventilation Load	0 cfm		1.04	66	0 cfm	0 Btu/h
Total Ventilation & Infiltration Load					473 cfm	32,350 Btu/h

Building Heating Load	61,033	btu/h
		23.4 btu/sf

Borough of Sussex
CHA #21181
Building: Administration Building
Downstairs Walls Windows and Doors

Doors

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet
North	3.0	7.0	1	21.0	20.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	21.0	20.0
East				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	0.0	0.0
South	3.0	7.0	1	21.0	20.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	21.0	20.0
West				0.0	0.0
				0.0	0.0
			Sub-total	0.0	0.0
			Total	**42.0**	**40.0**

LF/SF
0.95

Walls

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet		
North	60.0	11.0	1	660.0	142.0		All wall quantities must remain equal to 1
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	60.0			660.0	142.0	11.0	Average height wall automatically linked
East	58.0	11.0	1	638.0	138.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	58.0			638.0	138.0	11.0	Average height wall automatically linked
South	60.0	11.0	1	660.0	142.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	60.0			660.0	142.0	11.0	Average height wall automatically linked
West	58.0	11.0	1	638.0	138.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	58.0			638.0	138.0	11.0	Average height auto linked to block load sheet

Windows

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet
North	3.0	5.0	6	90.0	96.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	90.0	96.0
East				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	0.0	0.0
South	0.5	7.0	1	3.5	15.0
	3.0	5.0	6	90.0	96.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	93.5	111.0
West	0.5	7.0	1	3.5	15.0
	3.0	5.0	6	90.0	96.0
				0.0	0.0
				0.0	0.0
				0.0	0.0
			Sub-total	93.5	111.0
			Total	**277.0**	**318.0**

LF/SF
1.15

Borough of Sussex
CHA #21181
Building: Administration Building
Upstairs Walls Windows and Doors

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				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	0.0	0.0	
South				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	0.0	0.0	
West				0.0	0.0	
				0.0	0.0	
			Sub-total	0.0	0.0	
			Total	**0.0**	**0.0**	LF/SF #DIV/0!

Walls

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet		
North	45.0	11.0	1	495.0	112.0		All wall quantities must remain equal to 1
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	45.0			495.0	112.0	11.0	Average height wall automatically linked
East	58.0	11.0	1	638.0	138.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	58.0			638.0	138.0	11.0	Average height wall automatically linked
South	45.0	11.0	1	495.0	112.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	45.0			495.0	112.0	11.0	Average height wall automatically linked
West	58.0	11.0	1	638.0	138.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0		
				0.0	0.0	Ave. height	
	58.0			638.0	138.0	11.0	Average height auto linked to block load sheet

Windows

	Width (ft)	Height (ft)	Quantity	Area (SF)	Lineal Feet	
North				0.0	0.0	
	3.0	4.5	3	40.5	45.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	40.5	45.0	
East	3.0	4.5	3	40.5	45.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	40.5	45.0	
South				0.0	0.0	
				0.0	0.0	
	3.0	4.5	7	94.5	105.0	
				0.0	0.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	94.5	105.0	
West				0.0	0.0	
				0.0	0.0	
	3.0	4.5	4	54.0	60.0	
				0.0	0.0	
				0.0	0.0	
			Sub-total	54.0	60.0	
			Total	**229.5**	**255.0**	LF/SF 1.11