TOWNSHIP OF NORTH BRUNSWICK
SENIOR CENTER
ENERGY ASSESSMENT

for

NEW JERSEY
BUREAU OF PUBLIC UTILITIES

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CHA PROJECT NO. 20418

April 2010

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APPENDICES

1.0 INTRODUCTION & BACKGROUND

This report summarizes the energy audit for the North Brunswick Township Senior Center Building. The building is two stories and approximately 11,000 square feet. The building houses the meeting room, recreation rooms, activity room, kitchen, and staff offices for the Township of North Brunswick Senior Center.

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.

This report shall cover the energy audit for the North Brunswick Township Senior Center building.

2.0 EXECUTIVE SUMMARY

This report details the results of the North Brunswick Township Senior Center, a two story, approximately 11,000 square foot facility. The building houses recreation and activity rooms, kitchen, and staff offices. The following areas were evaluated for energy conservation measures:

- Lighting replacement with occupancy sensors
- Space temperature setback
- Domestic hot water heater replacement
- Boiler replacement
- Window AC unit replacement
- Water temperature reset

Various potential Energy Conservation Measures (ECMs) were identified for the above categories. Measures which are recommended for implementation have a payback of 10 years or less. This threshold is considered a viable return on investment. Potential annual savings of $6,700 for the recommended ECMs may be realized with a payback of 3.2 years.

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

ECM-3 Space Temperature Setback

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
2,200	0	1,470	1,070	1,800	11.3	N/A	1.2	N/A

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

ECM-7 Lighting Retrofit with Occupancy Sensors

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
14,800	7.3	23,250	0	4,100	3.2	1,700	3.6	3.2

* Incentive shown is per the New Jersey Smart Start Program, 2009 Lighting Controls Application. Incentive is based on the use of 22 wall-mounted, occupancy sensors. Incentive is based on the following: retrofitting 85, T-12 fixtures < 250 watt with T-8 lamps.

ECM-8 Replace Domestic Hot Water Heater

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
6,300	-	5,580	(150)	800	0.9	N/A	7.9	N/A

3.0 EXISTING CONDITIONS

3.1 Building General

3.1.1 Structure

The North Brunswick Senior Center (center) consists of an 11,000 square foot, two story building. The oldest section is two stories and was constructed in the 1930s, with single story additions in 1976 and 1988. The Senior Center consists of staff offices, meeting room, recreational rooms, and kitchen.

The building's exterior is composed of a combination of vinyl siding and stucco with some metal fascia built on a concrete foundation. The walls on the 1930s building portion are wood frame construction with lath and plaster and ¼" wood paneling on the interior walls. The walls of the 1976 and 1988 additions are constructed of CMU with 1" stucco surface material on both sides. The interior partitions of the single story additions are metal studs with ½" gypsum board.

The windows and doors are double pane glass with metal frames. The public can access the building through two main entrance doors located at the main lobby and one side entrance door located on the west side of the building. There are also separate doors for staff use only on the north, west, and south sides of the building.

The roofs are a combination of pitched sections with asphalt shingles and flat sections with vinyl membrane.

3.1.2 Operating Hours

The building is open Monday through Friday from 8:30 AM – 4:00 PM and Monday through Thursday from 7:00 PM to 9:30 PM. The town observes 13 holidays per year, and the center is closed.

3.2 Utility Usage

The building uses electricity, natural gas, municipal water and is connected into the municipal sewage system.

Electricity and natural gas are purchased from and delivered by the Public Service Electric and Gas Company (PSE&G). The Town of North Brunswick owns and operates the township domestic water supply and sewer disposal systems, and does not charge the building for water usage. For 2008, the center had electricity usage of 79,260 kWh, at a cost of $14,500 and natural gas usage of 5,800 therms at a cost of $8,500. The facility's annual utility bill was $23,000.

The largest portion of the energy bill is for electricity and the average blended rate was $0.182 per kWh. Electricity is used for air conditioning, lighting, computers, office equipment, domestic hot water, and kitchen appliances. The center had a maximum kW demand of 43 kW and a minimum of 17 kW during 2008. The monthly average over the observed 12 month period was 29 kW.

Pricing information obtained from the Energy Information Administration (EIA) indicated that the average blended rate for commercial customers in New Jersey over the same period was $0.147 per kWh. The average price is lower by 19% and equates to potential savings of approximately $2,800 per year. Lower electricity supply pricing may be available by switching to an alternate supplier. A list of electric

suppliers licensed by the NJ Board of Public Utilities to sell electricity to customers served by PSE&G is provided in Appendix A.

Natural gas was used in 2008 for building heating and kitchen appliances. The average blended rate for natural gas was $1.46 per therm. Pricing information obtained from the EIA indicated the average blended rate for commercial customers in New Jersey over the same period was $1.43 per therm. The facility's price for natural gas was higher by 2% and equates to potential savings of $200; a list of gas suppliers licensed by the NJ Board of Public Utilities to sell gas to customers served by PSE&G is provided in Appendix A, which may be utilized to determine if lower costs than currently being charged are available.

Utility data is also provided in Appendix A.

3.3 HVAC Systems

3.3.1 Hot Water Heating System

Hot water is produced by one Dunkirk model PIVB-8D natural gas fired boiler. The boiler is located in the recreation/kitchen building's mechanical room and has a heating output capacity of 196 MBH with an efficiency rating of 80%. Heating hot water from the boiler is circulated to hot water heating baseboard coils located throughout the recreation/kitchen building and to baseboard coils located in the meeting room. Hot water is circulated to the coils by use of a hot water circulating pump. The hot water heating system has multiple heating zones and each zone is controlled by a thermostat.

3.3.2 Split Systems

The building has two split air conditioning systems used for heating and cooling. Each system includes a natural gas fired furnace with a direct expansion cooling coil and a separate compressor/condenser unit located outside. The individual split systems provide heating and cooling for the main lobby, office areas, and the meeting room. Each system is controlled by an individual thermostat.

3.3.3 Window Air Conditioners

The building utilizes three window air conditioning units. The window air conditioners are located in the recreation room, kitchen, and the activity room. Each unit provides approximately 10,000 BTUH of cooling and is controlled by an individual thermostat.

3.4 Lighting/Electrical Systems

The interior lighting is a combination of T-12 fluorescent light fixtures, light fixtures with compact fluorescent bulbs (CFLs) and fixtures with incandescent bulbs. The interior lighting is manually controlled by switches.

The building's exterior lighting consists of high pressure sodium fixtures controlled by a combination of photocells and timers.

3.5 Plumbing Systems

The plumbing system consists of domestic water piping, sanitary piping, and vent piping. Domestic hot water is produced by an electric 40 gallon tank/heater. Plumbing fixtures include urinals, toilets, sinks, and hose bibbs.

4.0 ENERGY CONSERVATION MEASURES

4.1 ECM-1 Boiler Replacement

Hot water used for heat is produced by a Dunkirk gas fired boiler with a heating output capacity of 196 MBH. The boiler, located in the recreation/kitchen, has a standard thermal efficiency rating of 80%. The boiler provides hot water heating for the recreation room, kitchen, second story rooms and portions of the meeting room. This ECM evaluates replacement of the existing boiler with a high efficiency condensing boiler.

Condensing boilers recover waste heat, which would be ejected into the atmosphere from the flue of a conventional (non-condensing) boiler. Heat transfer from the burner is maximized, and useful heat normally lost with the flue gases is recovered. When in condensing mode, (condensing boilers do not condense continually) the flue gases give up latent heat which is recovered by the heat exchanger within the boiler. Temperature of the gases exiting the flue of a condensing boiler is typically 120-140°F; temperature in a current non-condensing boiler stack is higher. When used in conjunction with a hot water reset system, condensing boilers have the ability to operate at thermal efficiencies up to 96%, depending on the unit.

The building's current utility usage was analyzed to estimate the annual natural gas hot water heating boiler's consumption. It was determined that the boiler used approximately 3,050 therms of natural gas throughout the heating season. The firing efficiency rating (80%) was then applied to determine the building's baseline boiler load, or hot water heating demand. The building heating demand was then applied to the proposed boiler thermal efficiency rating of 96%. It was determined that the new boiler would have an annual consumption of approximately 2,540 therms, resulting in a savings of 510 therms of natural gas per year.

The existing boiler and exhaust flue, including immediate hot water supply and return piping, would have to be removed. A new gas-fired, condensing, hot water boiler, including a new boiler exhaust flue system, would then be installed.

Boilers have an expected life of 20 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 10,200 therms and $14,000.

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

ECM-1 Boiler Replacement

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
11,700	-	-	510	700	0.2	200	16.7	16.4

* Incentive shown is per the New Jersey Smart Start Program, 2009 Gas Heating Application. Incentive is based on the purchase of one 190 MBH hot water boiler.

This measure is not recommended.

4.2 ECM-2 Hot Water Temperature Reset

Heating hot water (HHW) is produced in the boilers and presently heated to a setpoint temperature of 180°F, which remains constant throughout the year. Varying the heating hot water supply temperature as building heating load decreases in relation to outside air temperature will save energy.

The HHW is circulated through piping to the baseboard heating coils. The hot water pipe is insulated; however, some heat energy is lost between the hot water in the pipe and the surrounding air. In general, HHW temperatures as low as 130°F are sufficient during periods of higher outside air temperatures and lower building heating loads. Lowering the temperature will reduce the amount of hot water piping energy loss and save on natural gas heating costs.

Temperature setpoints lower than 140°F are not possible with the existing non-condensing boiler. This ECM evaluates the use of the high efficiency condensing boiler (ECM-1) for hot water temperature reset.

To calculate the savings, the size and lengths of the HHW pipe was identified and the amount of heat energy lost at a 180°F temperature determined. Weather bin data was then used to calculate the varying HHW temperature setpoint and corresponding lower energy loss. The annual savings are 143 therms and $200.

This ECM requires implementation of ECM-1 along with an additional outside temperature controller which would be connected to the condensing boiler control system. Due to the long payback for ECM-1, it was not recommended. Therefore, this measure should be considered for implementation when the boiler requires replacement.

HVAC controls have a life expectancy of 15 years according to ASHRAE and total energy savings over the life of the project are estimated at 2,100 therms and $3,000.

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

ECM-2 Hot Water Temperature Reset

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
1,200	-	0	140	200	1.48	N/A	6.0	N/A

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

This measure is not recommended.

4.3 ECM-3 Space Temperature Setback

Existing heating and cooling systems are individually controlled by wall-mounted thermostats. The setpoints on the thermostats are continuously maintained at 73°F. This ECM evaluates applying night and weekend temperature setback to eliminate energy consumption during unoccupied periods. Reducing the unoccupied heating setpoint temperature to 64°F and raising the unoccupied cooling setpoint to 80°F, will result in a reduction in energy usage.

Block load building models were developed to approximate the existing energy load for the building. Since the kitchen/recreation and office/meeting room areas have differing building shells and mechanical equipment, separate block loads were created. The block loads, provided in Appendix D, model the maximum overall cooling and/or heating load for the spaces. Parameters including roof, wall, and window construction, total envelope surface area, ventilation and infiltration loads, building occupancy, internal heat generation, and other sources of heat gain and loss were considered. By entering this calculated maximum load into a spreadsheet containing bin temperature data, the total accumulated year-round cooling and/or heating energy requirements were determined. Bin data for North Brunswick, NJ was not available; therefore, data from nearby Newark, NJ was used. The loads were then reconciled to the average yearly natural gas and electric energy usage of the building.

To determine the proposed energy usage during temperature setback, a second bin spreadsheet was used for the new accumulated heating load, which was identical to the existing usage spreadsheet except the heating unoccupied temperature was lowered to 64°F. The difference in heating therms between the two models is taken as the savings. The same method was used to model the savings for night setback in the summer air conditioned areas with the unoccupied cooling temperature raised to 80°F.

Space temperature setback would be accomplished by replacing the existing wall mounted thermostats with programmable thermostats programmed to set back the temperatures during unoccupied hours.

This ECM will provide annual savings of 1,470 kWh, 1,070 therms and $1,800.

HVAC controls have a life expectancy of 15 years according to ASHRAE and total energy savings over the life of the project are estimated at 22,100 kWh, 16,150 therms and $27,000.

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

ECM-3 Space Temperature Setback

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
2,200	0	1,470	1,070	1,800	11.3	N/A	1.2	N/A

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

This measure is recommended.

4.4 ECM-4 Replace Window Air Conditioner Units

Three window air conditioning units, operated throughout the cooling season, are utilized for space cooling of the recreation room, kitchen, and activity room. Each unit provides approximately 10,000 BTUH of cooling at an energy efficiency ratio (EER) of about 9. This ECM evaluates replacement of the window units with a ductless split AC system. Split system units have a much higher EER value, do not obstruct the windows, and are programmable to only operate when desired.

The energy savings were determined by comparing the existing units' EER of 9 to the EER of the proposed split system unit of 14.4. It is assumed that the air conditioners run constantly when the outdoor air temperature is above 70°F, and weather bin data was used to determine the annual cooling operating

hours. The existing energy usage was calculated to be 6,510 kWh and the proposed units will reduce the usage to 4,070 kWh.

To implement this measure, each room would have a wall mounted cooling unit connected to an outdoor condenser/compressor unit. The installation would also require liquid and gas piping between the wall units and outdoor condenser, and include a programmable controller for each unit.

Ductless split systems have an expected life of 20 years, according to ASHRAE, and total energy savings over the life of the project are estimated at 48,800 kWh and $8,000.

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

ECM-4 Replace Window Air Conditioner Units

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
9,700	0	2,440	0	400	(0.2)	300	24.3	23.5

* Incentive shown is per the New Jersey Smart Start Program, 2009 Gas Electric Unitary HVAC Application. Incentive is based on the installation of a Unitary HVAC/Split System unit < 5.4 tons in capacity.

This measure is not recommended.

4.5 ECM-5 Retrofit Lighting Fixtures

The center utilizes approximately 123 interior fixtures with inefficient lamps, the majority are fluorescent T-12, 4' lamps. Other inefficient fixtures use incandescent bulbs. Overall energy consumption can be reduced by retrofitting the T-12 fixtures with more efficient T-8 fluorescent lamps and the incandescent fixtures with compact florescent bulbs (CFLs).

To compute the annual savings for this ECM, the energy consumption of the lighting fixtures was established, and it was determined to be 37,700 kWh per year. To calculate the annual energy consumption utilizing efficient lighting, the proposed fixture power requirement was used with the same annual hours of operation. The difference between the existing and proposed annual energy consumption are the energy savings. Calculations are provided in Appendix F.

Existing lamps and ballasts of each fluorescent fixture would be replaced with electronic ballasts and 4', T-8 fluorescent lamps. The incandescent bulbs would be replaced with CFLs. This ECM will provide annual savings of 18,700 kWh and $3,500.

The fluorescent lighting retrofits have an expected life of 15 years, according to the manufacturer, and total energy savings over the life of the project are estimated at 280,500 kWh and $52,500.

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

ECM-5 Lighting Retrofits

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
11,500	7.3	18,700	0	3,500	3.6	1,300	3.3	2.9

* Incentive shown is per the New Jersey Smart Start Program, 2009 Prescriptive Lighting Application. Incentive is based on the following: retrofitting 85, T-12 fixtures < 250 watt with T-8 lamps.

This measure is recommended when combined with ECM-6; see ECM-7.

4.6 ECM-6 Install Occupancy Sensors for Interior Lighting

Lighting fixtures throughout the building are manually switched on and off during the facility's operational hours, approximately 50 hours per week. Operation of some interior lighting fixtures can feasibly be reduced by installing occupancy sensors, including the meeting, activity, storage, and recreation rooms; kitchen; lobby; staff offices and lounge; and men's and women's restrooms. Occupancy sensors were not considered for hallways or stairways due to safety concerns.

Applying the same process used in the calculation of ECM-5, the existing baseline energy consumption for each fixture was determined. Typical traffic patterns for each space were then taken into account to approximate the actual occupancy hours per day. It was established that the annual energy consumption of the lighting fixtures can be reduced by 9,000 kWh.

Approximately 22 occupancy sensors and some standard electrical work are required for this measure.

Lighting controls have an expected life of 15 years, according to the manufacturer, and total energy savings over the life of the project are estimated at 135,600 kWh, and $16,500.

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

ECM-6 Install Occupancy Sensors for Interior Lighting

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
3,200		9,000	0	1,100	4.2	400	2.9	2.5

* Incentive shown is per the New Jersey Smart Start Program, 2009 Lighting Controls Application. Incentive is based on the use of 22 wall-mounted, occupancy sensors.

This measure is recommended when combined with ECM-5; see ECM-7.

4.7 ECM-7 Lighting Retrofit with Occupancy Sensors

Due to interactive effects, the energy and cost savings for occupancy sensors and lighting upgrades are not cumulative. This measure is a combination of ECMs-5 and 6 to allow for maximum energy and demand reduction.

The lighting retrofits and controls have an expected lifetime of 15 years, according to the manufacturer, and total energy savings over the life of the project are estimated at 348,800 kWh, and $61,500.

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

ECM-7 Lighting Retrofit with Occupancy Sensors

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
14,800	7.3	23,250	0	4,100	3.2	1,700	3.6	3.2

* Incentive shown is per the New Jersey Smart Start Program, 2009 Lighting Controls Application. Incentive is based on the use of 22 wall-mounted, occupancy sensors. Incentive is based on the following: retrofitting 85, T-12 fixtures < 250 watt with T-8 lamps.

This measure is recommended.

4.8 ECM-8 Replace Domestic Hot Water Heater

Domestic hot water is currently produced by a 40 gallon, electric, tank style, water heater. Tank style heaters must reheat water in the tank as it cools off. This constant reheating process, known as standby loss, consumes unnecessary energy.

This ECM evaluates replacing the existing DHW heater with an instantaneous, natural gas-fired, tankless water heater. Natural gas is generally a cheaper fuel and the elimination of tank standby losses will save energy. To calculate the savings, a model was used to determine the daily hot water consumption for the building. The model also compared the annual energy usage and costs of the electric water heater to the energy usage and costs of the instantaneous style heater. The model identified annual savings of $800.

The new heater would be located in the same mechanical room. Modifications to hot water piping, natural gas piping, flue connections and electrical wiring will be necessary.

Instantaneous water heaters have an expected life of 15 years, according to the manufacturer, and total energy savings over the life of the project are estimated at (2,200) therms, 83,700 kWh, and $12,000.

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

ECM-8 Replace Domestic Hot Water Heater

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
6,300	-	5,580	(150)	800	0.9	N/A	7.9	N/A

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

This measure is recommended.

4.9 Potential Incentives

The North Brunswick Senior Center energy conservation project may be eligible for incentives from the New Jersey Office of Clean Energy. The largest incentives available will be for the New Jersey Pay for Performance (P4P) Program. The P4P program is designed for qualified energy conservation projects in facilities that consume a minimum average electric demand of 200 kW per month (total of 12 months peak demand/12). Facilities that meet this criterion must also achieve a minimum performance target of 15% by using an approved simulation modeling tool before and after construction. Implementing the measures identified in this report will allow the building to achieve this reduction. To utilize this program, a P4P Partner would need to be engaged.

The 200 kW/month average minimum has been dropped so any structure can apply. This new incentive structure will be in effect until December 31, 2009.

Incentives for this program include the following:

- Incentive #1: The P4P Program pays $0.05 per square foot to a maximum of $25,000 or 25% of facility annual energy cost for the P4P Partner to develop an Energy Reduction Plan (ERP). This incentive is paid after approval of the ERP and signed Installation Agreement. Applicant must agree to commit to implementation of the ERP within 6 months or the incentive must be returned to the state.

- Incentive #2: Paid after installation of recommended measures; base incentives deliver $0.11/kWh and $1.10/therm not to exceed 30% of total project cost.

- Incentive #3: Paid after acceptance of Post-Construction Benchmarking Report showing energy savings over one year utilizing the approved simulation modeling tool and EPA Portfolio Manager. 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 deliver a total of $0.18/ kWh and $1.80/therm not to exceed 50% of total project cost. Incentives for #2 and #3 are increased by $0.005/kWh and $0.05/therm for each percentage increase above the minimum performance target calculated with the approved simulation modeling tool, not to exceed 50% of total project cost.

Incentives are also available for prescriptive measures for various types of equipment under the New Jersey SmartStart Buildings incentive program. Prescriptive measures are paid after installation and no energy savings verification will be required. There are incentives available under this program for boiler replacement (ECM-1), replacing window AC units with ductless split systems (ECM-4), and lighting retrofit with occupancy sensors (ECM-7) suggested in this study. These incentives were calculated utilizing the New Jersey SmartStart Building Equipment incentive program. This program provides incentives dependent upon the existing equipment type and proposed equipment retrofit measure. If the North Brunswick Senior Center qualifies and enters into the New Jersey Pay for Performance Program, the savings from the previously noted ECMs, which qualify for New Jersey SmartStart incentive program, will be included in total building energy usage and savings. Applicants cannot apply for both programs for the same project.

When calculating the total incentive for the New Jersey Pay for Performance Program, all energy conservation measures are applicable as the amount received is based on building-wide energy improvements. Since the overall energy reduction for the building is estimated at 31.7%, it does meet the

15% minimum. Therefore the building is eligible to receive monies based on Incentives #2 and #3 as discussed above if an application is submitted before December 31, 2009.

The P4P incentive calculations are presented in Appendix J.

5.0 ALTERNATIVE ENERGY SCREENING EVALUATION

5.1 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 has a mixture of heating and cooling systems including a hot water heating boiler, furnaces with DX cooing coils and window air conditioners. To take advantage of a GHP system, the building would have to install a low temperature closed loop water source heat pump system to realize the benefit of the consistent temperature of the ground. This will also include the removal of the existing heating and cooling systems. A water to water heat pump system could be utilized and used in conjunction with the existing equipment however system modifications and the installation of fluid heat exchangers would be necessary.

This measure is not recommended due to the high cost to retrofit the existing systems.

5.2 Solar

5.2.1 Photovoltaic Rooftop Solar Power Generation

The Senior Center 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 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 PVWAT 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 PVWAT solar power generation model is provided in Appendix K.

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 a period of 15 years from the date of installation. The cost of the ACP penalty for 2009 is $689; 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 2009 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 Senior Center had a maximum kW demand of 43 kW and a minimum kW of 17 kW during 2008. The monthly average over the observed 12 month period was 29 kW. The facility's existing load will not justify the use of the maximum incentive cap of 50 kW of installed PV solar array; therefore, a 20 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 Authority) estimates of total cost of system installation. It should be noted that the cost of installation is currently $10 per watt or $10,000 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.

Photovoltaic (PV) Rooftop Solar Power Generation – 20 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
200,000	0	23,700	0	4,300	4,300	20,000	11,500	>25	11.4

*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

This measure is not recommended at this time due to the long payback period; however, it could be a potentially viable renewable measure for the town to consider in the future if electricity rates continue to increase and if PV installation costs decline below $10 per watt.

5.2.2 Solar Thermal Domestic Hot Water Plant

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

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

Several options exist for using active solar thermal systems for space heating. The most common method involves using glazed collectors to heat a liquid held in a storage tank (similar to an active solar hot water system). The most practical system would transfer the heat from the panels to thermal storage tanks and transfer solar produced thermal energy to use for domestic hot water production. DHW is presently produced by an electric water heater and, therefore, this measure would save the 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 Township of North Brunswick 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 L 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
37,700	0	5,510	0	1,000	1,000	N/A	>25	N/A

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

This measure is not recommended.

5.3 Wind

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

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

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

The most important part of any small wind generation project is the mean annual wind speed at the height of which the turbine will be installed. In the North Brunswick area, the map indicates a mean annual wind speed of 10 miles per hour. The center has site restrictions; parking lots, trees and residential housing would greatly affect a tower location.

An aerial satellite image of the site and wind speed map is included in Appendix M.

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

5.4 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 senior center does have need for electrical generation and the ability to use most of the thermal byproduct during the winter. However thermal usage during the summer months is low, and thermal energy produced by the CHP plant will be wasted.

The most viable option for a CHP plant would be a reciprocating engine natural gas-fired unit. However, since the senior center is located in a residential area, noise would be an issue.

This measure is not recommended due to limited use of summertime heat and noise issues.

5.5 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 because the building does not have a waste stream that can be utilized for the production of electricity or thermal energy.

5.6 Demand Response Curtailment

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

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

A PSE&G pre-approved CSP will require a minimum of 100 kW of load reduction to participate in any curtailment program. The Senior Center had a maximum kW demand of 43 kW and a minimum kW of 17 kW during 2008. The monthly average over the observed 12 month period was 29 kW.

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

6.0 EPA PORTFOLIO MANAGER

The United States Energy Protection Agency (EPA) is a federal agency in charge of regulating environment waste and policy in the United States. The mission of the EPA is to protect human health and the environment. The EPA has released an interactive energy management tool known as the EPA Portfolio Manger that allows building owners to track and assess energy consumption across their facility. This 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. The Portfolio Manager was not able to provide the naturalized energy rating score for the facility because senior citizen activity centers are not yet listed under the categories needed to provide the score and generate a full report. Once an account is registered, monthly utility data can be entered to track the savings progress and retrieve an updated energy rating score on a monthly basis.

The building has a Site Energy Usage Index (EUI) of 77 kBtu/ft^2/yr. This EUI is higher than average compared to the EUI of similar facilities, and a lower index is preferable. Several factors are attributable to this high usage index, including wasted energy from lack of setting back space temperatures during unoccupied hours, inefficient lighting, and poor lighting controls.

If the all of the measures recommended in this report are fully implemented it is projected that the site EUI would be reduced to 53 kBtu/ft^2/yr.

Information regarding the Energy Star Portfolio Manager is located in Appendix N. The user name and password for the Senior Center EPA Portfolio Manager Account was given to Jessica Zink, Supervisor of Senior Citizen Activities.

7.0 CONCLUSIONS & RECOMMENDATIONS

The energy audit conducted by CHA at the North Brunswick Senior Center, in North Brunswick, New Jersey identified potential ECMs for lighting replacement with occupancy sensors, space temperature setback, and domestic hot water heater replacement. Potential annual savings of $6,700 may be realized for the recommended ECMs, with a summary of the costs, savings, and paybacks as follows:

ECM-3 Space Temperature Setback

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
2,200	0	1,470	1,070	1,800	11.3	N/A	1.2	N/A

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

ECM-7 Lighting Retrofit with Occupancy Sensors

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
14,800	7.3	23,250	0	4,100	3.2	1,700	3.6	3.2

* Incentive shown is per the New Jersey Smart Start Program, 2009 Lighting Controls Application. Incentive is based on the use of 22 wall-mounted, occupancy sensors. Incentive is based on the following: retrofitting 85, T-12 fixtures < 250 watt with T-8 lamps.

ECM-8 Replace Domestic Hot Water Heater

Budgetary Cost	Annual Utility Savings				ROI	Potential Incentive*	Payback (without incentive)	Payback (with incentive)
	Electricity		Natural Gas	Total				
$	kW	kWh	Therms	$		$	Years	Years
6,300	-	5,580	(150)	800	0.9	N/A	7.9	N/A

APPENDIX A

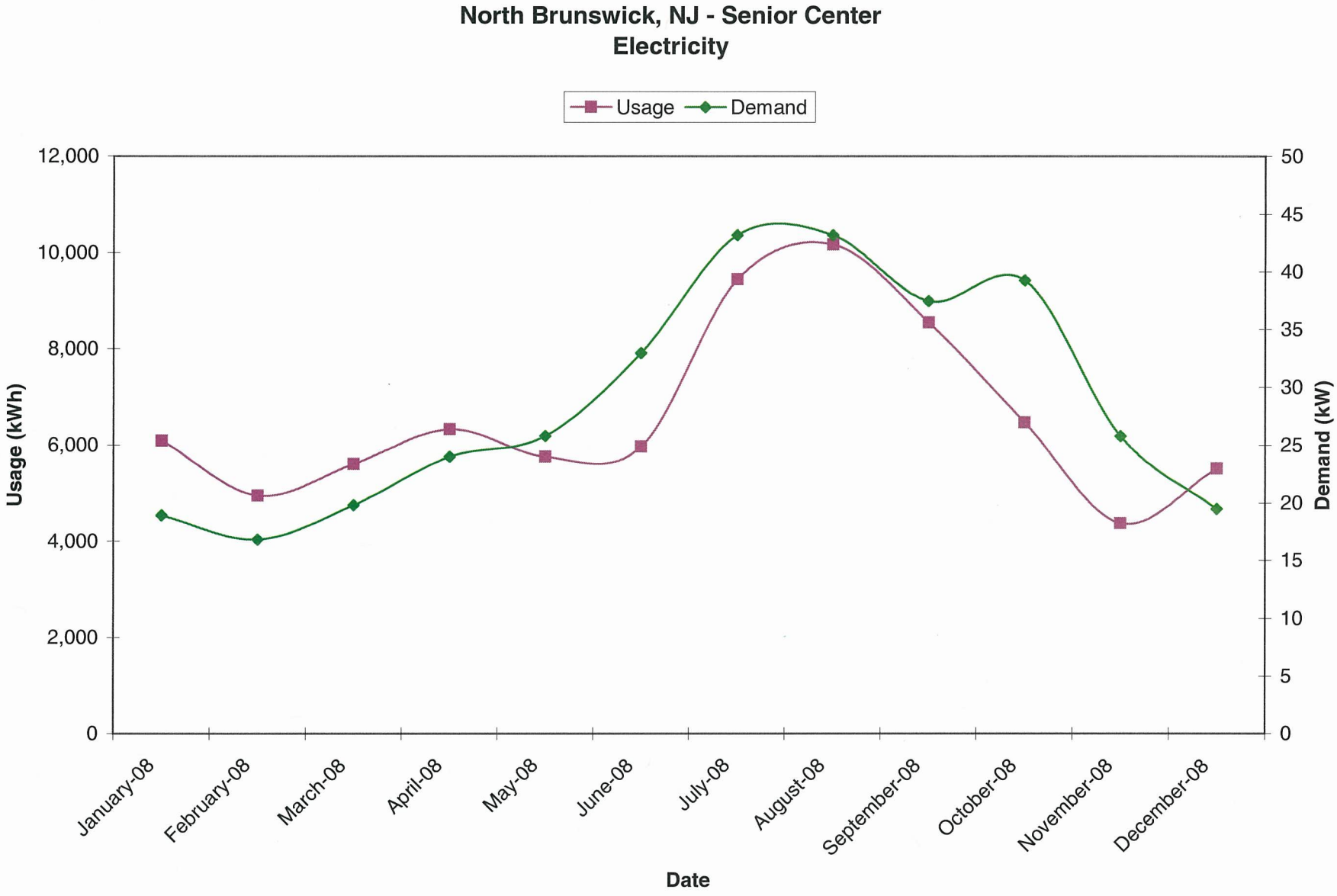
Utility Usage Analysis

New Jersey BPU Energy Audit Program
CHA #20418
Building: North Brunswick Township Senior Center

Account Number: 62 063 086 50 Meter Number: 278001941 Rate: GLP
Public Service Electric & Gas Company (PSE&G)

Electricity						
Period	kWh	kW	Cost	Demand Unit Cost	Supply Unit Cost	Blended Rate
			($)	($/kW)	($/kWh)	($/kWh)
Jan-08	6,090	18.90	825.02	9.01	0.1068	0.1355
Feb-08	4,950	16.80	697.69	9.25	0.1087	0.1409
Mar-08	5,610	19.80	794.12	8.45	0.1110	0.1416
Apr-08	6,330	24.00	873.11	7.65	0.1082	0.1379
May-08	5,760	25.80	811.58	7.39	0.1071	0.1409
Jun-08	5,970	33.00	1,195.34	14.62	0.1187	0.2002
Jul-08	9,450	43.20	2,064.46	16.71	0.1416	0.2185
Aug-08	10,170	43.20	2,195.81	16.70	0.1445	0.2159
Sep-08	8,550	37.50	1,935.61	17.55	0.1489	0.2264
Oct-08	6,480	39.30	1,270.54	10.03	0.1346	0.1961
Nov-08	4,380	25.80	849.77	13.31	0.1146	0.1940
Dec-08	5,520	19.50	941.71	16.35	0.1121	0.1706
Total	79,260	43.20	14,454.76		0.1249	0.1824
Monthly Ave.	6,605	28.90	1,204.56	13.00	0.1249	0.1824

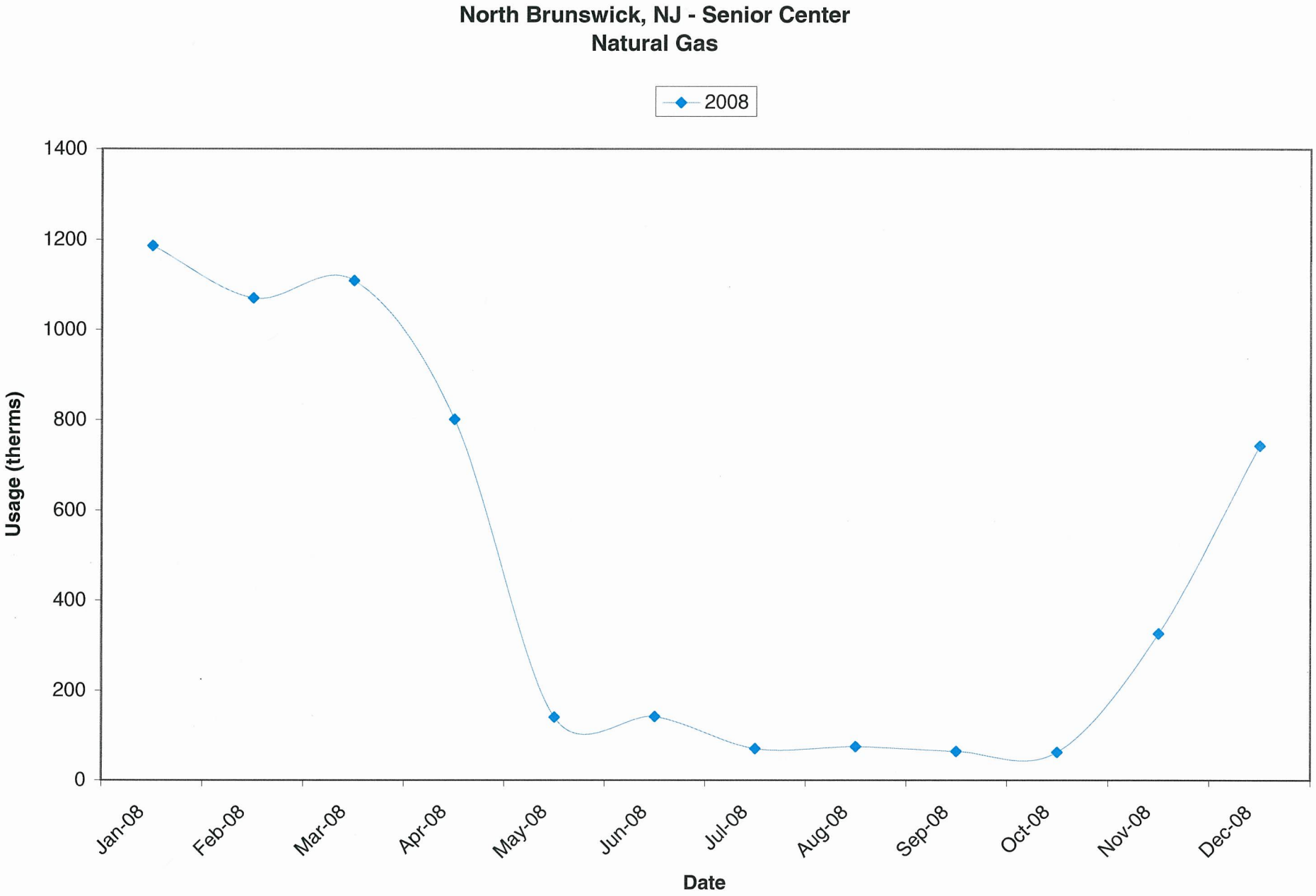
Electricity											
Service Charge	Annual Demand kW	Summer Demand kW	Delivery kWh	Societal Benefits kWh	Securitization Transition kWh	Delivery Total	Generation kW	Transmission kW	Supply kWh	Supply Total	Total
$4.24	$73.60	$0.00	$43.46	$36.46	$60.12	$217.88	$31.85	$64.86	$510.43	$607.14	$825.02
$4.24	$65.42	$0.00	$35.32	$29.64	$49.44	$184.06	$31.79	$58.26	$423.58	$513.63	$697.69
$4.24	$77.10	$0.00	$40.03	$33.59	$56.03	$210.99	$31.79	$58.42	$492.92	$583.13	$794.12
$4.24	$93.46	$0.00	$45.17	$37.90	$63.22	$243.99	$31.79	$58.42	$538.91	$629.12	$873.11
$4.24	$100.47	$0.00	$41.10	$34.49	$57.53	$237.83	$31.79	$58.42	$483.54	$573.75	$811.58
$4.24	$128.51	$238.49	$77.99	$35.74	$59.63	$544.60	$57.08	$58.41	$535.25	$650.74	$1,195.34
$4.24	$168.23	$312.21	$123.46	$56.58	$94.38	$759.10	$183.07	$58.38	$1,063.91	$1,305.36	$2,064.46
$4.24	$168.23	$312.21	$132.87	$60.89	$101.58	$780.02	$182.70	$58.38	$1,174.71	$1,415.79	$2,195.81
$4.24	$146.03	$271.01	$111.70	$51.19	$85.40	$669.57	$182.70	$58.38	$1,024.96	$1,266.04	$1,935.61
$4.24	$153.04	$0.00	$46.24	$38.77	$64.73	$307.02	$182.62	$58.65	$722.25	$963.52	$1,270.54
$4.24	$100.47	$0.00	$31.25	$26.89	$43.74	$206.59	$181.95	$60.95	$400.28	$643.18	$849.77
$4.24	$75.93	$0.00	$39.39	$36.51	$55.14	$211.21	$181.95	$60.95	$487.60	$730.50	$941.71
$50.88	$1,350.49	$1,133.92	$767.98	$478.65	$790.94	$4,572.86	$1,311.08	$712.48	$7,858.34	$9,881.90	


North Brunswick, NJ - Senior Center
Electricity
Usage
Demand
12,000
10,000
8,000
6,000
4,000
2,000
0
Usage (kWh)
50
45
40
35
30
25
20
15
10
5
0
Demand (kW)
January-08
February-08
March-08
April-08
May-08
June-08
July-08
August-08
September-08
October-08
November-08
December-08
Date

New Jersey BPU Energy Audit Program
CHA #20418
Building: North Brunswick Township Senior Center

Account Number: 62 063 086 50 Meter Number: 2196979 Rate: GSGH
Public Service Electric & Gas Company (PSE&G) Delivery & Supply

Natural Gas										
	Delivery							Supply		
Period	Service Charge	Therms	Distribution	Demand	Balancing Charge	Societal Benefits	Total Demand	Total Supply	Total Cost	Blended Cost $/therm
Jan-08	$9.93	1,186.420	$309.93	$0.00	$105.54	$46.02	$471.42	$1,177.82	$1,649.24	
Feb-08	$9.93	1,070.500	$279.65	$0.00	$94.94	$41.52	$426.04	$1,073.78	$1,499.82	
Mar-08	$9.93	1,109.071	$289.72	$0.00	$98.90	$43.02	$441.57	$1,219.98	$1,661.55	
Apr-08	$9.93	801.310	$209.33	$0.00	$0.00	$31.09	$250.35	$961.29	$1,211.64	
May-08	$9.93	140.855	$36.80	$0.00	$0.00	$5.46	$52.19	$182.04	$234.23	
Jun-08	$9.93	142.803	$37.30	$0.00	$0.00	$5.54	$52.77	$206.91	$259.68	
Jul-08	$9.93	70.949	$18.53	$0.00	$0.00	$2.75	$31.21	$109.17	$140.38	
Aug-08	$9.93	75.341	$19.68	$0.00	$0.00	$2.92	$32.53	$118.14	$150.67	
Sep-08	$9.93	65.003	$16.98	$0.00	$0.00	$2.52	$29.43	$77.52	$106.95	
Oct-08	$9.93	62.784	$16.40	$0.00	$0.00	$2.44	$28.77	$69.70	$98.47	
Nov-08	$9.93	327.209	$85.48	$0.00	$22.69	$13.27	$131.37	$329.50	$460.87	
Dec-08	$9.93	743.996	$194.35	$0.00	$62.69	$32.63	$299.60	$687.43	$987.03	
		5,796.241					$2,247.25	$6,213.28	$8,460.53	$1.46


North Brunswick, NJ - Senior Center
Natural Gas
2008
1400
1200
1000
800
600
400
200
0
Usage (therms)
Jan-08
Feb-08
Mar-08
Apr-08
May-08
Jun-08
Jul-08
Aug-08
Sep-08
Oct-08
Nov-08
Dec-08
Date

ELECTRIC MARKETERS LIST

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Jan 14, 2009

GAS MARKETERS LIST

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

RPL Holdings, Inc
601 Carlson Pkwy
Minnetonka, MN 55305

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

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

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

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

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

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

APPENDIX B

ECM-1 Boiler Replacement

North Brunswick
CHA #20418
Building: Senior Center

ECM 1 Boiler Replacement

Existing Fuel	Nat.Gas
Proposed Fuel	Nat.Gas

Item	Value	Units	Formula/Comments
Baseline Fuel Cost	$ 1.46		
Proposed Fuel Cost	$ 1.46		
Baseline Fuel Use	3,050	Therms	Based on historical utility data and reconcile thermal
Existing Boiler Plant Efficiency	80%		Estimated or Measured
Baseline Boiler Load	244,000	Mbtu/yr	Baseline Fuel Use x Existing Efficiency x 100 Mbtu/Therms
Baseline Fuel Cost	$ 4,453		
Proposed Boiler Plant Efficiency	96%		New Boiler Efficiency
Proposed Fuel Use	2,542	Therms	Baseline Boiler Load / Proposed Efficiency / 100 Mbtu/Therms
Proposed Fuel Cost	$ 3,711		
Annual Savings	508	Therms	
Annual Savings	**$ 742**	**/yr**	

North Brunswick
CHA #20418
Building: Senior Center

ECM 1 Boiler Replacement

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
						$ -	$ -	$ -	$ -	
Boiler Removal	1	ea		$ 200		$ -	$ 242	$ -	$ 242	
Condensate Neutralization Kit	1	ea	$ 100	$ 100		$ 98	$ 121	$ -	$ 219	
Flue Modifications	15	lf	$ 20	$ 40		$ 294	$ 726	$ -	$ 1,020	
Piping Modifications	1	ea	$ 650	$ 700		$ 637	$ 847	$ -	$ 1,484	
Electric Modifications	1	ea	$ 400	$ 700		$ 392	$ 847	$ -	$ 1,239	
Gas-Fired Condensing HW Boiler w/ freight *	1	ea	$ 4,500	$ 500		$ 4,410	$ 605	$ -	$ 5,015	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

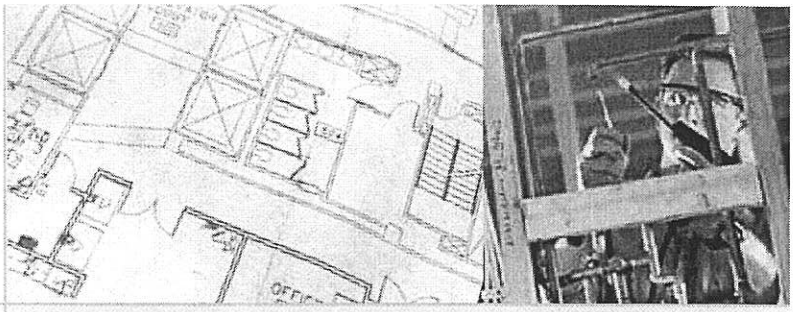
* Boiler price based on vendor quote

$ 9,219	Subtotal
$ 922	10% Contingency
$ 1,521	Contractor 15% O&P
$ -	Engineering
$ 11,662	**Total**

New Jersey Smart Start Incentive	QTY	UNIT	$ / UNIT	TOTAL SAVINGS	Cost W/O INCENTIV	Cost W/ INCENTIV
					$ -	$ -
NG Boilers > 1500 - ≤4000 MBH	190	MBH	$1	$190	$ -	$ (190)
					$ -	$ -
				$190	$0	-$190

Total ECM Cost w/ Incentives	**$11,472**

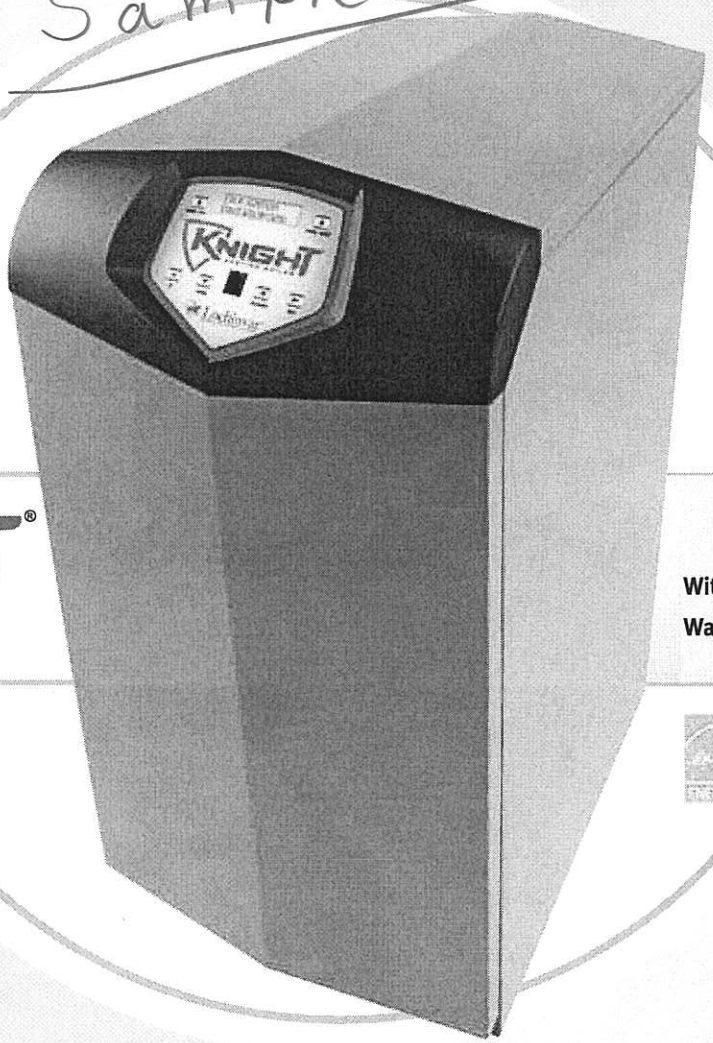
Up to $1500 Energy Tax Credit Qualified Product!

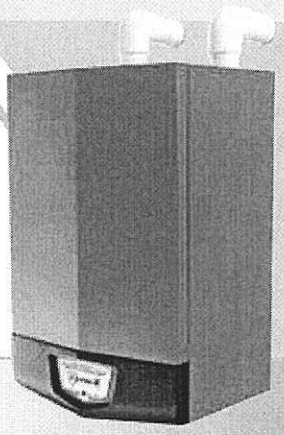


the best mod/con Performance and Versatility

UP TO 96% DOE AFUE Efficiency

Sample





KNIGHT® HEATING BOILER

With Floor *and* Wall Mount Models

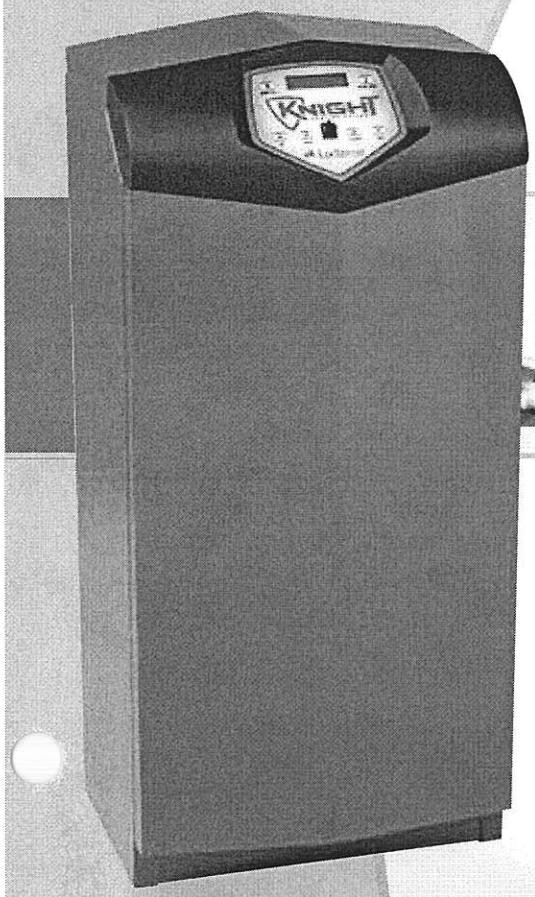
DEALER DESIGN AWARDS

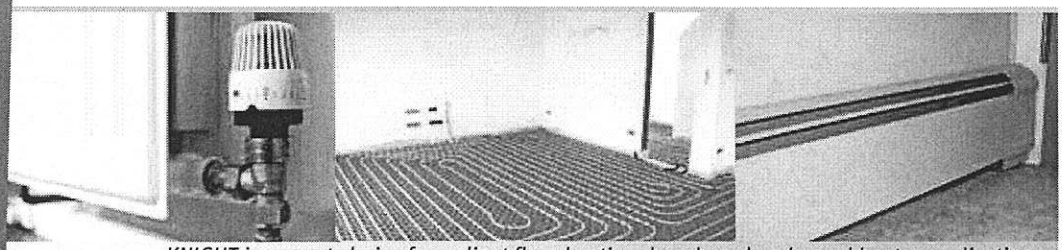
DESIGN EXCELLENCE IN DESIGN

Lochinvar®
High Efficiency Water Heaters, Boilers and Pool Heaters

www.knightheatingboiler.com

KNIGHT®
HEATING BOILER



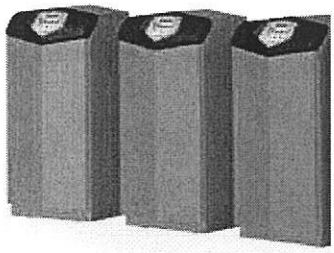


KNIGHT is a great choice for radiant floor heating, baseboard and panel heater applications.

Since its introduction in 2005, the KNIGHT modulating-condensing heating boiler has consistently delivered everything the professional needs for ease of installation and maintenance, and everything homeowners need for total comfort and long-term savings on energy costs.

With 5 floor-standing models and 5 compact Wall Mount units, Lochinvar offers the industry's broadest selection of modulating-condensing heating boilers. And KNIGHT is the industry's most advanced boiler design, including the SMART SYSTEM™ operating control that has quickly become a legendary benchmark among the trade!

For traditional space heating or radiant floor heating applications, KNIGHT offers your customers tremendous savings on energy costs compared to less efficient boilers. KNIGHT has earned the ENERGY STAR, signifying that it has met strict energy-efficiency guidelines set by the EPA and U.S. Department of Energy.



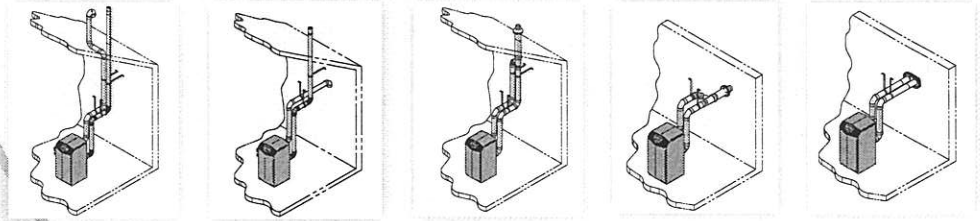
10 Models – The Right Choice, for Every Application

"Why do I like the KNIGHT? I don't know where to begin.
The direct venting with 100 feet of intake and exhaust eliminates a lot of problems. I also like the low voltage features, and the SMART SYSTEM's outdoor reset capability. The internal sequencer is tremendously powerful and ideal for multiple boiler installations. It's also great-looking, and aesthetics are important to my customers. When I install KNIGHT, my customers know they are getting a highly efficient state-of-the-art system, and they've all been completely satisfied."

– Paul Rohrs, Biggerstaff Radiant Solutions, Lincoln, NE

5 Flexible Venting Options

Direct Vent Vertical | **Vertical w/Sidewall Air** | **Direct Vent Vertical*** | **Direct Vent Sidewall*** | **Direct Vent Sidewall**



Vent using PVC, CPVC or Stainless Steel

Up to 100 feet of air intake and 100 feet of exhaust vent with PVC, CPVC or SS. *Optional Concentric Vent Kit sold seperately.

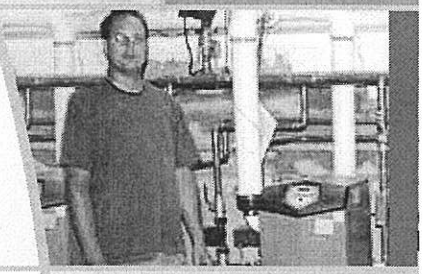
Heroic Quality and Innovation

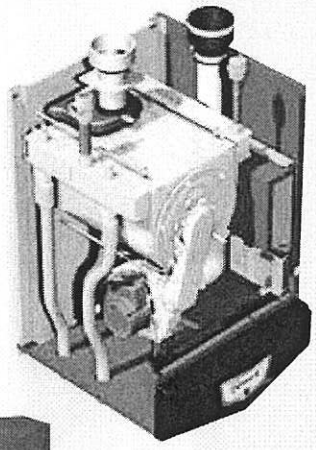
96% DOE AFUE Efficiency

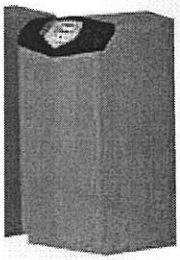
98% Efficiency in low-temp radiant applications

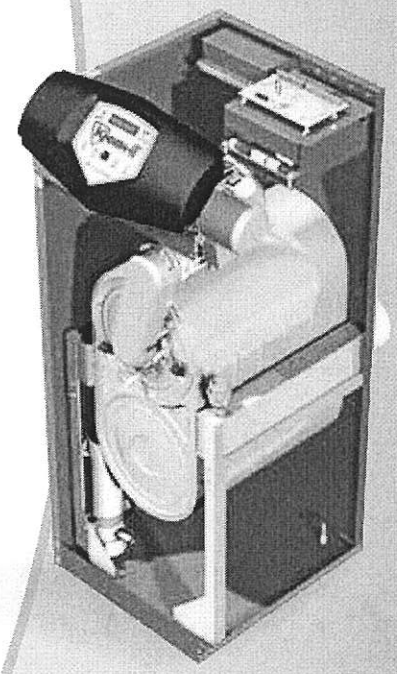
"I'm very impressed with the KNIGHT Boiler. It's lightweight, simple to install and works remarkably well. ***The SMART SYSTEM control is a definite advantage, because most other manufacturers sell the control separately and it has to be assembled on the job.*** *I also really like that the KNIGHT can modulate down to 20 percent, and that the wiring is very easy to understand. I recommend the KNIGHT to all of my customers who are looking for a quality boiler that will perform well and last for years."*

– Steve Ayotte, Ayotte's Water Works, Lansing, MI









Advanced Negative Regulation Technology

KNIGHT safely and reliably operates with supply gas pressure as low as 4 inches water column, because "Neg/Reg" technology automatically adjusts gas pressure to ensure the correct volume of fuel and air entering the burner.

Fail-Safe Direct-Spark Ignition

With each call for heat, two electrodes ignite the fuel/gas mixture. A third electrode then senses for flame. If no flame is detected, the system resets and attempts ignition four times. SMART SYSTEM will lock out and display a fault if ignition does not occur after four attempts.

Two-in-One Stainless Steel Heat Exchanger

A primary heat exchanger combined with a secondary heat exchanger capturing flue gas heat allows entering water temperatures as low as 32°F. The stainless steel, pH-tolerant design features a weld-sealed assembly with no O-rings or gaskets and does not require special glycol. ASME Section IV approved and stamped.

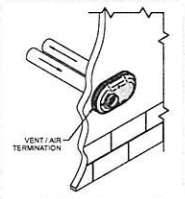
Fully Modulating Burner with 5:1 Turndown

The SMART SYSTEM allows fully modulating combustion with 5:1 turndown. The burner can fire as low as 20% of maximum input, and modulates the firing rate up to 100% as demand increases. The woven stainless steel mesh assembly fires in a 360° pattern along the entire length of the heat exchanger. These together allow KNIGHT's compact size to excel compared to units with larger multiple burners.

Ease of Installation

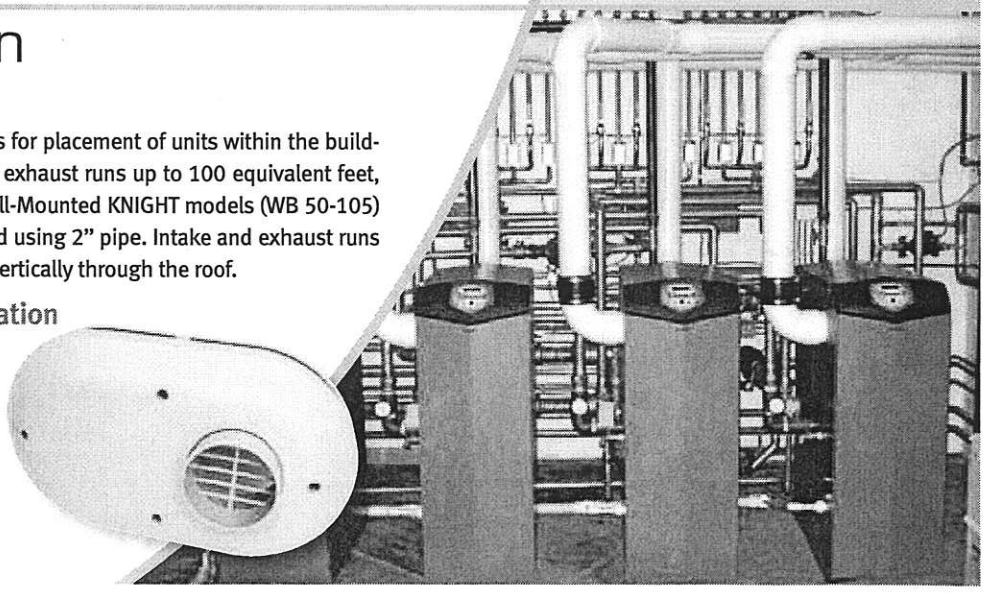
Direct Venting up to 100 Feet!

KNIGHT offers greater flexibility than other boilers for placement of units within the building, because it permits direct-vent air intake and exhaust runs up to 100 equivalent feet, using PVC, CPVC or SS pipe. Additionally with Wall-Mounted KNIGHT models (WB 50-105) intake and vent runs of up to 40 feet are approved using 2" pipe. Intake and exhaust runs can terminate horizontally through a sidewall or vertically through the roof.



Sidewall Vent Termination

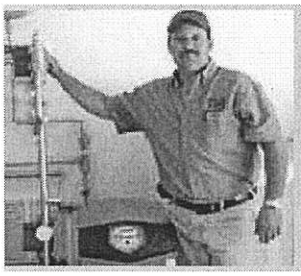
SIDEWALL VENT TERMINATION - FACTORY SUPPLIED AND SHIPPED STANDARD WITH EVERY MODEL



SMART SYSTEM™

The Industry's Smartest Design

SMART SYSTEM is the industry's most advanced operating control. Right out of the box, it gives you unequaled control and monitoring functions that are easy to understand and use.



"I really like the KNIGHT Boiler because it's very simple to install and program. The SMART SYSTEM control is great and I really like being able to troubleshoot with the PC software My customers choose KNIGHT for its high efficiency and state-of-the-art design, and they're all thrilled that KNIGHT operates so quietly and makes their home much more comfortable."

– Chad Padilla, The Socha Company, Albuquerque, NM

2-Line, 16-Character LCD Display
Displays setup and diagnostic information in words, not codes

Password Security
Dual passwords for installer and user

Product Service Indicator
Program reminders for cycle count, operation hours or last service

Pump Relay w/Freeze Protection
Ensures water temperature does not fall below 40°F

Low-Water Flow Indicator
Uses temperature differential to protect against low flow in the heat exchanger by reducing modulation or shutdown

Outdoor Reset
Outdoor temperature monitor guides the reset schedule to meet load

Night Setback
Program a heating loop water temperature setback for any time of the day, each day of the week

Building Management System (BMS) Control
0-10 VDC, BMS-driven input for modulation rate or temperature control

DHWP with Pump Control
On call for hot water, SMART SYSTEM overrides outdoor reset and starts DHWP pump to the indirect. Runtime can alternate between heating and domestic hot water to meet demand simultaneously

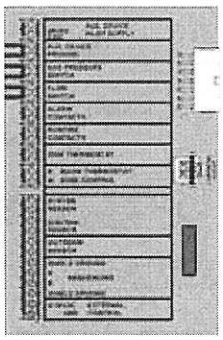
System & Boiler Pump Controls
Provides power to both system and boiler pumps based on a call for heat. Programmable delay allows pumps to operate after a call has been satisfied

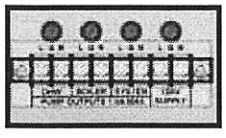
In/Out Temperature Sensors
Allows installer to select which sensor controls the boiler setpoint

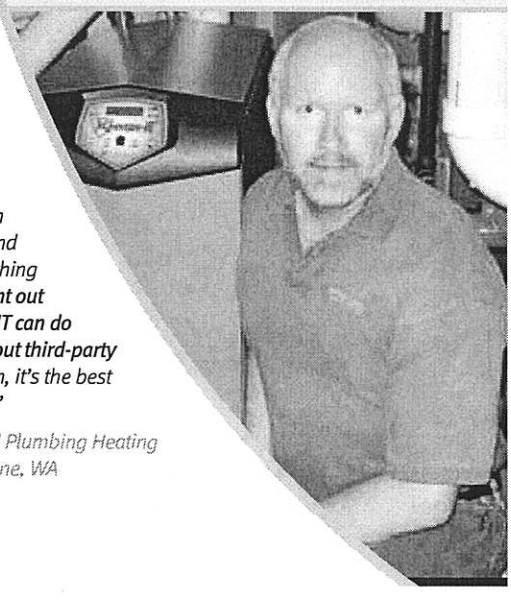
PC Connection –
Can be used with KNIGHT PC software to troubleshoot and program SMART SYSTEM functions and to track historical data, including faults, trends and energy consumption.

Field Connection Versatility
User-friendly terminal strip allows for 28 low-voltage field connections. Plus, 4 line voltage connections supply power to the unit, and up to three pumps operated by the SMART SYSTEM.

Built-in Cascading Sequencer
SMART SYSTEM includes a built-in sequencer for 2–8 units, eliminating the cost and labor of a third-party sequencer. On demand, one boiler acts as lead unit and modulates with demand to meet capacity. The additional load then "cascades" to the next boiler in line and continues until all are operating or demand is satisfied. When demand drops, the process reverses.







"The control system on the KNIGHT is head and shoulders above anything else available. ***Straight out of the box, the KNIGHT can do anything I need without third-party controls.*** *Hands-down, it's the best boiler on the market."*

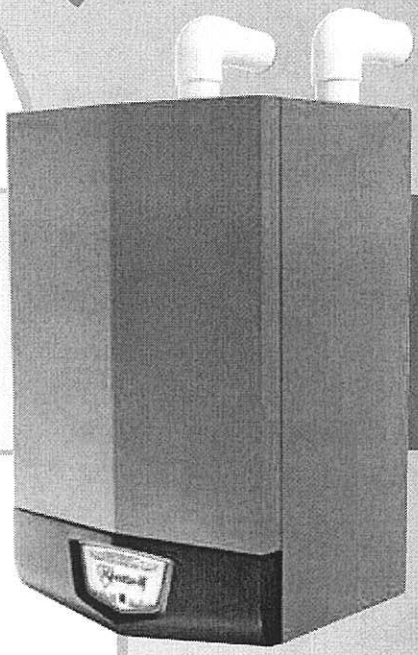
– Don Smet, Standard Plumbing Heating Controls Corp., Spokane, WA

Space Saving Convenience

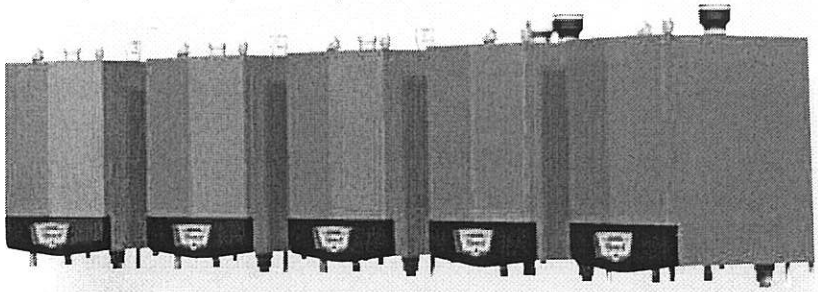
KNIGHT™
WALL MOUNT BOILER

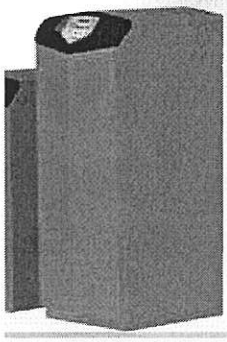
"After my first KNIGHT installation, I loved it so much I installed it in my own home, and now my heating bill is half what it used to be."

– Rick Brunner, Hydronic Solutions, Nassau County, NY



KNIGHT lineup includes 5 space-saving Wall Mount models from 50,000 to 210,000 Btu/hr





The KNIGHT floor-standing lineup features 5 small footprint designs from 80,000 to 285,000 Btu/hr

LOW NOx Certified
PROTECTING OUR ENVIRONMENT

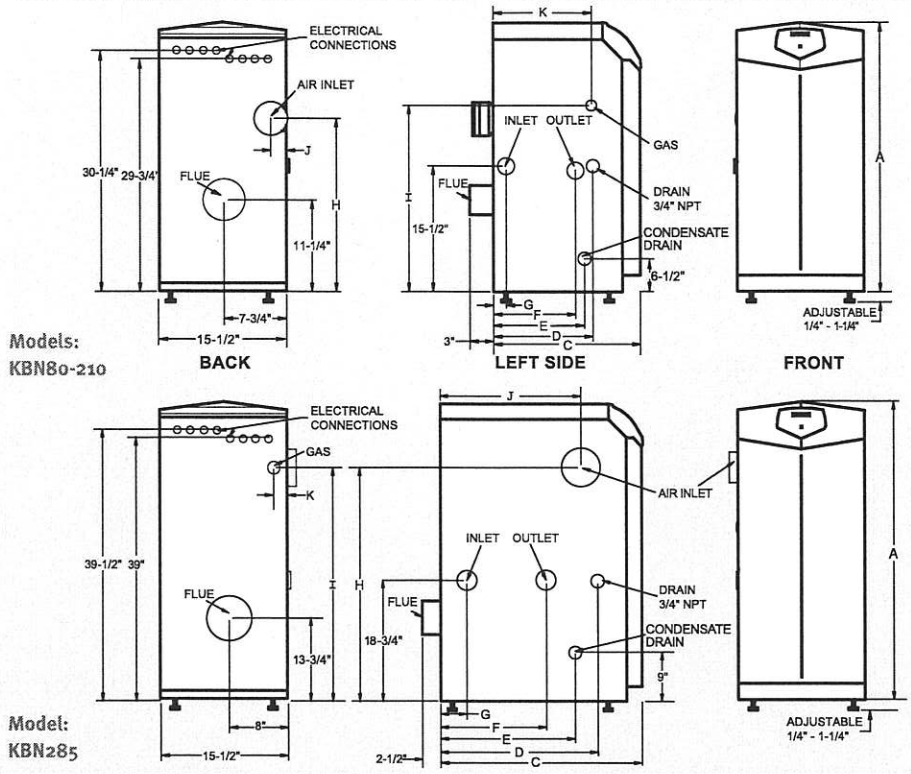
All KNIGHT Boilers meet or exceed the highest federal emissions requirements.

Squire models - 30 to 120 gallons

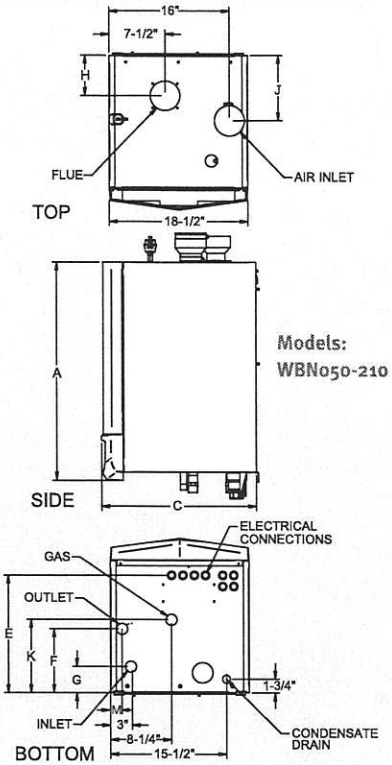
KNIGHT plus SQUIRE delivers domestic hot water for less!

The KNIGHT boiler's DHWP feature means you can easily install it with Lochinvar's new SQUIRE indirect water heater. With this winning combination, homeowners will get high-efficiency space heating from KNIGHT, plus all the domestic hot water they need from SQUIRE. Equipped with a stainless steel tank and heat exchanger, SQUIRE will provide more hot water with lower water heating costs compared to a standard gas or electric water heater.

Knight Heating Boiler Dimensions & Specifications– Floor Standing Models



Wall Mount Models



KNIGHT Heating Boiler						Dimensions and Specifications													
Model Number	Input Min MBH	Input Max MBH	AFUE %	Heating Capacity MBH	NET I=B=R MBH	A	C	D	E	F	G	H	I	J	K	M	Gas Conn.	Water Conn.	Air Inlet	Vent Size	Shipping Weight
WBN050	10	50	95.3	45	39	29-1/4"	15-3/4"	NA	10-3/4"	10-3/4"	2"	6-3/4"	NA	3-1/4"	4-1/4"	2-3/4"	1/2"	1"	2"	2"	130
WBN080	16	80	95.3	72	63	29-1/4"	15-3/4"	NA	10-3/4"	10-3/4"	2"	6-3/4"	NA	3-1/4"	4-1/4"	2-3/4"	1/2"	1"	2"	2"	130
WBN105	21	105	95.4	94	82	29-1/4"	15-3/4"	NA	10-3/4"	10-3/4"	3-1/2"	5-1/2"	NA	3-1/4"	4-1/4"	2-3/4"	1/2"	1"	2"	2"	134
WBN150	30	150	95.5	135	119	29-1/4"	20-3/4"	NA	15-3/4"	8-1/2"	3-1/2"	5-1/2"	NA	8-3/4"	9-3/4"	1-1/2"	1/2"	1"	3"	3"	162
WBN210	42	210	95.7	190	165	29-1/4"	25"	NA	20"	12"	3-1/2"	5-1/2"	NA	13"	14"	1-1/2"	1/2"	1"	3"	3"	177
KBN080	16	80	95.3	72	63	33-1/4"	14"	7"	5-3/4"	5"	3"	20-1/2"	22"	1-3/4"	6-1/2"	NA	1/2"	1"	3"	3"	125
KBN105	21	105	95.4	94	82	33-1/4"	14"	6-1/2"	5-3/4"	4-1/2"	1-1/2"	20-1/2"	22"	1-3/4"	6-1/2"	NA	1/2"	1"	3"	3"	129
KBN150	30	150	95.5	135	119	33-1/4"	18"	12-1/4"	11-1/2"	10"	1-1/2"	21-1/4"	23"	1-3/4"	12"	NA	1/2"	1"	3"	3"	157
→ KBN210	42	210	95.7	190	165	33-1/4"	22-1/4"	16-1/2"	15-3/4"	14-1/4"	5-1/4"	21-1/4"	23"	1-3/4"	16-1/4"	NA	1/2"	1"	3"	3"	172
KBN285	57	285	96.0	260	226	42-1/2"	19-3/4"	12-3/4"	13-1/2"	6"	2"	34"	31"	11-3/4"	4-1/4"	NA	3/4"	1-1/4"	4"	4"	224

Notes: Performance data based on manufacturer's test results. Indoor installation only. All information subject to change. Change "N" to "L" for LP gas models.

Standard Features

- **Energy Star® Qualified**
- **Up to 96% DOE AFUE Efficiency**
- **Modulating Burner with 5:1 Turndown**
  - Direct-Spark Ignition
  - Low NOx Operation
  - Field Convertible from Natural to LP Gas
- **Vertical & Horizontal Direct-Vent**
  - PVC, CPVC or SS Venting up to 100 Feet
  - Factory Supplied Sidewall Vent Termination
- ASME Stainless Steel Heat Exchanger
- Automatic Reset High Limit
- Inlet & Outlet Temperature Sensors
- Boiler Circulating Pump
- 30 psi ASME Relief Valve
- Adjustable Leveling Legs (KB Models only)
- Wall Mount Bracket (WB Models only)
- Zero Clearances to Combustible Material
- 12 Year Limited Warranty (See Warranty for Details)

SMART SYSTEM™ Features

- **SMART SYSTEM Digital Operating Control**
  - 2 line, 16 Character Display
  - Dual Level Password Security
  - Domestic Hot Water Prioritization
  - Built in Cascading Sequencer for up to 8 Boilers
  - 0-10 VDC Input Control
  - Outdoor Reset Control with Outdoor Air Sensor
  - Low Water Flow Safety Control & Indication
  - Alarm on Any Failure Contacts
  - Service Reminder
  - Freeze Protection
  - Night Setback
  - Time Clock
  - Three Pump Control (System, Boiler & DHWP)
  - Data Logging
    - *Examples:* Hours Running, Space Heating
  - Programmable System Efficiency Optimizers
    - *Examples:* Anti-cycling, Ramp Delay

Optional Equipment

- Adjustable High Limit w/ Manual Reset
- Flow Switch
- Low Water Cutoff w/Manual Reset & Test
- Alarm Bell
- Concentric Vent Kit
- Condensate Neutralization Kit
- SMART SYSTEM PC Software
- Multi-Stack Frame

Firing Codes

- M9 Standard Construction
- M7 California Code

AHRI MEMBER

Lochinvar®
High Efficiency Water Heaters, Boilers and Pool Heaters

300 Maddox Simpson Parkway, Lebanon, TN 37090 | 615-889-8900 | fax: 615-547-1000 | www.Lochinvar.com

MK-20M-5/09-Printed in U.S.A.

APPENDIX C

ECM-2 Hot Water Temperature Reset

North Brunswick
CHA #20418
Building: Senior Center

ECM-2 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.

					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
95-99	97.0	3	0	0	0	0	0%	0	0
90-94	92.0	34	0	0	0	0	0%	0	0
85-89	87.0	131	0	0	0	0	0%	0	0
80-84	82.0	500	0	0	0	0	0%	0	0
75-79	77.0	620	0	0	0	0	0%	0	0
70-74	72.0	664	0	0	0	0	0%	0	0
65-69	67.0	854	0	0	0	0	0%	0	0
60-64	62.0	927	0	0	0	0	0%	0	0
55-59	57.0	600	600	2,631	133	1,724	0%	33	0
50-54	52.0	610	610	2,675	137	1,752	96%	33	18
45-49	47.0	611	611	2,679	141	1,755	96%	33	18
40-44	42.0	656	656	2,876	146	1,885	96%	36	20
35-39	37.0	1,023	1,023	4,486	150	2,939	96%	56	31
30-34	32.0	734	734	3,218	154	2,109	96%	40	22
25-29	27.0	334	334	1,465	158	960	96%	18	10
20-24	22.0	252	252	1,105	163	724	96%	14	8
15-19	17.0	125	125	548	167	359	96%	7	4
10-14	12.0	47	47	206	171	135	96%	3	1
5-9	7.0	22	22	96	176	63	96%	1	1
0-4	2.0	13	13	57	180	37	96%	1	0
-5- -1	-3.0	0	0	0	180	0	96%	0	0
Totals		**8,760**	**5,027**	**22,042**		**14,442**		**276**	**132**

Existing Boiler Efficiency	80%	
Avg. Proposed Boiler Efficiency	96%	

Building HHW Piping System		
Heating On Temperature	60	°F
Total Length of Pipe	420	LF
Existing HHW Setpoint High	180	°F
Existing HHW Setpoint Low	130	°F
Avg HHW Temp	155	°F
Avg Pipe Size	1	Inches
Avg Insul Thickness	1	Inches
Existing Heat Loss	17.4	Btu/Hr/LF
Percent in Uncond. Space	60%	
Existing System Heat Loss	4,385	Btu/Hr
Avg Prop HHW Supply Temp	147	°F
Proposed Heat Loss	11.4	Btu/Hr/LF
Proposed System Heat Loss	2,873	Btu/Hr

Size (in)	Length (ft)
1	320
1.50	100
1	**Average**

Annual Energy Savings	**143**	**Therms/yr**
Annual Cost Savings	**$ 209**	**/yr**

Comments:

A-B	Newark, NJ weather bins
C	Based on building balance points and bin data.
D	Based on block load for building
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.
H	Utility usage to overcome heat loss in HHW piping system based on boiler efficiency.

North Brunswick
CHA #20418
Building: Senior Center

ECM-2 Boiler 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.		
						$ -	$ -	$ -	$ -	
Boiler temperature reset control kit	1	ea	$ 300	$ 300		$ 294	$ 363	$ -	$ 657	
Electric Modifications	1	ea	$ 100	$ 200		$ 98	$ 242	$ -	$ 340	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 997	Subtotal
$100	10% Contingency
$110	10% Contractor O&P
$0	0% Engineering
$1,206	**Total**

APPENDIX D

ECM-3 Space Temperature Setback

North Brunswick
CHA #20418
Building: Senior Center Recreation and Kitchen Building

ECM-3 Temperature Setback

Building Footprint	5,200	SF	Ex Occupied Clng Temp.	73	*F	Ex Occupied Htg Temp.	73	*F	**Heating Energy Savings**	**499**	**therms**	**$ 728**
Heating Efficiency	80%		Ex Unoccupied Clng Temp.	73	*F	Ex Unoccupied Htg Temp.	73	*F	**Cooling Energy Savings**		**kWh**	**$ -**
Cooling Efficiency	1.3	kW/ton	Prop Occupied Clng Temp.	73	*F	Prop Occupied Htg Temp.	73	*F				
Building Balance Temp.	60	*F	Prop Unoccupied Clng Temp.	78	*F	Prop Unoccupied Htg Temp.	64	*F				
Internal Gains	41,982	btu/h	Occupied Cooling UA	-1,398	btu/hr/°F	Occupied Heating UA	924	btu/hr/°F				
Unoc Internal Gain factor	0.03		Unoccupied Cooling UA	-1,071	btu/hr/°F	Unoccupied Heating UA	924	btu/hr/°F				
Ave Occ Internal Gain Factor	0.7		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	-41,234	-56,314	-29,388	-31,583	-56,314	-1,259	-41,234	-56,314	-29,388	-26,230	-56,314	-1,259	0	0	0	0
97.5	42.5	3	1	2	-34,246	-39,107	-29,388	-26,230	-39,107	-1,259	-34,246	-39,107	-29,388	-20,877	-39,107	-1,259	26	25	0	0
92.5	39.5	34	12	22	-27,257	-31,286	-29,388	-20,877	-31,286	-1,259	-27,257	-31,286	-29,388	-15,524	-31,286	-1,259	242	229	0	0
87.5	36.6	131	46	85	-20,268	-23,725	-29,388	-15,524	-23,725	-1,259	-20,268	-23,725	-29,388	-10,171	-23,725	-1,259	740	691	0	0
82.5	34	500	177	323	-13,279	-16,946	-29,388	-10,171	-16,946	-1,259	-13,279	-16,946	-29,388	-4,818	-16,946	-1,259	2,136	1,948	0	0
77.5	31.6	620	219	401	-6,290	-10,689	-29,388	-4,818	-10,689	-1,259	-6,290	-10,689	-29,388	0	0	-1,259	1,830	1,157	0	0
72.5	29.2	664	235	429	462	313	-29,388	462	313	-1,259	462	313	-29,388	0	0	-1,259	751	787	0	0
67.5	27	854	302	552	5,080	3,441	-29,388	5,080	3,441	-1,259	5,080	3,441	-29,388	0	0	-1,259	683	758	0	0
62.5	24.5	927	328	599	9,699	6,570	-29,388	9,699	6,570	-1,259	9,699	6,570	-29,388	1,386	939	-1,259	466	466	0	0
57.5	21.4	600	212	388	14,317	9,699	-29,388	14,317	9,699	-1,259	14,317	9,699	-29,388	6,004	4,067	-1,259	124	124	0	0
52.5	18.7	610	216	394	18,936	12,827	-29,388	18,936	12,827	-1,259	18,936	12,827	-29,388	10,622	7,196	-1,259	0	0	157	88
47.5	16.2	611	216	395	23,554	15,956	-29,388	23,554	15,956	-1,259	23,554	15,956	-29,388	15,241	10,324	-1,259	0	0	216	147
42.5	14.4	656	232	424	28,172	19,084	-29,388	28,172	19,084	-1,259	28,172	19,084	-29,388	19,859	13,453	-1,259	0	0	296	222
37.5	12.6	1,023	362	661	32,791	22,213	-29,388	32,791	22,213	-1,259	32,791	22,213	-29,388	24,478	16,581	-1,259	0	0	560	445
32.5	10.7	734	260	474	37,409	25,341	-29,388	37,409	25,341	-1,259	37,409	25,341	-29,388	29,096	19,710	-1,259	0	0	473	390
27.5	8.6	334	118	216	42,028	28,470	-29,388	42,028	28,470	-1,259	42,028	28,470	-29,388	33,714	22,839	-1,259	0	0	248	210
22.5	6.8	252	89	163	46,646	31,599	-29,388	46,646	31,599	-1,259	46,646	31,599	-29,388	38,333	25,967	-1,259	0	0	211	183
17.5	5.5	125	44	81	51,264	34,727	-29,388	51,264	34,727	-1,259	51,264	34,727	-29,388	42,951	29,096	-1,259	0	0	117	103
12.5	4.1	47	17	30	55,883	37,856	-29,388	55,883	37,856	-1,259	55,883	37,856	-29,388	47,570	32,224	-1,259	0	0	48	43
7.5	2.6	22	8	14	60,501	40,984	-29,388	60,501	40,984	-1,259	60,501	40,984	-29,388	52,188	35,353	-1,259	0	0	25	22
2.5	1	13	5	8	65,120	44,113	-29,388	65,120	44,113	-1,259	65,120	44,113	-29,388	56,807	38,481	-1,259	0	0	16	14
-2.5	0	0	0	0	69,738	47,241	-29,388	69,738	47,241	-1,259	69,738	47,241	-29,388	61,425	41,610	-1,259	0	0	0	0
-7.5	-1.5	0	0	0	74,357	50,370	-29,388	74,357	50,370	-1,259	74,357	50,370	-29,388	66,043	44,738	-1,259	0	0	0	0
TOTALS		**8,760**	**3,100**	**5,660**													**6,997**	**6,185**	**2,366**	**1,867**

Existing Building Ventilation & Infiltration (occ)	**579**	**cfm**
Overheat Ventilation Factor	**1.00**	
Additional ventilation to offset overheat	**0**	**cfm**
Existing Building Ventilation & Infiltration (unocc)	**579**	**cfm**

North Brunswick
CHA #20418
Building: Senior Center Meeting Hall & Office Areas

ECM-3B Temperature Setback

Building Footprint	5,800	SF	Ex Occupied Clng Temp.	73	*F	Ex Occupied Htg Temp.	73	*F	**Heating Energy Savings**	**575**	**therms**	**$ 839**
Heating Efficiency	80%		Ex Unoccupied Clng Temp.	73	*F	Ex Unoccupied Htg Temp.	73	*F	**Cooling Energy Savings**	**1,474**	**kWh**	**$ 269**
Cooling Efficiency	1.3	kW/ton	Prop Occupied Clng Temp.	73	*F	Prop Occupied Htg Temp.	73	*F				
Building Balance Temp.	60	*F	Prop Unoccupied Clng Temp.	80	*F	Prop Unoccupied Htg Temp.	64	*F				
Internal Gains	67,695	btu/h	Occupied Cooling UA	-2,569	btu/hr/°F	Occupied Heating UA	1,445	btu/hr/°F				
Unoc Internal Gain factor	0.03		Unoccupied Cooling UA	-2,258	btu/hr/°F	Unoccupied Heating UA	1,445	btu/hr/°F				
Ave Occ Internal Gain Factor	0.7		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	-75,787	-56,314	-47,386	-66,609	-56,314	-2,031	-75,787	-56,314	-47,386	-50,804	-56,314	-2,031	0	0	0	0
97.5	42.5	3	1	2	-62,942	-39,107	-47,386	-55,320	-39,107	-2,031	-62,942	-39,107	-47,386	-39,514	-39,107	-2,031	37	34	0	0
92.5	39.5	34	12	22	-50,096	-31,286	-47,386	-44,030	-31,286	-2,031	-50,096	-31,286	-47,386	-28,224	-31,286	-2,031	352	314	0	0
87.5	36.6	131	46	85	-37,251	-23,725	-47,386	-32,740	-23,725	-2,031	-37,251	-23,725	-47,386	-16,935	-23,725	-2,031	1,081	936	0	0
82.5	34	500	177	323	-24,406	-16,946	-47,386	-21,450	-16,946	-2,031	-24,406	-16,946	-47,386	-5,645	-16,946	-2,031	3,116	2,563	0	0
77.5	31.6	620	219	401	-11,561	-10,689	-47,386	-10,161	-10,689	-2,031	-11,561	-10,689	-47,386	0	0	-2,031	2,648	1,743	0	0
72.5	29.2	664	235	429	723	313	-47,386	723	313	-2,031	723	313	-47,386	0	0	-2,031	1,226	1,274	0	0
67.5	27	854	302	552	7,949	3,441	-47,386	7,949	3,441	-2,031	7,949	3,441	-47,386	0	0	-2,031	1,178	1,300	0	0
62.5	24.5	927	328	599	15,176	6,570	-47,386	15,176	6,570	-2,031	15,176	6,570	-47,386	2,168	939	-2,031	911	911	0	0
57.5	21.4	600	212	388	22,403	9,699	-47,386	22,403	9,699	-2,031	22,403	9,699	-47,386	9,395	4,067	-2,031	352	352	0	0
52.5	18.7	610	216	394	29,630	12,827	-47,386	29,630	12,827	-2,031	29,630	12,827	-47,386	16,621	7,196	-2,031	115	115	0	0
47.5	16.2	611	216	395	36,856	15,956	-47,386	36,856	15,956	-2,031	36,856	15,956	-47,386	23,848	10,324	-2,031	0	0	265	173
42.5	14.4	656	232	424	44,083	19,084	-47,386	44,083	19,084	-2,031	44,083	19,084	-47,386	31,075	13,453	-2,031	0	0	370	271
37.5	12.6	1,023	362	661	51,310	22,213	-47,386	51,310	22,213	-2,031	51,310	22,213	-47,386	38,302	16,581	-2,031	0	0	709	555
32.5	10.7	734	260	474	58,536	25,341	-47,386	58,536	25,341	-2,031	58,536	25,341	-47,386	45,528	19,710	-2,031	0	0	604	493
27.5	8.6	334	118	216	65,763	28,470	-47,386	65,763	28,470	-2,031	65,763	28,470	-47,386	52,755	22,839	-2,031	0	0	318	268
22.5	6.8	252	89	163	72,990	31,599	-47,386	72,990	31,599	-2,031	72,990	31,599	-47,386	59,982	25,967	-2,031	0	0	272	235
17.5	5.5	125	44	81	80,217	34,727	-47,386	80,217	34,727	-2,031	80,217	34,727	-47,386	67,208	29,096	-2,031	0	0	151	133
12.5	4.1	47	17	30	87,443	37,856	-47,386	87,443	37,856	-2,031	87,443	37,856	-47,386	74,435	32,224	-2,031	0	0	63	56
7.5	2.6	22	8	14	94,670	40,984	-47,386	94,670	40,984	-2,031	94,670	40,984	-47,386	81,662	35,353	-2,031	0	0	32	29
2.5	1	13	5	8	101,897	44,113	-47,386	101,897	44,113	-2,031	101,897	44,113	-47,386	88,889	38,481	-2,031	0	0	21	19
-2.5	0	0	0	0	109,123	47,241	-47,386	109,123	47,241	-2,031	109,123	47,241	-47,386	96,115	41,610	-2,031	0	0	0	0
-7.5	-1.5	0	0	0	116,350	50,370	-47,386	116,350	50,370	-2,031	116,350	50,370	-47,386	103,342	44,738	-2,031	0	0	0	0
TOTALS		**8,760**	**3,100**	**5,660**													**11,017**	**9,542**	**2,805**	**2,231**

Existing Building Ventilation & Infiltration (occ)	**579**	**cfm**
Overheat Ventilation Factor	**1.00**	
Additional ventilation to offset overheat	**0**	**cfm**
Existing Building Ventilation & Infiltration (unocc)	**579**	**cfm**

North Brunswick
CHA #20418
Building: Senior Center

ECM-3 Space Temperature 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 for Office Unit	1	ea	$ 100	$ 100	$ -	$ 98	$ 121	$ -	$ 219	
Programmable thermostat for Main Room	1	ea	$ 100	$ 100	$ -	$ 98	$ 121	$ -	$ 219	
Programmable thermostats HHW systems	4	ea	$ 200	$ 150	$ -	$ 784	$ 726	$ -	$ 1,510	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 1,948		Subtotal
$ 97.40	5%	Contingency
$ 204.54	10%	Contractor O&P
$ -	0%	Engineering
$ 2,250		**Total**

HEAT GAIN/LOSS WORKSHEET

Project Name:	North Brunswick	**Project No.:**	CHA #20418		
Location	North Brunswick, NJ	**Site Elevation:**	460 **Feet**	**Specific Volume**	14.00 CF/#
Building Name	Senior Center Rec Room and Kitchen	**Date:**	11/04/09		
Engineer:	G Pfaff				

Building/Facility Designation

Outdoor Winter Design DB Temperature	1	*F	**Indoor Winter Design DB Temperature**	73	*F
Outdoor Summer Design DB Temperature	98	*F	**Indoor Summer Design DB Temperature**	73	*F
Outdoor Summer Design WB Temperature	74	*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	1/2" Gypsum, frame construction, 2" Insulation, 8" LW CMU	6.8	

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	Wood Deck, 4" insulation, Felt & Shingles, 1/2" drywall	16.00	

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

			Frame (multiply by)	
	No Storm	Storm	Metal	Thermal
Flat Glass	1.05	0.50	1.05	0.95
Flat Glass (e=.6)	1.00	0.55	1.05	0.95
Flat Glass (e=0.4)	0.90	0.54	1.05	0.95
Flat Glass (e=0.2)	0.77	0.45	1.05	0.95
Double Glaze (3/16 in air)	0.63	0.38	1.25	1.05
Double Glaze (1/4 in air)	0.60	0.37	1.25	1.05
Double Glaze (1/2 in air)	0.53	0.36	1.25	1.05
Double Glaze (e=.6)	0.50	0.35	1.25	1.05
Double Glaze (e=0.4)	0.42	0.33	1.25	1.05
Double Glaze (e=0.2)	0.35	0.29	1.25	1.05
Triple Glaze (1/4 in air)	0.42	0.30	1.40	1.15
Triple Glaze (1/2 in air)	0.35	0.27	1.40	1.15

BUILDING CHARACTERISTICS

Roof Area	3,100 SF		
Occupied Area	5,200 SF	**Return Plenum?**	n

	Gross Wall Length	Average Wall Height	Ceiling Height	Window Area	Door Area	Net Wall Area	Net Wall Area Below Ceiling
North Exposure	40 Ft	18.0 Ft	12.0 Ft	49 SF	49 SF	622 SF	382 SF
East Exposure	65 Ft	18.0 Ft	12.0 Ft	19 SF	0 SF	1,151 SF	761 SF
South Exposure	40 Ft	18.0 Ft	12.0 Ft	59 SF	0 SF	661 SF	421 SF
West Exposure	65 Ft	18.0 Ft	12.0 Ft	61 SF	74 SF	1,036 SF	646 SF

Forced Ventilation 0 cfm

HEAT GAIN/LOSS WORKSHEET

Project Name:	North Brunswick	**Project No.:**	CHA #20418		
Location	North Brunswick, NJ	**Site Elevation:**	460 Feet	**Specific Volume**	14.00 CF/#
Building Name	Senior Center Rec Room and Kitchen	**Date:**	11/04/09		
Engineer:	G Pfaff				

Building/Facility Designation

COOLING HEAT GAINS TO THE ROOM - SENSIBLE

SOLAR GAINS

WINDOWS	AREA (SF)	SHGF		Shade Coef	Cooling Load Factor		Solar Heat Gain	
North Exposure	49	38	btu/h/sf	0.8	0.75	Glass Type C	1,109 Btu/hr	
East Exposure	19	216	btu/h/sf	0.8	0.31	Glass Type C	1,018 Btu/hr	
South Exposure	59	109	btu/h/sf	0.8	0.58	Glass Type C	3,005 Btu/hr	
West Exposure	61	216	btu/h/sf	0.8	0.29	Glass Type C	3,047 Btu/hr	
								8,179 Btu/h

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain	
North Exposure	382	0.15	20 °F	1.0	1,125 Btu/hr	
East Exposure	761	0.15	39 °F	1.0	4,365 Btu/hr	
South Exposure	421	0.15	27 °F	1.0	1,670 Btu/hr	
West Exposure	646	0.15	22 °F	1.0	2,089 Btu/hr	
Roof	3,100	0.06	73 °F	1.0	14,144 Btu/hr	
Fenestration	188	0.62	25 °F		2,912 Btu/hr	
Doors	123	0.14	27 °F		462 Btu/hr	
Ceiling	5,200	0.14	0 °F		0 Btu/hr	
Partition		0.05	0 °F		0 Btu/hr	
Floor	5,200	0.04	0 °F		0 Btu/hr	
						26,766 Btu/h

INTERNAL HEAT GAINS

								Room Heat Gain	
Lights	1.50	w/sf x	5,200	Occ Area =	7.8	kW x 3.4x	1.0 RAF =	26,621 Btu/h	
Plug Load	0.25	w/sf x	5,200	Occ Area =	1.3	kW x 3.4x	1.0 RAF =	4,437 Btu/h	
People	7	people x	255	btu/person x	25%	time in space =		446 Btu/h	
Computer Work Stations			1	Units x	120	W/Unit x 3414 =		410 Btu/h	
Equipment	1.0	kW x 3.413 =						3,413 Btu/h	
Misc.								0 Btu/h	
									35,327 Btu/h

VENTILATION AND INFILTRATION

		Infiltration Factor		Perimeter Ratio		Coef	Temp. Diff.	Room Heat Gain	
Walls	2,210 SF	0.10	CFM/SF			1.04	25 °F	6,227 Btu/h	
Doors	123 SF	0.40	CFM/LF	0.86	LF/SF	1.04	25 °F	1,184 Btu/h	
Windows	188 SF	0.30	CFM/LF	1.36	LF/SF	1.04	25 °F	2,154 Btu/h	
Ventilation	0 cfm	0				1.04	25 °F	0 Btu/h	
									9,565 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	240	0.15	20	1.0	706 Btu/hr	
East Exposure	390	0.15	39	1.0	2,237 Btu/hr	
South Exposure	240	0.15	27	1.0	953 Btu/hr	
West Exposure	390	0.15	22	1.0	1,262 Btu/hr	
Roof	3,100	0.06	73	0.0	0 Btu/hr	
						Btu/h

INTERNAL HEAT GAINS

							Room Heat Gain	
Lights	1.50	w/sf x	5,200	Occ Area =	7.8	kW x3413x 0.25 RAF =	6,655 Btu/h	
Misc.							0 Btu/h	
								6,655 Btu/h

SENSIBLE HEAT GAINS - TEMP. DEPENDENT	
Solar	8,179
Conduction to Room	26,766
Conduction to Plenum	0
Ventilation and Infiltration	9,565
Sub Total	44,510

SENSIBLE HEAT GAINS - TEMP. INDEPENDENT	
Internal Gains to Room	35,327
Internal Gains to Plenum	6,655
Sub Total	41,982

HEAT GAIN/LOSS WORKSHEET

Project Name:	North Brunswick	**Project No.:**	CHA #20418		
Location	North Brunswick, NJ	**Site Elevation:**	460 **Feet**	**Specific Volume**	14.00 CF/#
Building Name	Senior Center Rec Room and Kitchen	**Date:**	11/04/09		
Engineer:	G Pfaff				

Building/Facility Designation

LATENT COOLING LOADS

Infiltration

		Infiltration Factor	Air Density	Humidity Ratio Dif.	Room Heat Gain
Walls	4,360 SF	0.10 CFM/SF	4,629	0.0042 ##/#	8,562 Btu/h
Doors	123 SF	1.00 CFM/LF	4,629	0.0042 ##/#	2,062 Btu/h
Windows	188 SF	0.50 CFM/LF	4,629	0.0042 ##/#	2,502 Btu/h
Ventilation	0 cfm		4,629	0.0042 ##/#	0 Btu/h
People	7 people	0.25 time in space		250 Btu/hr/person	438 Btu/h
					13,564 Btu/h

Cooling Load Summary

	Sensible	Latent	Total		
Temperature Dependent Gains	44,510	13,564	58,074		
Temperature Indep. Gains	41,982		41,982	SHR=	0.86
Total	86,492	13,564	100,056		

Building Cooling Load 8.3 Tons at 624 SF/Ton

Building Air Flow to Condition Space based on a 12*F Temp Rise is 6,374 CFM / 1.23 CFM/sf

HEATING CALCULATION

CONDUCTION

	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.	Room Heat Gain
North Exposure	622	0.15	72	6,590 Btu/h
East Exposure	1,151	0.15	72	12,187 Btu/h
South Exposure	661	0.15	72	6,994 Btu/h
West Exposure	1,036	0.15	72	10,966 Btu/h
Fenestration	188	0.62	72	8,386 Btu/h
Roof	3,100	0.06	72	13,950 Btu/h
Doors	123	0.14	72	1,232 Btu/h
Ceiling	5,200	0.14	0	0 Btu/h
Partition	0	0.05	0	0 Btu/h
Floor	3,100	0.04	50	6,200 Btu/h

Ventilation and Infiltration

		Infiltration Factor	Coef	Temp. Difference	Air Flow	Room Heat Gain
Walls	3,470 SF	0.10 CFM/SF	1.04	72	347 cfm	26,076 Btu/h
Doors	123 SF	1.00 CFM/LF	1.04	72	105 cfm	7,891 Btu/h
Windows	188 SF	0.50 CFM/LF	1.04	72	127 cfm	9,575 Btu/h
Ventilation Load	0 cfm		1.04	72	0 cfm	0 Btu/h
Total Ventilation & Infiltration Load					579 cfm	43,542 Btu/h

Building Heating Load 110,047 btu/h

21.2 btu/sf

HEAT GAIN/LOSS WORKSHEET

Project Name:	North Brunswick	**Project No.:**	CHA #20418		
Location	North Brunswick, NJ	**Site Elevation:**	460 **Feet**	**Specific Volume**	14.00 CF/#
Building Name	Senior Center Main Meeting Room & Offices	**Date:**	11/04/09		
Engineer:	G Pfaff				

Building/Facility Designation

Outdoor Winter Design DB Temperature	1 *F	**Indoor Winter Design DB Temperature**	73 *F
Outdoor Summer Design DB Temperature	98 *F	**Indoor Summer Design DB Temperature**	73 *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
x	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
	4" wood stud walls w/ R-11 insulation, stuco/vinyl siding, 1/2 drywall	16.2	

Roofs (Select One)		R Value	Roof Type
x	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	

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

			Frame (multiply by)	
	No Storm	Storm	Metal	Thermal
Flat Glass	1.05	0.50	1.05	0.95
Flat Glass (e=.6)	1.00	0.55	1.05	0.95
Flat Glass (e=0.4)	0.90	0.54	1.05	0.95
Flat Glass (e=0.2)	0.77	0.45	1.05	0.95
Double Glaze (3/16 in air)	0.63	0.38	1.25	1.05
Double Glaze (1/4 in air)	0.60	0.37	1.25	1.05
Double Glaze (1/2 in air)	0.53	0.36	1.25	1.05
Double Glaze (e=.6)	0.50	0.35	1.25	1.05
Double Glaze (e=0.4)	0.42	0.33	1.25	1.05
Double Glaze (e=0.2)	0.35	0.29	1.25	1.05
Triple Glaze (1/4 in air)	0.42	0.30	1.40	1.15
Triple Glaze (1/2 in air)	0.35	0.27	1.40	1.15

BUILDING CHARACTERISTICS

Roof Area	7,400 SF		
Occupied Area	7,400 SF	**Return Plenum?**	y

	Gross Wall Length	Average Wall Height	Ceiling Height	Window Area	Door Area	Net Wall Area	Net Wall Area Below Ceiling
North Exposure	70 Ft	11.0 Ft	9.0 Ft	72 SF	74 SF	625 SF	485 SF
East Exposure	80 Ft	11.0 Ft	9.0 Ft	43 SF	74 SF	764 SF	604 SF
South Exposure	135 Ft	11.0 Ft	9.0 Ft	53 SF	0 SF	1,433 SF	1,163 SF
West Exposure	120 Ft	11.0 Ft	9.0 Ft	24 SF	49 SF	1,247 SF	1,007 SF

Forced Ventilation 0 cfm

HEAT GAIN/LOSS WORKSHEET

Project Name:	North Brunswick	**Project No.:**	CHA #20418		
Location	North Brunswick, NJ	**Site Elevation:**	460 Feet	**Specific Volume**	14.00 CF/#
Building Name	Senior Center Main Meeting Room & Offices	**Date:**	11/04/09		
Engineer:	G Pfaff				

Building/Facility Designation

COOLING HEAT GAINS TO THE ROOM - SENSIBLE

SOLAR GAINS

WINDOWS	AREA (SF)	SHGF		Shade Coef	Cooling Load Factor		Solar Heat Gain	
North Exposure	72	38	btu/h/sf	0.8	0.75	Glass Type C	1,640	Btu/hr
East Exposure	43	216	btu/h/sf	0.8	0.31	Glass Type C	2,280	Btu/hr
South Exposure	53	109	btu/h/sf	0.8	0.58	Glass Type C	2,655	Btu/hr
West Exposure	24	216	btu/h/sf	0.8	0.29	Glass Type C	1,203	Btu/hr
								7,778 Btu/h

CONDUCTION

	NET AREA (SF)	U-VALUE	Cooling Load Temp. Dif.	Return Air Factor	Room Heat Gain	
North Exposure	485	0.13	20 °F	1.0	1,250	Btu/hr
East Exposure	604	0.13	39 °F	1.0	3,038	Btu/hr
South Exposure	1,163	0.13	27 °F	1.0	4,049	Btu/hr
West Exposure	1,007	0.13	22 °F	1.0	2,858	Btu/hr
Roof	7,400	0.08	73 °F	1.0	41,554	Btu/hr
Fenestration	191	0.62	25 °F		2,960	Btu/hr
Doors	196	0.14	27 °F		739	Btu/hr
Ceiling	7,400	0.14	0 °F		0	Btu/hr
Partition		0.05	0 °F		0	Btu/hr
Floor	7,400	0.04	0 °F		0	Btu/hr
						56,449 Btu/h

INTERNAL HEAT GAINS

									Room Heat Gain	
Lights	1.50	w/sf x	7,400	Occ Area =	11.1	kW x 3.4x	1.0	RAF =	37,884	Btu/h
Plug Load	0.25	w/sf x	7,400	Occ Area =	1.9	kW x 3.4x	1.0	RAF =	6,314	Btu/h
People	8	people x	255	btu/person x	25%	time in space =			510	Btu/h
Computer Work Stations			8	Units x	120	W/Unit x 3414 =			3,276	Btu/h
Equipment	3.0	kW x 3.413 =							10,239	Btu/h
Misc.									0	Btu/h
										58,224 Btu/h

VENTILATION AND INFILTRATION

		Infiltration Factor		Perimeter Ratio		Coef	Temp. Diff.	Room Heat Gain	
Walls	3,258 SF	0.10	CFM/SF			1.04	25 °F	9,182	Btu/h
Doors	196 SF	0.40	CFM/LF	0.86	LF/SF	1.04	25 °F	1,894	Btu/h
Windows	191 SF	0.30	CFM/LF	1.30	LF/SF	1.04	25 °F	2,100	Btu/h
Ventilation	0 cfm					1.04	25 °F	0	Btu/h
									13,176 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	140	0.13	20	1.0	361	Btu/hr
East Exposure	160	0.13	39	1.0	805	Btu/hr
South Exposure	270	0.13	27	1.0	940	Btu/hr
West Exposure	240	0.13	22	1.0	681	Btu/hr
Roof	7,400	0.08	73	0.0	0	Btu/hr
						Btu/h

INTERNAL HEAT GAINS

Lights	1.50	w/sf x	7,400	Occ Area =	11.1	kW x3413x	0.25	RAF = 9,471 Btu/h
Misc.								0 Btu/h
								9,471 Btu/h

SENSIBLE HEAT GAINS - TEMP. DEPENDENT

Solar	7,778
Conduction to Room	56,449
Conduction to Plenum	0
Ventilation and Infiltration	13,176
Sub Total	77,402

SENSIBLE HEAT GAINS - TEMP. INDEPENDENT

Internal Gains to Room	58,224
Internal Gains to Plenum	9,471
Sub Total	67,695

HEAT GAIN/LOSS WORKSHEET

Project Name:	North Brunswick	**Project No.:**	CHA #20418		
Location	North Brunswick, NJ	**Site Elevation:**	460 **Feet**	**Specific Volume**	14.00 CF/#
Building Name	Senior Center Main Meeting Room & Offices	**Date:**	11/04/09		
Engineer:	G Pfaff				

Building/Facility Designation

LATENT COOLING LOADS

Infiltration

		Infiltration Factor	Air Density	Humidity Ratio Dif.	Room Heat Gain
Walls	8,210 SF	0.10 CFM/SF	4,629	0.0042 ##/#	16,123 Btu/h
Doors	196 SF	1.00 CFM/LF	4,629	0.0042 ##/#	3,299 Btu/h
Windows	191 SF	0.50 CFM/LF	4,629	0.0042 ##/#	2,439 Btu/h
Ventilation	0 cfm		4,629	0.0042 ##/#	0 Btu/h
People	40 people	0.25 time in space		250 Btu/hr/person	2,500 Btu/h
					24,361 Btu/h

Cooling Load Summary

	Sensible	Latent	Total		
Temperature Dependent Gains	77,402	24,361	101,764		
Temperature Indep. Gains	67,695		67,695	SHR=	0.86
Total	145,097	24,361	169,459		

Building Cooling Load 14.1 Tons at 524 SF/Ton

Building Air Flow to Condition Space based on a 12*F Temp Rise is 10,828 CFM / 1.46 CFM/sf

HEATING CALCULATION

CONDUCTION

	NET AREA (SF)	U-VALUE	Heating Load Temp. Dif.	Room Heat Gain
North Exposure	625	0.13	72	5,801 Btu/h
East Exposure	764	0.13	72	7,095 Btu/h
South Exposure	1,433	0.13	72	13,305 Btu/h
West Exposure	1,247	0.13	72	11,582 Btu/h
Fenestration	191	0.62	72	8,525 Btu/h
Roof	7,400	0.08	72	40,985 Btu/h
Doors	196	0.14	72	1,971 Btu/h
Ceiling	7,400	0.14	0	0 Btu/h
Partition	0	0.05	0	0 Btu/h
Floor	7,400	0.04	50	14,800 Btu/h

Ventilation and Infiltration

		Infiltration Factor	Coef	Temp. Difference	Air Flow	Room Heat Gain
Walls	4,068 SF	0.20 CFM/SF	1.04	72	814 cfm	61,146 Btu/h
Doors	196 SF	1.00 CFM/LF	1.04	72	168 cfm	12,626 Btu/h
Windows	191 SF	0.50 CFM/LF	1.04	72	124 cfm	9,334 Btu/h
Ventilation Load	0 cfm		1.04	72	0 cfm	0 Btu/h
Total Ventilation & Infiltration Load					1,106 cfm	83,106 Btu/h

Building Heating Load 187,170 btu/h

25.3 btu/sf

APPENDIX E

ECM-4 Replace Window AC Units with Ductless Split System

North Brunswick

CHA #20418

Building: Senior Center

ECM-4: Replace Window AC units w/ Ductless Splits (Electric Efficiency savings sheet)
(utilize remote outdoor condensers)

ASSUMPTIONS				Comments
Electric Cost		$0.182	/ kWh	
Annual Cooling Hours / Year		1,952	Hours/yr	(Assumed to run when outdoor temp. is 70°F or above)
Avg. BTU / Hr Rating of existing AC unit		10,000	Btu / Hr	(typical size for cooling office spaces in this type of building)
Average EER		9.0		Average per manufacturers nameplate

Item		Value	Units	Comments
Total Number of Units		3		
Existing Annual Electric Usage		6,507	kWh	
Annual Cooling Hours / Year		1,952	Hours	(Assumed to run when outdoor temp. is 70°F or above)
Proposed EER		14.0		New ductless mini-splits (per manufacturer)
Proposed Annual Electric Usage		4,183	kWh	Unit will cycle on w/ temp of room. Possible operating time shown below

ANNUAL SAVINGS			
Annual Savings		2,324	kWh
Annual Cost Savings		$424	

Set Point	70	deg F

OAT - DB Bin Temp F	Hrs of Occurrence Annually	Cooling Hrs at Temp Above set point	Assumed % of time of operation	Assumed hrs of Operation
102.5	0	0	100%	0
97.5	3	3	100%	3
92.5	34	34	100%	34
87.5	131	131	100%	131
82.5	500	500	100%	500
77.5	620	620	100%	620
72.5	664	664	100%	664
67.5	854	0	25%	0
62.5	927	0	13%	0
57.5	600	0	0%	0
52.5	610	0	0%	0
47.5	611	0	0%	0
42.5	656	0	0%	0
37.5	1,023	0	0%	0
32.5	734	0	0%	0
27.5	334	0	0%	0
22.5	252	0	0%	0
17.5	125	0	0%	0
12.5	47	0	0%	0
7.5	22	0	0%	0
2.5	13	0	0%	0
-2.5	0	0	0%	0
Total	8,760	1,952	100%	1952

North Brunswick
CHA #20418
Building: Senior Center

ECM-4: Replace Window AC units w/ Ductless Splits (Electric Efficiency savings sheet)

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.		
						$ -	$ -	$ -	$ -	
Window AC Unit Removal	3	LS	$ 50	$ 50		$ 147	$ 182	$ -	$ 329	
						$ -	$ -	$ -	$ -	
12,000 BTUH split system	3	LS	$ 1,450	$ 500		$ 4,263	$ 1,815	$ -	$ 6,078	Includes Labor
Line set, wiring, hardware	3	LS	$ 300	$ 200		$ 882	$ 726	$ -	$ 1,608	Includes Labor & Piping kit
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 8,015	Subtotal
$ 801	10% Contingency
$ 882	10% Contractor O&P
$ -	0% Engineering
$ 9,698	**Total**

New Jersey Smart Start Incentive	QTY	UNIT	$ / UNIT	TOTAL SAVINGS	Cost W/O INCENTIVE	Cost W/ INCENTIVE
					$ -	$ -
Unitary Split System < 5.4 tons	3	Tons	$92	$276	$ 7,686	$ 7,410
					$ -	$ -
				$276	$7,686	$7,410

Total ECM Cost w/ Incentives	**$9,422**

APPENDIX F

ECM-5 Retrofit Lighting Fixtures

Energy Audit of North Brunswick Township
CHA Project No. 20418
ECM-5 Lighting Retrofits

Supply Cost of Electricity: **$0.125 $/kWh**
Demand: **$13.00 $/kW**

		EXISTING CONDITIONS								RETROFIT CONDITIONS								COST & SAVINGS ANALYSIS					
	Area Description	No. of Fixtures	Standard Fixture Code	NYSERDA Fixture Code	Watts per Fixture	kW/Space	Exist Control	Annual Hours	Annual kWh	Number of Fixtures	Standard Fixture Code	Fixture Code	Watts per Fixture	kW/Space	Exist Control	Annual Hours	Annual kWh	Annual kWh Saved	Annual $ Saved	Retrofit Cost	NJ Lighting Incentive	Simple Payback With Out Incentive
Field Code	Unique description of the location - Room number/Room name: Floor number (if applicable)	No. of fixtures before the retrofit	"Lighting Fixture Code" Example 2T 40 R F(U) = 2'x2' Troff 40 w Recess. Floor 2 lamps U shape	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Watts/Fixt) * (Fixt No.)	Pre-inst. control device	Estimated daily hours for the usage group	(kW/space) * (Annual Hours)	No. of fixtures after the retrofit	"Lighting Fixture Code" Example 2T 40 R F(U) = 2'x2' Troff 40 w Recess. Floor 2 lamps U shape	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Watts/Fixt) * (Number of Fixtures)	Retrofit control device	Estimated annual hours for the usage group	(kW/space) * (Annual Hours)	(Original Annual kWh) - (Retrofit Annual kWh)	(kWh Saved) * ($/kWh) + (kW Saved) * 12 * ($/kW)	Cost for renovations to lighting system	Prescriptive Lighting Measures	Length of time for renovations cost to be recovered
	Main Meeting Room Area																						
185	Meeting Room (South Section)	16	DC 40 W F 4	F44SE	172	2.8	SW	2750	7,568	16	DC 28 W F 4	F44SSILL	96	1.5	SW	2,750	4,224	3,344	$ 607.70	$ 2,268.00	$320	3.7
185	Meeting Room (North Section)	16	DC 40 W F 4	F44SE	172	2.8	SW	2750	7,568	16	DC 28 W F 4	F44SSILL	96	1.5	SW	2,750	4,224	3,344	$ 607.70	$ 2,268.00	$320	3.7
168	Activity Room Section	15	W 40 C F 2 (MAG)	F42SS	94	1.4	SW	2750	3,878	15	W 28 C F 2	F42SSILL	48	0.7	SW	2,750	1,980	1,898	$ 344.83	$ 1,518.75	$150	4.4
109	Speaker Platform	4	SP I 150	I150/1	150	0.6	SW	2750	1,650	4	CF 26	CFQ26/1-L	27	0.1	SW	2,750	297	1,353	$ 245.88	$ 81.00	$0	0.3
	Older Section																						
168	Kitchen	9	W 40 C F 2 (MAG)	F42SS	94	0.8	SW	2000	1,692	9	W 28 C F 2	F42SSILL	48	0.4	SW	2,000	864	828	$ 168.08	$ 911.25	$90	5.4
78	Electrical Room	2	EP I 100	I100/1	100	0.2	SW	2250	450	2	CF 26	CFQ26/1-L	27	0.1	SW	2,250	122	329	$ 63.84	$ 40.50	$0	0.6
114	Storage room	2	G 65 C I 1	I65/1	65	0.1	SW	2250	293	2	CF 26	CFQ26/1-L	27	0.1	SW	2,250	122	171	$ 33.23	$ 40.50	$0	1.2
129	Mens Bathroom	2	SP 75 I	I75/1	75	0.2	SW	2750	413	2	CF 26	CFQ26/1-L	27	0.1	SW	2,750	149	264	$ 47.98	$ 40.50	$0	0.8
129	Womens Bathroom	2	SP 75 I	I75/1	75	0.2	SW	2750	413	2	CF 26	CFQ26/1-L	27	0.1	SW	2,750	149	264	$ 47.98	$ 40.50	$0	0.8
168	Pool Room	6	W 40 C F 2 (MAG)	F42SS	94	0.6	SW	2250	1,269	6	W 28 C F 2	F42SSILL	48	0.3	SW	2,250	648	621	$ 120.68	$ 607.50	$60	5.0
129	Pool Room	1	SP 75 I	I75/1	75	0.1	SW	2250	169	1	CF 26	CFQ26/1-L	27	0.0	SW	2,250	61	108	$ 20.99	$ 20.25	$0	1.0
184	Upstairs Class Room	2	8' 40 W F 4	F44SE	172	0.3	OCC	1500	516	2	8' 28 W F 4	F44SSILL	96	0.2	OCC	1,500	288	228	$ 52.21	$ 283.50	$40	5.4
	Atrium																						
33	Atrium	7	13 W CF 1	CFQ13/1-L	15	0.1	SW	2250	236	7	13 W CF 1	CFQ13/1-L	15	0.1	SW	2,250	236	-	$ -	$ -	$0	
	Main Lobby / Office Area																						
114	Lobby/Sitting Room	6	G 65 C I 1	I65/1	65	0.4	SW	2750	1,073	6	CF 26	CFQ26/1-L	27	0.2	SW	2,750	446	627	$ 113.94	$ 121.50	$0	1.1
73	Lobby/Sitting Room	6	I 120	I120/1	120	0.7	SW	2750	1,980	6	CF 26	CFQ26/1-L	27	0.2	SW	2,750	446	1,535	$ 278.86	$ 121.50	$0	0.4
33	Lobby/Sitting Room	6	13 W CF 1	CFQ13/1-L	15	0.1	SW	2750	248	6	13 W CF 1	CFQ13/1-L	15	0.1	SW	2,750	248	-	$ -	$ -	$0	
168	Mens Bathroom	2	W 40 C F 2 (MAG)	F42SS	94	0.2	SW	2750	517	2	W 28 C F 2	F42SSILL	48	0.1	SW	2,750	264	253	$ 45.98	$ 202.50	$20	4.4
168	Womens Bathroom	3	W 40 C F 2 (MAG)	F42SS	94	0.3	SW	2250	776	3	W 28 C F 2	F42SSILL	48	0.1	SW	2,750	396	380	$ 68.97	$ 303.75	$30	4.4
185	Offices	4	DC 40 W F 4	F44SE	172	0.7	SW	2250	1,548	4	DC 28 W F 4	F44SSILL	96	0.4	SW	2,250	864	684	$ 132.92	$ 567.00	$80	4.3
168	Storage room	4	W 40 C F 2 (MAG)	F42SS	94	0.4	SW	2250	846	4	W 28 C F 2	F42SSILL	48	0.2	SW	2,250	432	414	$ 80.45	$ 405.00	$40	5.0
185	Activity Room 107	6	DC 40 W F 4	F44SE	172	1.0	SW	2250	2,322	6	DC 28 W F 4	F44SSILL	96	0.6	SW	2,250	1,296	1,026	$ 199.39	$ 850.50	$120	4.3
185	Staff Office 104	2	DC 40 W F 4	F44SE	172	1.0	SW	2250	2,322	6	DC 28 W F 4	F44SSILL	96	0.6	SW	2,250	1,296	1,026	$ 199.39	$ 850.50	$40	4.3
	Total	**123**				**14.9**			**37,744**	**127**				**7.5**			**19,049**	**18,695**	**$3,481**	**$11,543**	**$1,310**	
																	Demand Savings		**7.3**	**$1,144**		
																	kWh Savings		**18,695**	**$2,337**		
																	Total savings			**$3,481**		**3.32**

APPENDIX G

ECM-6 Install Occupancy Sensors for Interior Lighting

Energy Audit of North Brunswick Township

CHA Project No. 20418

Supply Cost: **$0.125 $/kWh**

ECM-6 Install Occupancy Sensors

Demand: **$13.00 $/kW**

									RETROFIT CONDITIONS								COST & SAVINGS ANALYSIS				
	Area Description	**No. of Fixtures**	**Standard Fixture Code**	**NYSERDA Fixture Code**	**Watts per Fixture**	**kW/Space**	**Exist Control**	**Annual Hours**	**Annual kWh**	**Number of Fixtures**	**Standard Fixture Code**	**Fixture Code**	**Watts per Fixture**	**kW/Space**	**Retrofit Control**	**Annual Hours**	**Annual kWh**	**Annual kWh Saved**	**Annual $ Saved**	**Retrofit Cost**	**NJ Lighting Incentive**	**Simple Payback With Out Incentive**
Field Code	Unique description of the location - Room number/Room name: Floor number (if applicable)	No. of fixtures before the retrofit	"Lighting Fixture Code" Example 2T 40 R F(U) = 2'x2' Troff 40 w Recess. Floor 2 lamps U shape	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Watts/Fixt) * (Fixt No.)	Pre-inst. control device	Estimated annual hours for the usage group	(kW/space) * (Annual Hours)	No. of fixtures after the retrofit	"Lighting Fixture Code" Example 2T 40 R F(U) = 2'x2' Troff 40 w Recess. Floor 2 lamps U shape	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Watts/Fixt) * (Number of Fixtures)	Retrofit control device	Estimated annual hours for the usage group	(kW/space) * (Annual Hours)	(Original Annual kWh) - (Retrofit Annual kWh)	($/kWh) * (kW Saved)	Cost for renovations to lighting system		Length of time for renovations cost to be recovered
	Main Meeting Room Area																					
185	Meeting Room (South Section)	16	DC 40 W F 4	F44SE	172	2.8	SW	2750	7,568.0	16	DC 40 W F 4	F44SE	172	2.8	OCC	2063	5,676.0	1,892.0	$236.50	$118.75	$20.00	0.5
185	Meeting Room (North Section)	16	DC 40 W F 4	F44SE	172	2.8	SW	2750	7,568.0	16	DC 40 W F 4	F44SE	172	2.8	OCC	2063	5,676.0	1,892.0	$236.50	$118.75	$20.00	0.5
168	Activity Room Section	15	W 40 C F 2 (MAG)	F42SS	94	1.4	SW	2750	3,877.5	15	W 40 C F 2 (MAG)	F42SS	94	1.4	OCC	2063	2,908.1	969.4	$121.17	$118.75	$20.00	1.0
109	Speaker Platform	4	SP I 150	I150/1	150	0.6	SW	2750	1,650.0	4	SP I 150	I150/1	150	0.6	OCC	2063	1,237.5	412.5	$51.56	$118.75	$20.00	2.3
	Older Section																					
168	Kitchen	9	W 40 C F 2 (MAG)	F42SS	94	0.8	SW	2000	1,692.0	9	W 40 C F 2 (MAG)	F42SS	94	0.8	OCC	1500	1,269.0	423.0	$52.88	$118.75	$20.00	2.2
78	Electrical Room	2	EP I 100	I100/1	100	0.2	SW	2250	450.0	2	EP I 100	I100/1	100	0.2	OCC	1688	337.5	112.5	$14.06	$118.75	$20.00	8.4
114	Storage room	2	G 65 C I 1	I65/1	65	0.1	SW	2250	292.5	2	G 65 C I 1	I65/1	65	0.1	OCC	1688	219.4	73.1	$9.14	$118.75	$20.00	13.0
129	Mens Bathroom	2	SP 75 I	I75/1	75	0.2	SW	2750	412.5	2	SP 75 I	I75/1	75	0.2	OCC	1100	165.0	247.5	$30.94	$118.75	$20.00	3.8
129	Womens Bathroom	2	SP 75 I	I75/1	75	0.2	SW	2750	412.5	2	SP 75 I	I75/1	75	0.2	OCC	1100	165.0	247.5	$30.94	$118.75	$20.00	3.8
168	Pool Room	6	W 40 C F 2 (MAG)	F42SS	94	0.6	SW	2250	1,269.0	6	W 40 C F 2 (MAG)	F42SS	94	0.6	OCC	1688	951.8	317.3	$39.66	$237.50	$20.00	6.0
129	Pool Room	1	SP 75 I	I75/1	75	0.1	SW	2250	168.8	1	SP 75 I	I75/1	75	0.1	OCC	1688	126.6	42.2	$5.27	$25.00	$20.00	4.7
184	Upstairs Class Room	2	8' 40 W F 4	F44SE	172	0.3	OCC	1500	516.0	2	8' 40 W F 4	F44SE	172	0.3	OCC	1125	387.0	129.0	$16.13	$118.75	$20.00	7.4
	Atrium																					
33	Atrium	7	13 W CF 1	CFQ13/1-L	15	0.1	SW	2750	236.3	7	13 W CF 1	CFQ13/1-L	15	0.1	OCC	1913	200.8	35.4	$4.43	$118.75	$20.00	26.8
	Main Lobby / Office Area						SW	2750							OCC	2475						
114	Lobby/Sitting Room	6	G 65 C I 1	I65/1	65	0.4	SW	2750	1,072.5	6	G 65 C I 1	I65/1	65	0.4	OCC	2475	965.3	107.3	$13.41	$118.75	$20.00	8.9
73	Lobby/Sitting Room	6	I 120	I120/1	120	0.7	SW	2750	1,980.0	6	I 120	I120/1	120	0.7	OCC	2475	1,782.0	198.0	$24.75	$237.50	$20.00	9.6
33	Lobby/Sitting Room	6	13 W CF 1	CFQ13/1-L	15	0.1	SW	2750	247.5	6	13 W CF 1	CFQ13/1-L	15	0.1	OCC	2475	222.8	24.8	$3.09			0.0
168	Mens Bathroom	2	W 40 C F 2 (MAG)	F42SS	94	0.2	SW	2750	517.0	2	W 40 C F 2 (MAG)	F42SS	94	0.2	OCC	1100	206.8	310.2	$38.78	$237.50	$20.00	6.1
168	Womens Bathroom	3	W 40 C F 2 (MAG)	F42SS	94	0.3	SW	2750	775.5	3	W 40 C F 2 (MAG)	F42SS	94	0.3	OCC	1100	310.2	465.3	$58.16	$237.50	$20.00	4.1
185	Offices	4	DC 40 W F 4	F44SE	172	0.7	SW	2250	1,548.0	4	DC 40 W F 4	F44SE	172	0.7	OCC	1913	1,315.8	232.2	$29.03	$237.50	$20.00	8.2
168	Storage room	4	W 40 C F 2 (MAG)	F42SS	94	0.4	SW	2250	846.0	4	W 40 C F 2 (MAG)	F42SS	94	0.4	OCC	1688	634.5	211.5	$26.44	$237.50	$20.00	9.0
185	Activity Room 107	6	DC 40 W F 4	F44SE	172	1.0	SW	2250	2,322.0	6	DC 40 W F 4	F44SE	172	1.0	OCC	1913	1,973.7	348.3	$43.54	$237.50	$20.00	5.5
185	Staff Office 104	2	DC 40 W F 4	F44SE	172	1.0	SW	2250	2,322.0	6	DC 40 W F 4	F44SE	172	1.0	OCC	1913	1,973.7	348.3	$43.54	$118.75	$20.00	2.7
	Total	**123**				**14.9**			**37,744**	**127**				**14.9**				**28,704**	**9,039**	**$1,130**	**$3,231**	**$420**	
																		Demand Savings		**0.0**	**$0**		
																		kWh Savings		**9,039**	**$1,130**		
																		Total Savings			**$1,130**		**2.9**

APPENDIX H

ECM-7 Lighting Retrofit with Occupancy Sensors

Energy Audit of North Brunswick Township

CHA Project No. 20418

ECM-7 Lighting Retrofits with Occupancy Sensors

Supply Cost of Electricity: **$0.125 $/kWh**

Demand: **$13.00 $/kW**

		EXISTING CONDITIONS							RETROFIT CONDITIONS								COST & SAVINGS ANALYSIS				
	Area Description	**No. of Fixtures**	**Standard Fixture Code**	**NYSERDA Fixture Code**	**Watts per Fixture**	**kW/Space**	**Exist Control**	**Annual Hours**	**Annual kWh**	**No. of Fixtures**	**Standard Fixture Code**	**Fixture Code**	**Watts per Fixture**	**kW/Space**	**Retrofit Control**	**Annual Hours**	**Annual kWh**	**Annual kWh Saved**	**Annual $ Saved**	**Retrofit Cost**	**NJ Lighting Incentive**	**Simple Payback With Out Incentive**
Field Code	Unique description of the location - Room number/Room name: Floor number (if applicable)	No. of fixtures before the retrofit	"Lighting Fixture Code" Example 2T 40 R F(U) = 2'x2' Troff 40 w Recess. Floor 2 lamps U shape	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Watts/Fixt) * (Fixt No.)	Pre-inst. control device	Estimated annual hours for the usage group	(kW/space) * (Annual Hours)	No. of fixtures after the retrofit	"Lighting Fixture Code" Example 2T 40 R F(U) = 2'x2' Troff 40 w Recess. Floor 2 lamps U shape	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Watts/Fixt) * (Number of Fixtures)	Retrofit control device	Estimated annual hours for the usage group	(kW/space) * (Annual Hours)	(Original Annual kWh) - (Retrofit Annual kWh)	(kWh Saved) * ($/kWh) + (kW Saved) * 12 * ($/kW)	Cost for renovations to lighting system		Length of time for renovations cost to be recovered
	Main Meeting Room Area																						
185	Meeting Room (South Section)	16	DC 40 W F 4	F44SE	172	2.752	SW	2750	7,568	16	DC 28 W F 4	F44SSILL	96	1.536	OCC	2,063	3,168	4,400	$ 739.70	$ 2,386.75	$ 340	3.2
185	Meeting Room (North Section)	16	DC 40 W F 4	F44SE	172	2.752	SW	2750	7,568	16	DC 28 W F 4	F44SSILL	96	1.536	OCC	2,063	3,168	4,400	$ 739.70	$ 2,386.75	$ 340	3.2
168	Activity Room Section	15	W 40 C F 2 (MAG)	F42SS	94	1.41	SW	2750	3,878	15	W 28 C F 2	F42SSILL	48	0.72	OCC	2,063	1,485	2,393	$ 406.70	$ 1,637.50	$ 170	4.0
109	Speaker Platform	4	SP I 150	I150/1	150	0.6	SW	2750	1,650	4	CF 26	CFQ26/1-L	27	0.108	OCC	2,063	223	1,427	$ 255.16	$ 199.75	$ 20	0.8
	Older Section																						
168	Kitchen	9	W 40 C F 2 (MAG)	F42SS	94	0.846	SW	2000	1,692	9	W 28 C F 2	F42SSILL	48	0.432	OCC	1,500	648	1,044	$ 195.08	$ 1,030.00	$ 110	5.3
78	Electrical Room	2	EP I 100	I100/1	100	0.2	SW	2250	450	2	CF 26	CFQ26/1-L	27	0.054	OCC	1,688	91	359	$ 67.64	$ 159.25	$ 20	2.4
114	Storage room	2	G 65 C I 1	I65/1	65	0.13	SW	2250	293	2	CF 26	CFQ26/1-L	27	0.054	OCC	1,688	91	201	$ 37.03	$ 159.25	$ 20	4.3
129	Mens Bathroom	2	SP 75 I	I75/1	75	0.15	SW	2750	413	2	CF 26	CFQ26/1-L	27	0.054	OCC	1,100	59	353	$ 59.11	$ 159.25	$ 20	2.7
129	Womens Bathroom	2	SP 75 I	I75/1	75	0.15	SW	2750	413	2	CF 26	CFQ26/1-L	27	0.054	OCC	1,100	59	353	$ 59.11	$ 159.25	$ 20	2.7
168	Pool Room	6	W 40 C F 2 (MAG)	F42SS	94	0.564	SW	2250	1,269	6	W 28 C F 2	F42SSILL	48	0.288	OCC	1,688	486	783	$ 140.93	$ 845.00	$ 80	6.0
129	Pool Room	1	SP 75 I	I75/1	75	0.075	SW	2250	169	1	CF 26	CFQ26/1-L	27	0.027	OCC	1,688	46	123	$ 22.89	$ 45.25	$ 20	2.0
184	Upstairs Class Room	2	8' 40 W F 4	F44SE	172	0.344	OCC	1500	516	2	8' 28 W F 4	F44SSILL	96	0.192	OCC	1,125	216	300	$ 61.21	$ 402.25	$ 60	6.6
	Atrium																						
33	Atrium	7	13 W CF 1	CFQ13/1-L	15	0.105	SW	2250	236	7	13 W CF 1	CFQ13/1-L	15	0.105	OCC	1,913	201	35	$ 4.43	$ 118.75	$ 20	26.8
	Main Lobby / Office Area						SW	2750							OCC	2,475							
114	Lobby/Sitting Room	6	G 65 C I 1	I65/1	65	0.39	SW	2750	1,073	6	CF 26	CFQ26/1-L	27	0.162	OCC	2,475	401	672	$ 119.51	$ 240.25	$ 20	2.0
73	Lobby/Sitting Room	6	I 120	I120/1	120	0.72	SW	2750	1,980	6	CF 26	CFQ26/1-L	27	0.162	OCC	2,475	401	1,579	$ 284.43	$ 359.00	$ 20	1.3
33	Lobby/Sitting Room	6	13 W CF 1	CFQ13/1-L	15	0.09	SW	2750	248	6	13 W CF 1	CFQ13/1-L	15	0.09	OCC	2,475	223	25	$ 3.09	$ -	$ -	0.0
168	Mens Bathroom	2	W 40 C F 2 (MAG)	F42SS	94	0.188	SW	2750	517	2	W 28 C F 2	F42SSILL	48	0.096	OCC	1,100	106	411	$ 65.78	$ 440.00	$ 40	6.7
168	Womens Bathroom	3	W 40 C F 2 (MAG)	F42SS	94	0.282	SW	2750	776	3	W 28 C F 2	F42SSILL	48	0.144	OCC	1,100	158	617	$ 98.67	$ 541.25	$ 50	5.5
185	Offices	4	DC 40 W F 4	F44SE	172	0.688	SW	2250	1,548	4	DC 28 W F 4	F44SSILL	96	0.384	OCC	1,913	734	814	$ 149.12	$ 804.50	$ 100	5.4
168	Storage room	4	W 40 C F 2 (MAG)	F42SS	94	0.376	SW	2250	846	4	W 28 C F 2	F42SSILL	48	0.192	OCC	1,688	324	522	$ 93.95	$ 642.50	$ 60	6.8
185	Activity Room 107	6	DC 40 W F 4	F44SE	172	1.032	SW	2250	2,322	6	DC 28 W F 4	F44SSILL	96	0.576	OCC	1,913	1,102	1,220	$ 223.69	$ 1,088.00	$ 140	4.9
185	Staff Office 104	2	DC 40 W F 4	F44SE	172	1.032	SW	2250	2,322	6	DC 28 W F 4	F44SSILL	96	0.576	OCC	1,913	1,102	1,220	$ 223.69	$ 969.25	$ 60	4.3
	Total	**123**				**14.9**			**37,744**	**127.0**				**7.5**			**14,491**		**$4,051**	**$14,774**	**$1,730**	
																		Demand Savings		**7.3**	**$1,144**		
																		kWh Savings		**23,252**	**$2,907**		
																		Total Savings			**$4,051**		**3.6**

APPENDIX I

ECM-8 Replace DHW Heater with Instantaneous Style

North Brunswick
CHA #20418
Building: Senior Center

ECM-8: Replace Electric DHW Heater w/ Instantaneous Condensing Gas-Fired DHW Heater

Summary

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

Item	Value	Units	Formula/Comments
Occupied days per week	5	days/wk	
Water supply Temperature	50	°F	Temperature of water coming into building
Hot Water Temperature	130	°F	
Hot Water Usage per day	77	gal/day	Calculated from usage below
Annual Hot Water Energy Demand	13,330	MBTU/yr	Energy required to heat annual quantity of hot
Existing Tank Size	40	Gallons	Per manufacturer nameplate
Hot Water Temperature	130	°F	Per building personnel
Average Room Temperature	70	°F	
Standby Losses (% by Volume)	2.5%		(2.5% of stored capacity per hour, per U.S.
Standby Losses (Heat Loss)	0.5	MBH	
Annual Standby Hot Water Load	4,380	MBTU/yr	
Total Annual Hot Water Demand (w/ standb	17,710	Mbtu/yr	Building demand plus standby losses
Existing Water Heater Efficiency	93%		Per Manufacturer
Total Annual Energy Required	19,044	Mbtu/yr	
Total Annual Electric Required	5,580	kWh/yr	Existing electricity required to meet hot water
New Tank Size	0	Gallons	Based on Takagi Flash T-H1 instantaneous,
Hot Water Temperature	130	°F	
Average Room Temperature	70	°F	
Standby Losses (% by Volume)	2.5%		(2.5% of stored capacity per hour, per U.S.
Standby Losses (Heat Loss)	0.0	MBH	
Annual Standby Hot Water Load	0	MBTU/yr	
Prop Annual Hot Water Demand (w/ standb	13,330	MBTU/yr	
Proposed Avg. Hot water heater efficiency	92%		Based on Takagi Flash T-H1 instantaneous,
Proposed Total Annual Energy Required	14,537	MBTU/yr	
Proposed Fuel Use	145	Therms/yr	Standby Losses and inefficient DHW heater
Elec Utility Unit Cost	$0.18	$/kWh	
NG Utility Unit Cost	$1.46	$/Therm	
Existing Operating Cost of DHW	$1,018	$/yr	
Proposed Operating Cost of DHW	$212	$/yr	
Annual Utility Cost Savings	**$805**	**$/yr**	

Daily Hot Water Demand

			#USES PER DAY		FULL TIME				
FIXTURE	BASE WATER USE GPM	DURATION OF USE (MIN)	MALE	FEMALE	MALE	FEMALE	TOTAL GAL/DAY	% HOT WATER	TOTAL HW GAL/DAY
LAVATORY	2.5	0.25	3	3	5	20	47	50%	23
KITCHEN SINK	2.5	2	1	1	1	1	10	75%	8
DISHWASHER	3.5	11	1		1		39	100%	39
MOP SINK	2.5	2	1	1	1	1	10	75%	8
						TOTAL	105		77

North Brunswick
CHA #20418
Building: Senior Center

ECM-8: Replace Electric DHW Heater w/ Instantaneous Condensing Gas-Fired DHW Heater

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
						$ -	$ -	$ -	$ -	
Electric DHW Heater Removal	1	LS		$ 50		$ -	$ 61	$ -	$ 61	
						$ -	$ -	$ -	$ -	
Instantaneous Gas-Fired DHW Heater	1	EA	$ 1,600	$ 280		$ 1,568	$ 339	$ -	$ 1,907	
Miscellaneous Electrical	1	LS	$ 500			$ 490	$ -	$ -	$ 490	
Venting Kit	1	EA	$ 450	$ 650		$ 441	$ 787	$ -	$ 1,228	
Miscellaneous Piping and Valves	1	LS	$ 500	$ 500		$ 490	$ 605	$ -	$ 1,095	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	
						$ -	$ -	$ -	$ -	

$ 4,780	Subtotal
$ 717	15% Contingency
$ 825	Contractor 15% O&P
$ -	0% Engineering
$ 6,321	**Total**

APPENDIX J

New Jersey Pay For Performance Incentive Program

North Brunswick
CHA #20418
Building: Senior Center

New Jersey Pay For Performance Incentive Program

Note: The following calculation is based on the New Jersey Pay For Performance Incentive Program per September, 2009.
The values represented below are only applicable through December 31, 2009.

	Annual Utilities	
	kWh	Therms
Existing Usage	79,260	5,796
Proposed Savings *	32,746	1,580
Existing Total MMBtus	850	
Proposed Savings MMBtus	270	
% Reduction	31.7%	
Proposed Annual Savings	$8,089	

	≥%15 - < 20%	
	$/kWh	$/therm
Incentive #2	$0.11	$1.10
Incentive #3	$0.07	$0.70

	≥20%	
	$/kWh	$/therm
Incentive #2	$0.22	$2.20
Incentive #3	$0.14	$1.40

	Incentives $		
	Elec	Gas	Total
Incentive #2	$7,204	$3,475	$10,679
Incentive #3	$4,584	$2,211	$6,796
Totals	**$11,789**	**$5,687**	**$17,475**

Total Project Cost	$39,590
% Incentives of Project Cost**	44.1%
Project Cost w/ Incentives*	$22,115

Project Payback (years)	
w/o Incentives	w/ Incentives
4.9	2.7

* ECM-5 and ECM-6 not included.

** Maximum allowable incentive is 80% of total project cost, or
$2 million per gas account and $2 million per electric account

APPENDIX K

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:	20.0 kW
DC to AC Derate Factor:	0.770
AC Rating:	15.4 kW
Array Type:	Fixed Tilt
Array Tilt:	40.7°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	18.2 ¢/kWh

Results			
Month	Solar Radiation ($kWh/m^2/day$)	AC Energy (kWh)	Energy Value ($)
1	3.36	1656	301.39
2	4.05	1788	325.42
3	4.58	2169	394.76
4	4.84	2119	385.66
5	5.30	2335	424.97
6	5.33	2202	400.76
7	5.27	2224	404.77
8	5.25	2201	400.58
9	5.06	2135	388.57
10	4.46	2011	366.00
11	3.15	1435	261.17
12	2.87	1384	251.89
Year	4.46	23660	4306.12

Output Hourly Performance Data

About the Hourly Performance Data

*

Output Results as Text

Saving Text from a Browser

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

Please send questions and comments regarding PVWATTS to Webmaster

Disclaimer and copyright notice

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

Cautions for Interpreting the Results

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

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

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

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

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

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

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

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

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

Township of North Brunswick
Senior Center
15 Linwood Place
North Brunswick, NJ 08902

APPENDIX L

Solar Thermal Domestic Hot Water Plant

Home

What Can I Do?

Electric Choice

Home Energy

FAQs

LEARN
Fact Sheets
Lesson Plans

PLAY
Calculators

NETWORK
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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)	40	? Ambient Temperature (Degrees F)	70
? Surface Area (calculated - sq ft)	17.79	? Hot Water Temperature (Degrees F)	130
? Effective R-value	7	? Hot Water Usage (Gallons per Day)	77
Energy Use			
1976		? Heat Delivered in Hot Water (BTU/hr)	
152.5		? Heat loss through insulation (BTU/hr)	

Gas vs. Electric Water Heating		
Gas		**Electric**
0.8009	? Overall Efficiency	0.9098
0.8627	? Conversion Efficiency	0.98
2467 BTU/hr	? Power Into Water Heater	2172 BTU/hr
Cost		
$ 1.46 /Therm	? Utility Rates	$ 0.18 /kWh
$ 315.519	? Yearly Water Heating Cost	$ 1003.04
How Does Solar Compare?		
? Solar Water Heater Cost: $ 37704		? Percentage Solar: 70
170.7111 years for gas	? Payback Time for Solar System	53.6995 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

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NJBPU Energy Audits
CHA #20418
Building: North Brunswick Senior Center

Multipliers	
Material:	0.98
Labor:	1.21
Equipment:	1.09

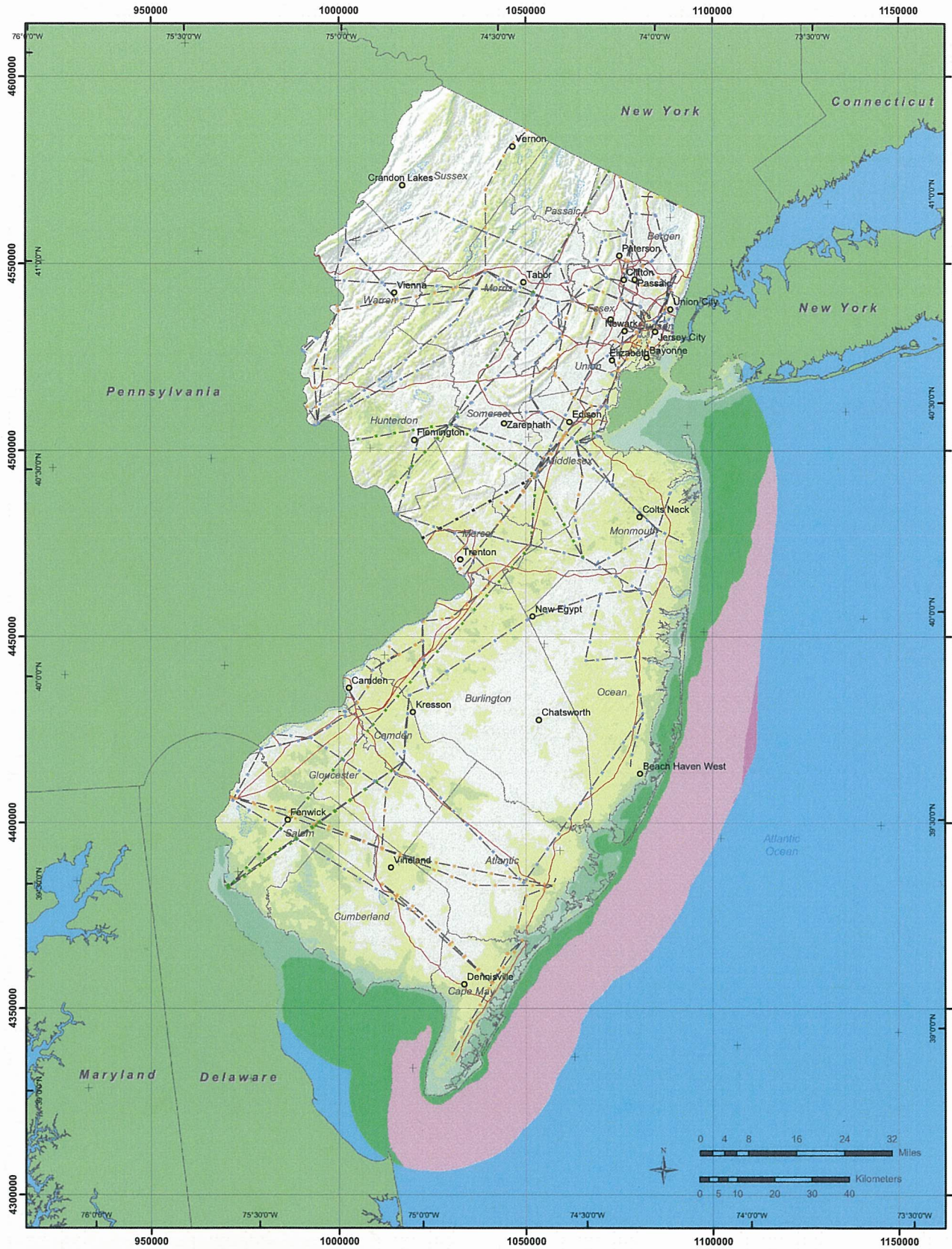
Description	QTY	UNIT	UNIT COSTS			SUBTOTAL COSTS			TOTAL COST	REMARKS
			MAT.	LABOR	EQUIP.	MAT.	LABOR	EQUIP.		
Synergy Solar Thermal System	4	ea				$ -	$ -	$ 3,600	$ 14,400	
Piping modifications	1	ls	$ 2,000	$ 3,500		$ 1,960	$ 4,235	$ -	$ 6,195	
Electrical modifications	1	ls	$ 1,500	$ 1,500		$ 1,470	$ 1,815	$ -	$ 3,285	
65 GallonStorage Tanks	2	ea	$ 200	$ 250		$ 400	$ 500	$ -	$ 900	
10 Gallon Drip Tank	2	ea	$ 100	$ 78		$ 200	$ 156	$ -	$ 356	
						$ -	$ -	$ -	$ -	

$ 25,136	Subtotal
$ 3,770	15% Contingency
$ 3,770	15% Contractor O&P
$ 5,027	20% Engineering
$ 37,704	**Total**

APPENDIX M

Wind

Township of North Brunswick
Senior Center
15 Linwood Place
North Brunswick, NJ 08902



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

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

AWS Truewind

Projection: Tranverse Mercator,
UTM Zone 17 WGS84
Spatial Resolution of Wind Resource Data: 200m
This map was created by AWS Truewind using the MesoMap system and historical weather data. Although it is believed to represent an accurate overall picture of the wind energy resource, estimates at any location should be confirmed by measurement.
The transmission line information was obtained by AWS Truewind from the Global Energy Decisions Velocity Suite. AWS does not warrant the accuracy of the transmission line information.

APPENDIX N

EPA Portfolio Manager

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
North Brunswick Senior Center

Building ID: 1932163
For 12-month Period Ending: December 31, 2008[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: November 11, 2009

Facility
North Brunswick Senior Center
15 Linwood Place
North Brunswick, NJ 08902

Facility Owner
Township of North Brunswick
710 Herman Road
North Brunswick, NJ 08902

Primary Contact for this Facility
Jessica Zink
15 Linwood Place
North Brunswick, NJ 08902

Year Built: 1976
Gross Floor Area (ft²): 11,000

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

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	270,435
Natural Gas (kBtu)[4]	579,600
Total Energy (kBtu)	850,035

Energy Intensity[5]

Site (kBtu/ft²/yr)	77
Source (kBtu/ft²/yr)	137

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	72

Electric Distribution Utility
PSE&G - Public Service Elec & Gas Co

National Average Comparison

National Average Site EUI	52
National Average Source EUI	102
% Difference from National Average Source EUI	35%
Building Type	Social/Meeting

Stamp of Certifying Professional

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

Certifying Professional
N/A

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

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

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

ENERGY STAR® Data Checklist for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) 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	North Brunswick Senior Center	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Social/Meeting	Is this an accurate description of the space in question?		☐
Location	15 Linwood Place, North Brunswick, NJ 08902	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		☐
Senior Center (Other)				
CRITERION	**VALUE AS ENTERED IN PORTFOLIO MANAGER**	**VERIFICATION QUESTIONS**	**NOTES**	☑
Gross Floor Area	11,000 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.		☐
Number of PCs	8 (Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	55 Hours(Optional)	Is this the total number of hours per week that the space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	8 (Optional)	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100.		☐

ENERGY STAR® Data Checklist for Commercial Buildings

Energy Consumption

Power Generation Plant or Distribution Utility: PSE&G - Public Service Elec & Gas Co

Fuel Type: Electricity		
Meter: Electric Meter (kWh (thousand Watt-hours)) **Space(s):** Entire Facility **Generation Method:** Grid Purchase		
Start Date	**End Date**	**Energy Use (kWh (thousand Watt-hours))**
12/01/2008	12/31/2008	5,520.00
11/01/2008	11/30/2008	4,380.00
10/01/2008	10/31/2008	6,480.00
09/01/2008	09/30/2008	8,550.00
08/01/2008	08/31/2008	10,170.00
07/01/2008	07/31/2008	9,450.00
06/01/2008	06/30/2008	5,970.00
05/01/2008	05/31/2008	5,760.00
04/01/2008	04/30/2008	6,330.00
03/01/2008	03/31/2008	5,610.00
02/01/2008	02/29/2008	4,950.00
01/01/2008	01/31/2008	6,090.00
Electric Meter Consumption (kWh (thousand Watt-hours))		**79,260.00**
Electric Meter Consumption (kBtu (thousand Btu))		**270,435.12**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**270,435.12**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Natural Gas		
Meter: Natural Gas (therms) **Space(s):** Entire Facility		
Start Date	**End Date**	**Energy Use (therms)**
12/01/2008	12/31/2008	744.00
11/01/2008	11/30/2008	327.00
10/01/2008	10/31/2008	63.00
09/01/2008	09/30/2008	65.00
08/01/2008	08/31/2008	75.00
07/01/2008	07/31/2008	71.00
06/01/2008	06/30/2008	143.00
05/01/2008	05/31/2008	141.00
04/01/2008	04/30/2008	801.00
03/01/2008	03/31/2008	1,109.00

02/01/2008	02/29/2008	1,071.00
01/01/2008	01/31/2008	1,186.00
Natural Gas Consumption (therms)		**5,796.00**
Natural Gas Consumption (kBtu (thousand Btu))		**579,600.00**
Total Natural Gas Consumption (kBtu (thousand Btu))		**579,600.00**
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
North Brunswick Senior Center
15 Linwood Place
North Brunswick, NJ 08902

Facility Owner
Township of North Brunswick
710 Herman Road
North Brunswick, NJ 08902

Primary Contact for this Facility
Jessica Zink
15 Linwood Place
North Brunswick, NJ 08902

General Information

North Brunswick Senior Center	
Gross Floor Area Excluding Parking: (ft^2)	11,000
Year Built	1976
For 12-month Evaluation Period Ending Date:	December 31, 2008

Facility Space Use Summary

Senior Center	
Space Type	Other - Social/Meeting
Gross Floor Area(ft^2)	11,000
Number of PCs°	8
Weekly operating hours°	55
Workers on Main Shift°	8

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 12/31/2008)	**Baseline** (Ending Date 12/31/2008)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft²)	77	77	0	N/A	52
Source (kBtu/ft²)	137	137	0	N/A	102
Energy Cost					
$/year	$ 22,917.00	$ 22,917.00	N/A	N/A	$ 15,420.34
$/ft²/year	$ 2.08	$ 2.08	N/A	N/A	$ 1.40
Greenhouse Gas Emissions					
$MtCO_2e$/year	72	72	0	N/A	48
$kgCO_2e/ft^2$/year	7	7	0	N/A	5

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

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

APPENDIX O

Equipment Inventory

New Jersey BPU Energy Audit Program
CHA #20418
Township of North Brunswick
Equipment Inventory - Senior Center

Description	Manufacturer Name	Model No.	Equipment Type	Capacity/Size	Estimated Efficiency	Location	Areas Served	Date Installed	Useable Life Expectancy	Other Info.
Boiler	Dunkirk	PVIB-8D (S/N 180300119)	Boiler	245 MBH input 196 MBH output	80%	Mechanical Room	Entire Building	1988	20 years	Natural Gas
Domestic Hot Water Circulating Pump	TACO	007-BF5	Domestic Hot Water Circulating Pump	1/25 HP, 110 volt/0.76 amp	Motor - 85%	Offices	Offices	2004	15 Years	110 volt
Furnace	Arco Aire	QUE150A0 (S/N tag rusted not readable)	Furnace with separate DX coil above	150 MBH	80%	Storage Room	Offices	1986	20 years	Natural Gas
5-Ton Condensing Unit	Goodman Manufacturing	3K60-36 S/N 97060885642	Condensing Unit	5-Ton	12 EER	Outside near storage room	Mar-95	1986	20 years	
Furnace	RUDD	N/A (name plate tag missing)	Furnace with separate DX coil above	N/A (name plate tag missing)	80%	Storage Room	Offices	1986	20 years	Natural Gas
5-Ton Condensing Unit	Commercial Comfort	CA6060HCA S/N E041235610	Condensing Unit	5-Ton	12 EER	Outside near storage room	Mar-95	1986	20 years	
Window Air Conditioner	Maytag	M6Q10F2B-E	Window AC	10,000 Btu/hr	9.8 EER	Rec Room	Rec Room	Varies	15 Years	110 Volt
Window Air Conditioner	GE	ASH10AKS	Window AC	10,000 Btu/hr	9.8 EER	Kitchen	Kitchen	Varies	15 Years	110 Volt
Window Air Conditioner	Airtemp	B7D12E7B	Window AC	12,000 Btu/hr	9.8 EER	Kitchen	Main Meeting Room	Varies	15 Years	110 Volt
Roof Top HVAC unit	Inter City Products	PAB120N2HB (S/N L9724 46228)	Package HVAC Roof Top Unit	5-Ton	11 EER	Main Meeting Room roof	Main Meeting Room	1976	20 Years	Out of service
Exhaust Fan	Greenheck	CE 10 4	Roof Top Exhaust Fan			Main Meeting Room	Main Meeting Room	1976	20 Years	Not in operation
Hot Water Heater	Bradford White	M240T6DS5 BM7080223	HW Heater/Tank	40 gallons 5,000 Watts		Mechanical Room	Entire Building	9/1/2004	20 Years	