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June 29, 2010

Local Government Energy Program
Energy Audit Report

Township of Middletown Housing Authority

Alice V. Tomaso Plaza
2 Oakdale Drive
Middletown, NJ 07748

Project Number: LGEA59

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Tomaso Plaza is a six-story senior citizen residential development with a basement comprising a total conditioned floor area of 140,853 square feet. The residential development was built in 1978, and there have been several renovations since then. The following chart provides an overview of current energy usage in the building based on the analysis period of March 2009 through February 2010:

Table 1: State of Building—Energy Usage

	Electric Usage, kWh/yr	Gas Usage, Therms/yr	Current Annual Cost of Energy, $	Site Energy Use Intensity, kBtu/sq ft yr	Joint Energy Consumption, MMBtu/yr
Current	2,231,833	28,724	394,028	74.5	10,487
Proposed	2,039,849	24,863	354,301	67.1	9,446
Savings	191,984	3,861	39,727	7.4	1,041
% Savings	9	13	10	10	10

*The Solar Photovoltaic system recommendation is excluded from this table
**Total Annual Cost savings are equal to energy cost savings plus incurred operations and maintenance savings

Table 2: Proposed Photovoltaic System

Initial Investment, $	Total Recommended System Capacity	Electricity Generated, (kWh/year)	Demand Reduction (kW)	SRECs earned (SRECs/year)	Total Revenue ($/year)
270,000	45,080	60,377	45.0	60	45,660

*Revenue generated from producing electricity and collecting Solar Renewable Energy Credits (SRECs) has been factored into the total revenue

There may be energy procurement opportunities for the residential complex to reduce annual utility costs, which are $22,162 higher, when compared to the average estimated NJ commercial utility rates.

SWA has entered energy information about the residential complex into the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* energy benchmarking system. The residential complex is categorized as a non-eligible (""multifamily housing") space type. Because it is a "multifamily housing" space type, there is no rating available. Consequently, the residential complex is not eligible to receive a national energy performance rating at this time. The Site Energy Use Intensity is 74.5 $\frac{kBtu}{ft^2-yr}$ however; there is no national average available for multifamily buildings. See ECM section for guidance on how to improve the building's rating.

Based on the current state of the building and its energy use, SWA recommends implementing various energy conservation measures from the savings detailed in Tables 1 and 2. The measures are categorized by payback period in Table 3 below:

Table 3: Energy Conservation Measure Recommendations

ECMs	Savings ($)	Simple Payback Period (years)	Initial Investment, $	CO2 Savings, lbs/yr
0-5 Year	25,299	1.5	37,451	242,055
5-10 Year	14,428	8.2	118,832	144,252
>10 year	-	-	-	-
Solar PV	45,660	5.9	270,000	108,105
Total	85,387	5.0	426,283	494,412

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 41 cars from the roads each year or avoiding the need of 1,203 trees to absorb the annual CO_2 generated.

Other recommendations to increase building efficiency pertaining to operations and maintenance and capital improvements are listed below:

Further Recommendations:

SWA recommends that the residential complex further explore the following:

- **Capital Improvements**
    - Conduct a ventilation feasibility study
    - Increase level of insulation at roof level
    - Replace existing remaining thru-wall AC units that are not ENERGY STAR® rated with high efficiency units
    - Replace existing chiller and unit ventilators with high efficiency units
    - Replace existing rooftop exhaust fans with direct-drive units

- **Operations and Maintenance**
    - Install low flow aerators at sinks and low flow showerheads
    - Maintain roofs
    - Provide weather-stripping/air-sealing
    - Repair/seal wall cracks and penetrations
    - Always purchase the most energy efficient appliances
    - Use smart power electric strips
    - Create an energy educational program

Note: The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for the Township of Middletown Housing Authority. Based on the requirements of the LGEA program, the Township of Middletown Housing Authority must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The minimum amount to be spent, net of other NJCEP incentives, is $8,411.00.

Financial Incentives and Other Program Opportunities

There are various incentive programs that the Middletown Housing Authority could apply for that could also help lower the cost of installing the ECMs. Please refer to Appendix F for details.

SWA recommends that the Middletown Housing Authority implement all recommended Energy Conservation Measures in order to reduce the current annual energy-related consumption and costs. Appendix H contains an Energy Conservation Measures table that orders each ECM in order of the Simple Payback. SWA recommends that the building first undergo retro-commissioning of the ventilation system to determine how much exhaust air can be reduced since this could potentially have the largest impact on the building's heating and cooling loads. After the retro-commissioning occurs and it has been decided how to reduce corridor exhaust air, the building should undertake all HVAC related measures such as the installation of programmable thermostats. All of these measures will have a large impact on the building operations and will also address other issues such as complaints about thermal comfort. All lighting and Vending Miser recommendations should be addressed at the same time in order to reduce labor costs. All other measures such as the installation of the 45kW PV system should be addressed as funding becomes available within the Middletown Housing Authority. SWA recommends that the Middletown Housing Authority enroll in the SmartStart program and the Renewable Energy Incentive Program through the NJ Office of Clean Energy in order to reduce the installation costs of most measures. The building would not be eligible for the Direct Install program since monthly demand exceeds 200kW. The building is also not eligible for the Pay-for-Performance program at this time, without intensive Capital Improvement planning since the energy audit report does not show a minimum of 15% energy savings, without Capital Improvement measures.

INTRODUCTION

Launched in 2008, the LGEA Program provides subsidized energy audits for municipal and local government-owned facilities, including offices, courtrooms, town halls, police and fire stations, sanitation buildings, transportation structures, schools and community centers. The Program will subsidize up to 100% of the cost of the audit. The Board of Public Utilities (BPUs) Office of Clean Energy has assigned TRC Solutions to administer the Program.

Steven Winter Associates, Inc. (SWA) is a 37-year-old architectural/engineering research and consulting firm, with specialized expertise in green technologies and procedures that improve the safety, performance, and cost effectiveness of buildings. SWA has a long-standing commitment to creating energy-efficient, cost-saving and resource-conserving buildings. As consultants on the built environment, SWA works closely with architects, developers, builders, and local, state, and federal agencies to develop and apply sustainable, 'whole building' strategies in a wide variety of building types: commercial, residential, educational and institutional.

SWA performed an energy audit and assessment for the residential complex at 2 Oakdale Drive. The process of the audit included facility visits on March 25th and March 26th, 2010, benchmarking and energy bills analysis, assessment of existing conditions, energy modeling, energy conservation measures and other recommendations for improvements. The scope of work includes providing a summary of current building conditions, current operating costs, potential savings, and investment costs to achieve these savings. The facility description includes energy usage, occupancy profiles and current building systems along with a detailed inventory of building energy systems, recommendations for improvement and recommendations for energy purchasing and procurement strategies.

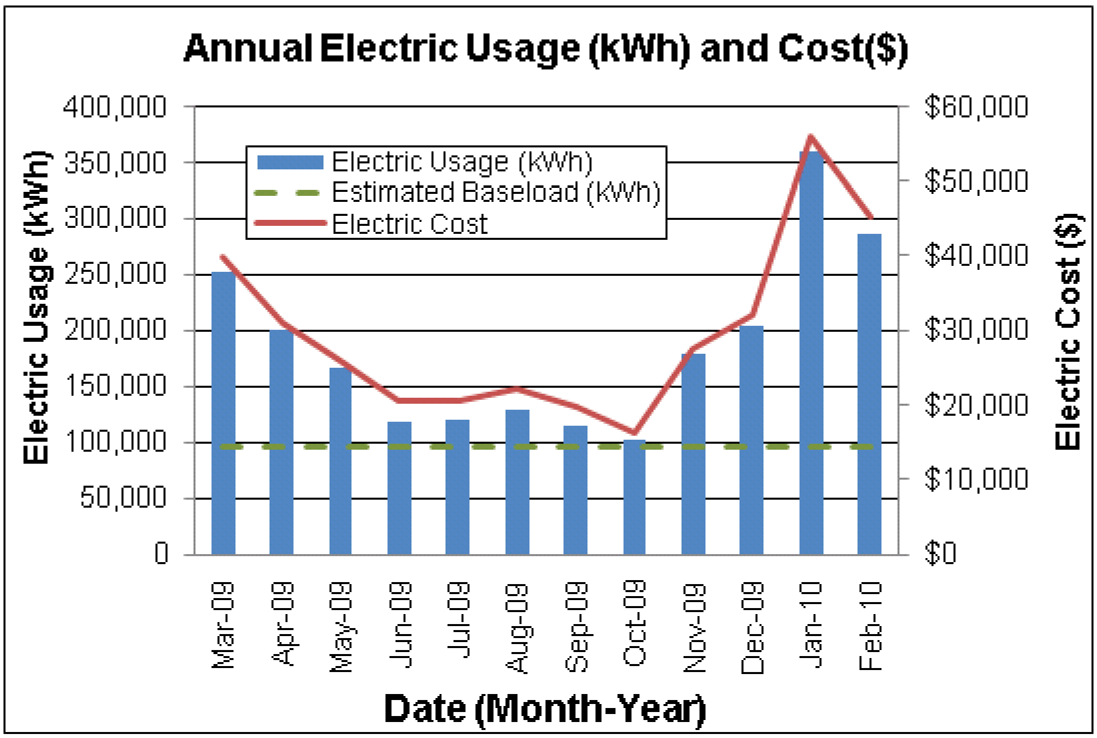
The goal of this Local Government Energy Audit (LGEA) is to provide sufficient information to the Township of Middletown to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the residential complex.

HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

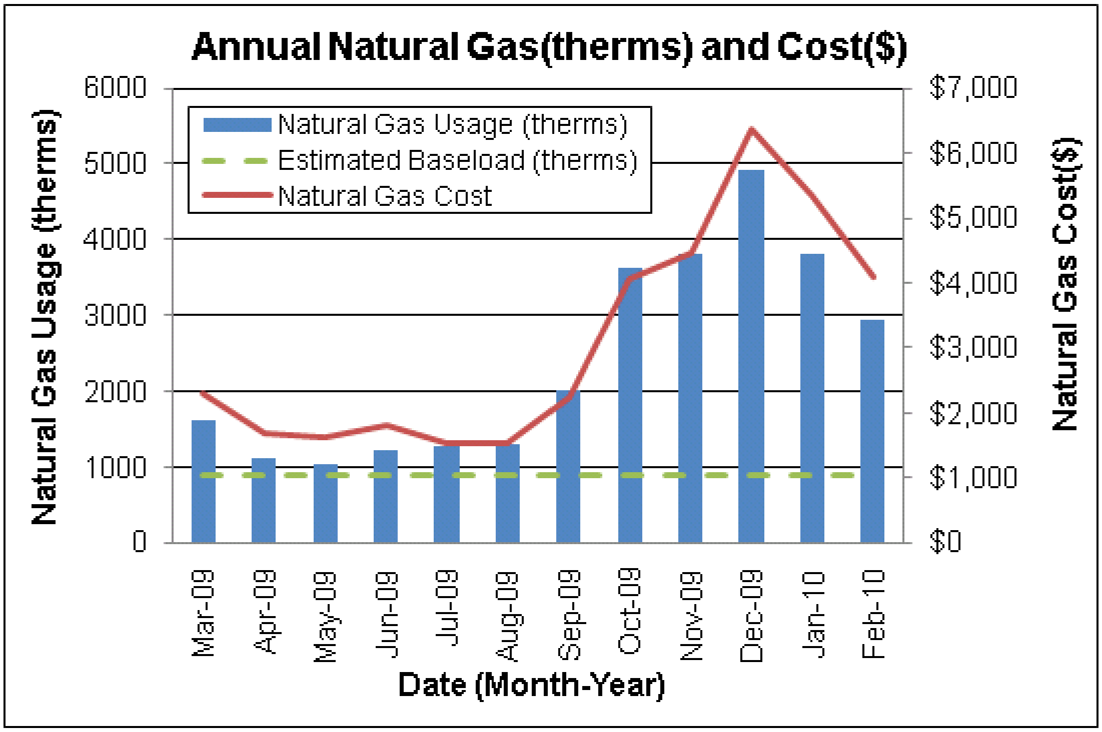
SWA reviewed utility bills from March 2008 through February 2010 that were received from the utility companies supplying the residential complex with electric and natural gas. A 12 month period of analysis from March 2009 through February 2010 was used for all calculations and for purposes of benchmarking the building.

Electricity - The residential complex is currently served by one electric meter. The residential complex currently buys electricity from JCP&L at **an average aggregated rate of $0.160/kWh**. The residential complex purchased **approximately 2,231,833 kWh, or $356,937 worth of electricity,** in the previous year. The average monthly demand was 434.8 kW and the annual peak demand was 564.8 kW.

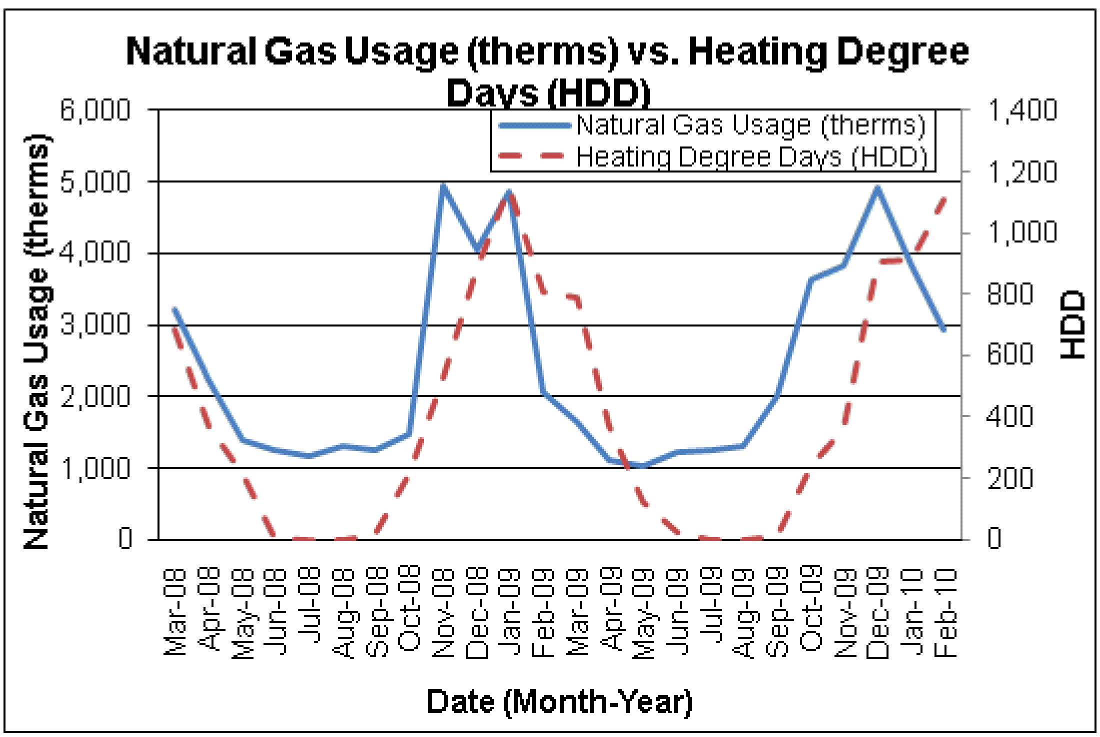


In the above chart, electric usage increases during the summer when air conditioning is used. The estimated baseload is formed primarily by electric domestic hot water, lighting and appliances within the building.

Natural gas - The residential complex is currently served by one meter for natural gas. The residential complex currently buys natural gas from New Jersey Natural Gas Co. at **an average aggregated rate of $1.291/therm**. The residential complex purchased **approximately 28,724 therms or $37,091 worth of natural gas** in the previous year.



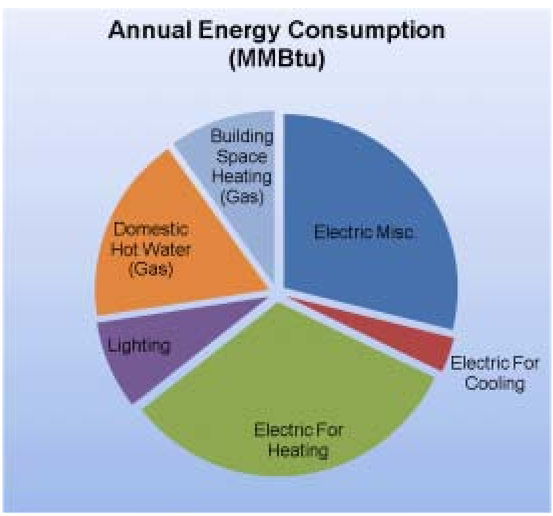
Natural Gas usage in relation to costs

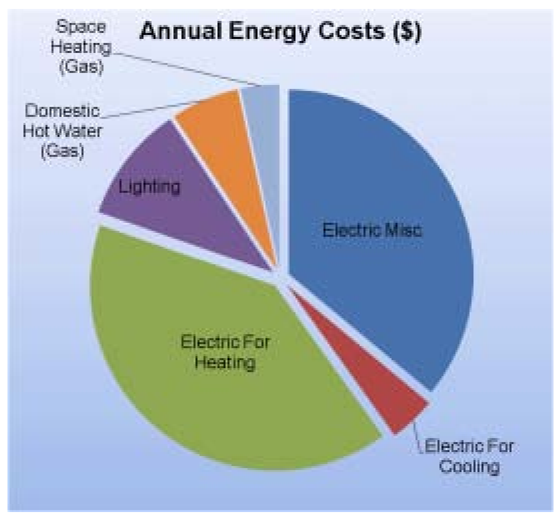


The above chart shows that the natural gas usage curve follows the heating degree days curve closely. Heating Degree Days are used as a metric for estimating heating required by a building based on location. Heating Degree Days are based on average outdoor temperatures.

The following graphs, pie charts, and table show energy use for the residential complex based on utility bills for the 12 month period. Note: electrical cost at $47/MMBtu of energy is almost 4 times as expensive as natural gas at $13/MMBtu

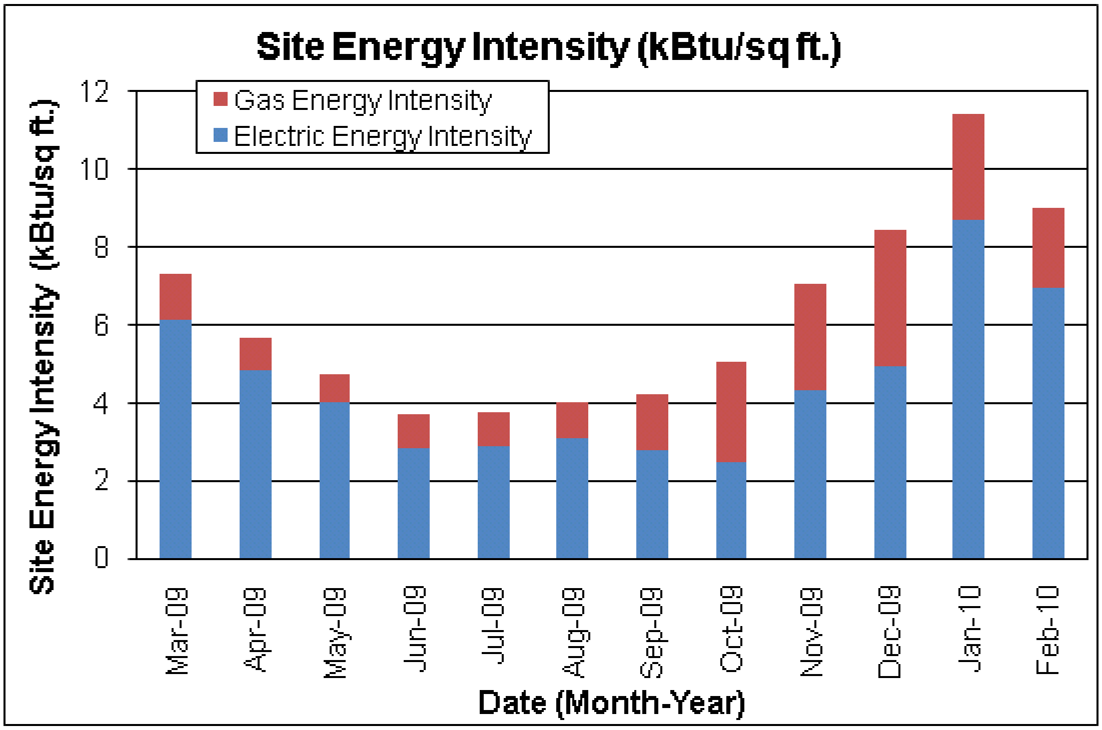
March 2009 - February 2010 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	3,028	29%	$141,920	36%	47
Electric For Cooling	343	3%	$16,081	4%	47
Electric For Heating	3,383	32%	$158,536	40%	47
Lighting	862	8%	$40,400	10%	47
Domestic Hot Water (Gas)	1,832	17%	$23,659	6%	13
Building Space Heating (Gas)	1,040	10%	$13,432	3%	13
Totals	10,488	100%	$394,028	100%	
Total Electric Usage	7,616	73%	$356,937	91%	47
Total Gas Usage	2,872	27%	$37,091	9%	13
Totals	10,488	100%	$394,028	100%	





Energy benchmarking

SWA has entered energy information about the residential complex into the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* energy benchmarking system. The residential complex is categorized as a non-eligible (""multifamily housing") space type. Because it is a "multifamily housing" space type, there is no rating available. Consequently, the residential complex is not eligible to receive a national energy performance rating at this time. The Site Energy Use Intensity is $74.3\frac{kBtu}{ft^2-yr}$ however; there is no national average for comparison as this figure is not available for multifamily buildings. See ECM section for guidance on how to improve the building's rating.



Per the LGEA program requirements, SWA has assisted the Middletown Housing Authority to create an *Energy Star Portfolio Manager* account and share the residential complex's information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager account information with the Municipality (user name of "MiddletownHA" with a password of "*Middletown")* and TRC Solutions.

Tariff analysis

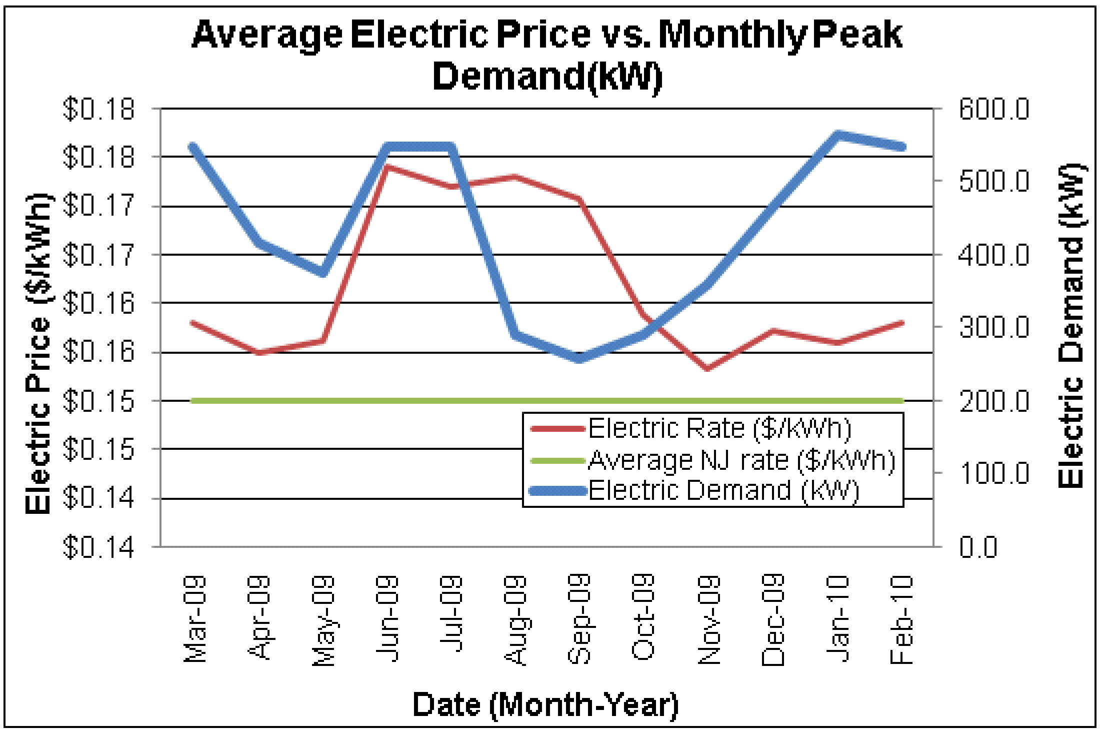
As part of the utility bill analysis, SWA evaluated the current utility rates and tariffs. Tariffs are typically assigned to buildings based on size and building type.

Tariff analysis is performed to determine if the rate that a municipality is contracted to pay with each utility provider is the best rate possible resulting in the lowest costs for electric and gas provision. Typically, the natural gas prices increase during the heating months when natural gas is used by the hot water boiler units. Some high gas price per therm fluctuations in the summer may be due to high energy costs that recently occurred and low use caps for the non-heating months. Typically, electricity prices also increase during the cooling months when electricity is used by the air conditioning units.

The natural gas supplier charges a market-rate price based on use, and the billing does not break down demand costs for all periods because usage and demand are included in the rate. Currently, the Middletown Housing Authority is paying a general service rate for natural gas through a consortium. The agreement between Middletown Housing Authority and the consortium was established on 11/2009. Demand is not broken out in the bill. Thus the building pays for fixed costs such as meter reading charges during the summer months. The building is direct metered and currently purchases electricity at a general service rate for usage with an additional charge for electrical demand factored into each monthly bill. The general service rate for electric charges are market-rate based on use. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year.

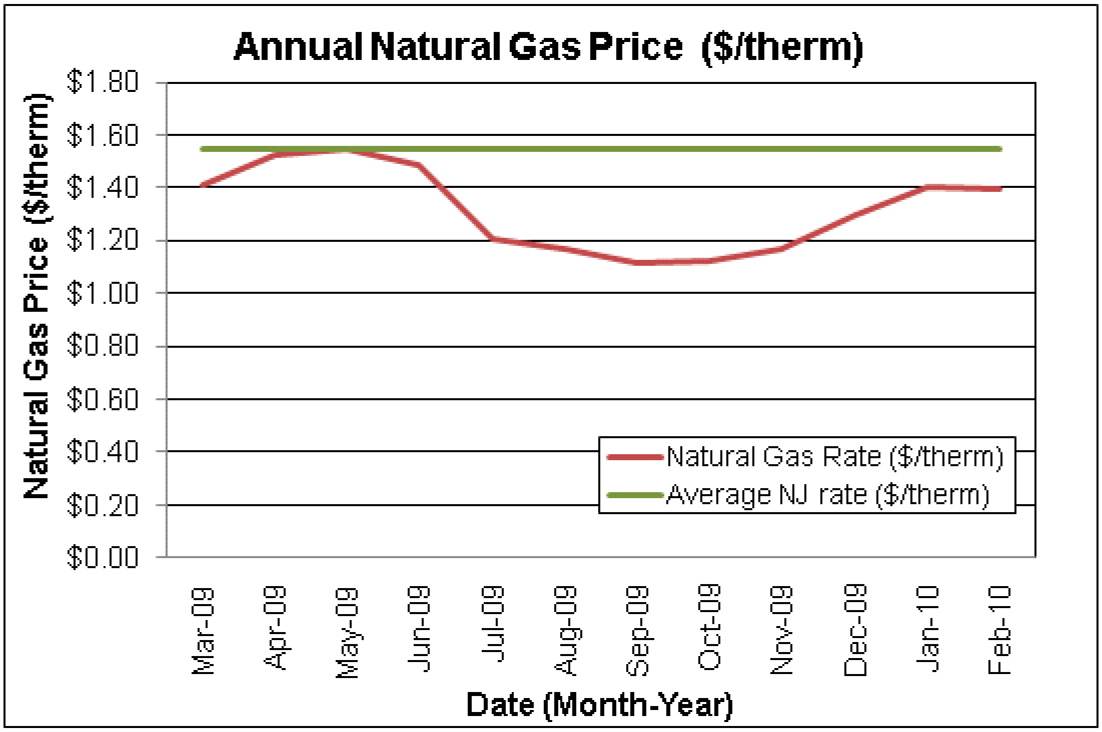
Energy Procurement strategies

The average estimated NJ commercial utility rates for electric are $0.150/kWh, while the residential complex pays an average rate of $0.160/kWh. The average rate was determined by dividing the total annual cost by the total annual consumption for the building. The residential complex's annual electric utility costs are $22,162 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 12% over the most recent 12 month period.



The above chart shows that the average annual electric rate ($/kWh) is much higher than NJ state averages.

The average estimated NJ commercial utility rates for gas are $1.550/therm, while the residential complex pays a rate of $1.290/therm which is below market rate. Natural gas bill analysis shows fluctuations up to 28% over the most recent 12 month period.



The above chart shows that during medium to high usage months, the natural gas rate ($/therm) is in line with average NJ rates. During the summer months, natural gas is not used however the building is still charged a minimum charge per utility meter. This minimum charge causes a peak to appear in the above graph.

Utility rate fluctuations may have been caused by adjustments between estimated and actual meter readings; others may be due to unusual high and recent escalating energy costs.

SWA recommends that the residential complex further explore opportunities of purchasing electricity from third-party suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the residential complex. Appendix C contains a complete list of third-party energy suppliers for the Middletown Housing Authority service area.

EXISTING FACILITY AND SYSTEMS DESCRIPTION

This section gives an overview of the current state of the facility and systems. Please refer to the Proposed Further Recommendations section for recommendations for improvement.

Based on visits from SWA on dates, the following data was collected and analyzed.

Building Characteristics

- Free-standing, six-story, slab on grade building with basement.
- Constructed in 1978 with several renovations since.
- Approximately 140,853 square feet of conditioned space
- The building houses dwelling units, meeting room, library, laundry room and offices for the housing authority.

Building occupancy profiles

- Typical occupancy of 168 hours per week.
- The building is always open as it is a residence however; the office portion of the building is only open from 8:00 AM to 4:00 PM.
- There are 163 residents and 6 full time employees present.

Building envelope

This is an overview of the current state of the building. SWA has included recommendations to improve the efficiency and sustainability of the building. Implementing the suggestions will reduce the energy demand.

Exterior Walls

The exterior wall envelope is mostly constructed of brick veneer over concrete block with no assumed insulation. The interior is mostly painted concrete block.

Note: Wall insulation levels *could not be verified in the field and are based on reports from building management.*

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall good condition with only a few signs of uncontrolled moisture, air-leakage or other energy-compromising issues detected on all facades.

The following specific exterior wall problem spots and areas were identified:

Water damage due to uncontrolled roof water run-off due to missing gutters and downspouts, efflorescence on brick and masonry walls indicate moisture presence within the wall cavity, signs of water damage at wall penetrations, signs of mold/vegetation overgrowth and cracked/aged caulk.

Roof

The building's roof is predominantly a flat and parapet type over steel decking, with a built-up asphalt finish. The roof surface was replaced in 1995 and there is no assumed insulation.

Note: Roof insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.

Roofs, related flashing, gutters and downspouts were inspected during the field audit. They were reported to be in overall good condition, with no signs of uncontrolled moisture, air-leakage or other energy-compromising issues detected on all roof areas.

The following typical roof surface was identified:

Typical roof surface with no signs of uncontrolled moisture, air-leakage or other energy-compromising issues

Base

The building's base is a concrete slab-on grade with a perimeter footing and concrete block stem walls. There was not any moisture or water-related issues reported or detected.

Windows

The building contains basically three different types of windows that were all replaced in 2008 as part of a major upgrade to the building:

1. Fixed type windows with an insulated aluminum frame, tempered glazing and interior roller blinds. The windows are located on either side of the building and are original/have never been replaced.

2. Double-hung type windows with an insulated aluminum frame clear double glazing and interior mini blinds. The windows are located on either side of the building and are original/have never been replaced.

3. Fixed type windows with an insulated aluminum frame, tinted double glazing and interior drapes. The windows are located on the basement floor and are original/have never been replaced.

4. Sidelight and Transom windows that are part of the existing glass door systems.

Windows, shading devices, sills, related flashing and caulking were inspected as far as accessibility allowed for signs of moisture, air-leakage and other energy compromising issues. Overall, the windows were found to be in good condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following typical installations and specific window problem spots were identified:

Cracked or aged caulk around frame/sill on the exterior

Exterior doors

The building contains several different types of exterior doors that were installed in 2008 as part of a major building upgrade:

1. Louvered solid metal type exterior doors. They are located in the rear of the building and are original/have never been replaced.

2. Solid metal type exterior doors with glass panels. They are located in the rear of the building and are original/have never been replaced.

3. Glass with aluminum frame type exterior door. They are located on the main floor and are original/have never been replaced.

All exterior doors, thresholds, related flashing, caulking and weather-stripping were inspected for signs of moisture, air-leakage and other energy-compromising issues. Overall, the doors were found to be in good condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific door problem spots were identified:

Missing/worn weather-stripping and damaged door frame

Building air tightness

Overall the field auditors found the building to be reasonably air-tight, considering the building's use and occupancy, as described in more detail earlier in this chapter.

The air tightness of buildings helps maximize all other implemented energy measures and investments, and minimizes potentially costly long-term maintenance, repair and replacement expenses.

Mechanical Systems

The Tomaso Plaza building consists of 152 apartment units and also contains offices for the Middletown Housing Authority on the first floor. The apartments are typically heated by electric baseboard heaters and cooled using thru-wall AC units. The common areas including each corridor and first floor areas are provided heating and cooling through unit ventilators, additional heating through electric baseboards and additional cooling by area-specific split AC systems.

Equipment

Common Areas and Corridors – The common areas and corridors of the Tomaso Plaza building are heated and cooled using a central unit ventilator system. Each unit ventilator contains a cooling coil as well as a heating coil. The cooling coil is supplied by a glycol loop circulate by the roof-mounted Trane chiller. The Trane chiller, as well as all unit ventilators were installed in 2001 and were observed to be in good condition. The hot water coils are heated by heating hot water circulated by the Patterson-Kelly Thermific boiler located in the basement boiler room. This unit was installed in 2001 and is 85% efficient.

Trane chiller located on roof (L); Heating ventilator located in basement ®

First Floor Offices and Common Areas – The first floor offices and common areas are heated using electric baseboard heaters. These areas are also supplied supply air from a heating ventilator located in the first floor mechanical room. The offices and common areas also have room specific cooling using thru-wall air conditioners. There is one vestibule located in the back of the building, near the maintenance office that contains a Dayton electric unit heater. The mechanical room located directly adjacent to the maintenance office contains a Trane air handler with connected condenser that provides heated and cooled force air to the large meeting room located at the 1st floor level. This Trane unit was installed in 2001, has an efficiency EER value of 9.9 and was observed to be in good condition.

Trane air handling unit near Maintenance office (L); Connected Trane condenser (R)

Apartments – Apartment units are equipped with electric baseboard heating and thru-wall AC units. Based on tenant interviews, there were no major complaints with the heating or cooling equipment that resulted in comfort issues. On average, units with 2 bedrooms contained 2 AC units, while all others contained 1 unit. All AC units are in the process of being replaced and were observed to have an efficiency of 9.5 EER and are within the useful lifetime of the units. The units are upgraded upon apartment vacancies, which typically equates to 14-25 new units installed per year as part of the AC upgrade.


Electric baseboard and thru-wall AC unit in a typical apartment unit

Distribution Systems

Common Areas and Corridors – The building contains 3 corridors that meet in a central location, roughly shaped as a 'Y'. At the center of the building where the corridors meet, there is an elevator bank. All 6 floors contain a unit ventilator at the center of the corridors, near this elevator bank that were all installed approximately 6 years ago and were not part of the original design. These 6 unit ventilators are all identical models, with the exception of the 6th floor which is slightly larger. The unit ventilators are mounted on an interior wall that contains central ductwork inside of a common chase. This ductwork provides outside air from one of two heating ventilators located in the basement. This heating ventilator contains a hot water coil from the gas-fired boiler located in the basement to pre-heat air during colder months. Outside air enters the heating ventilator at the basement level; it is pushed by a fan through the ductwork to each ventilator and then either cooled or heated by the unit ventilator depending on the season before entering the common corridor. At the end of each corridor, there are exhaust grills that are attached to common ductwork leading up to the roof. This ductwork draws exhaust air from the hallways by exhaust fans located on the roof. The system is designed to draw supply air from the center area down through each corridor to provide even ventilation throughout the common areas.


Inside of Trane unit ventilator (L); Thermostat on unit ventilator (R)

West wing roof-mounted corridor exhaust fan

In addition to the corridors, much of the first floor common areas are served by forced air furnaces located in two individual mechanical rooms on the first floor. One Trane unit serves the large meeting area and maintenance offices with electric heat and DX cooling, while the other unit provides gas-heated air and DX cooling to the front offices and vestibule.

Controls

Apartments – Each apartment in the building contains a thru-wall window AC unit and an electric baseboard. Heating and cooling are controlled by separate non-programmable thermostats.

Non-programmable thermostat for electric baseboard heater

Common Areas – Commons areas such as the large meeting room and office contain programmable thermostats that control the forced air furnaces that deliver conditioned air to the spaces. All electric baseboards and thru-wall AC units are still controlled by non-programmable thermostats.

Common Area Programmable thermostat (L); Typical electric baseboard thermostat (R)

Domestic Hot Water

Domestic hot water (DHW) for the Tomaso Plaza building is provided by an AO Smith – Burkay, gas-fired hot water heater connected to an approximate 400 gallon storage tank. This DHW heater was installed in 2002 and is within the useful life expectancy. DHW is stored in the storage tank at 150ºF and is delivered via pump to apartment units as well as common areas.

AO Smith – Burkay DHW heater (L); Approximate 400 gallon DHW storage tank (R)

Electrical systems

Lighting

See attached lighting schedule in Appendix B for a complete inventory of lighting throughout the building including estimated power consumption and proposed lighting recommendations.

Interior Lighting - The residential complex currently contains mostly efficient T8 fluorescent fixtures with electronic ballasts and CFL's (compact fluorescents). However, there are also inefficient magnetically ballasted T12 fixtures, and incandescent which are common in the dwelling units. Based on measurements of lighting levels for each space, there are no vastly over-illuminated areas. Occupancy sensors and bi-level lighting are recommended as they both will reduce runtime of light fixtures and the bi-level will also reduce the required power to operate the fixture.

Exit Lights - Exit signs were found to be LED type.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a mix of metal halide and high pressure sodium fixtures. Exterior lighting is controlled by timers.

Appliances and process

SWA has conducted a general survey of larger, installed equipment. Appliances and other miscellaneous equipment account for a significant portion of electrical usage within the building. Typically, appliances are referred to as “plug-load” equipment, since they are not inherent to the building’s systems, but rather plug into an electrical outlet. Equipment such as process motors, computers, computer servers, radio and dispatch equipment, refrigerators, vending machines, printers, etc. all create an electrical load on the building that is hard to separate out from the rest of the building’s energy usage based on utility analysis.

In the public areas of the housing complex the following appliances were installed, five older model inefficient 17 cubic foot refrigerators, one newer model efficient 17 cubic foot refrigerator and one older model refrigerated vending machine. The following typical appliances were installed in the dwelling units, one older model inefficient 17 cubic foot refrigerator and one combination oven, broiler and range with overhead exhaust fan. However, approximately 20% of the installed refrigerators where newer model efficient or ENERGY STAR® labeled units. The following commercial laundry equipment was installed in the public laundry room, eight washing machines and eight dryers all of which were manufactured by Maytag. The dryers and one of the washing machines are part of Maytag’s Neptune line of commercial laundry equipment, the washing machines model # is MAH21PDDWW and the dryers are model # MLE23PDHYW. The remaining washing machines are part of Maytag’s commercial equipment line, model # MAT12CSFWW. The dryers use an estimated 750 kWh annually per unit. When purchasing commercial laundry equipment it is always advisable to purchase ENERGY STAR® labeled equipment or in the case of dryers since there is no ENERGY STAR® labeled dryers, the units with the highest possible efficiency to save energy.

Elevators

The residential complex has two passenger elevators.

Other electrical systems

There is a Kohler diesel generator used as a backup for emergency conditions.

RENEWABLE AND DISTRIBUTED ENERGY MEASURES

Renewable energy is defined as any power source generated from sources which are naturally replenished, such as sunlight, wind and geothermal. Technology for renewable energy is improving, and the cost of installation is decreasing, due to both demand and the availability of state and federal government-sponsored funding. Renewable energy reduces the need for using either electricity or fossil fuel, therefore lowering costs by reducing the amount of energy purchased from the utility company. Technology such as photovoltaic panels or wind turbines, use natural resources to generate electricity on the site. Geothermal systems offset the thermal loads in a building by using water stored in the ground as either a heat sink or heat source. Solar thermal collectors heat a specified volume of water, reducing the amount of energy required to heat water using building equipment. Cogeneration or CHP allows you to generate electricity locally, while also taking advantage of heat wasted during the generation process.

Existing systems

Currently there are no renewable energy systems installed in the building.

Evaluated Systems

SWA evaluated the following renewable and distributed energy measure possibilities: wind, solar photovoltaic, solar thermal collectors, combined heat and power, and geothermal.

Solar Photovoltaic

Photovoltaic panels convert light energy received from the sun into a usable form of electricity. Panels can be connected into arrays and mounted directly onto building roofs, as well as installed onto built canopies over areas such as parking lots, building roofs or other open areas. Electricity generated from photovoltaic panels is generally sold back to the utility company through a net meter. Net-metering allows the utility to record the amount of electricity generated in order to pay credits to the consumer that can offset usage and demand costs on the electric bill. In addition to generation credits, there are incentives available called Solar Renewable Energy Credits (SRECs) that are subsidized by the state government. Specifically, the New Jersey State government pays a market-rate SREC to facilities that generate electricity in an effort to meet state-wide renewable energy requirements.

Based on utility analysis and a study of roof conditions, Tomaso Plaza is a good candidate for a 45 kW Solar Panel installation. See ECM #8 for details.

Solar Thermal Collectors

Solar thermal collectors are not cost-effective for this building and would not be recommended due to the insufficient and intermittent use of domestic hot water throughout the building to justify the expenditure.

Geothermal

The residential complex is not a good candidate for geothermal installation since it would require replacement of the entire existing HVAC system, of which major components still have between 20% and 84% remaining useful life.

Combined Heat and Power

The residential complex is not a good candidate for CHP installation and would not be cost-effective due to the size and operations of the building. Typically, CHP is best suited for buildings with a high electrical baseload to accommodate the electricity generated, as well as a means for using waste heat generated. Typical applications include buildings with an absorption chiller, where waste heat would be used efficiently.

PROPOSED ENERGY CONSERVATION MEASURES

Energy Conservation Measures (ECMs) are recommendations determined for the building based on improvements over current building conditions. ECMs have been determined for the building based on installed cost, as well as energy and cost-savings opportunities.

Recommendations: Energy Conservation Measures

ECM#	Description of ECMs with 0-5 Year Payback
1	Install (160) programmable thermostats
2	Install (8) new occupancy sensors
3	Install (152) new CFL fixtures
4	Install (48) new bi-level T8 fluorescent fixtures in stairwells
5	Retrofit (1) refrigerated vending machine with Vending Miser device
6	Install (3) new T8 fluorescent fixtures
7	Replace (8) common area washing machines with Energy Star units
	Description of ECMs with 5-10 Year Payback
8	Install a 45kW Solar PV system
9	Install (30) new Pulse Start Metal Halide fixtures
10	Replace (5) common area refrigerators with Energy Star units
11	Replace (120) apartment refrigerators with Energy Star units
12	Replace existing West wing roof-mounted corridor exhaust fan with a direct drive unit
13	Retro-commissioning of Common Area ventilation system

ECM#1: *Install (160) programmable thermostats*

On the day of the site visit, SWA observed that heating and cooling in all apartment units are controlled using non-programmable thermostats. Each apartment is equipped with at least 1 thru-wall AC unit and electric baseboards. Based on tenant interviews and the nature of the building used for Senior Housing, apartment thru-wall units are used minimally and would not benefit from programmable thermostats. SWA recommends installing a programmable thermostat in each of the 152 apartment units. In addition to the apartment units, SWA recommends installing a programmable thermostat for each one of the 6 unit ventilators in the main corridors and 2 additional programmable thermostats for common area electric baseboard heaters. Programmable thermostats will allow the building to setback temperatures during night time when common areas are used minimally.

Installation cost:

Estimated installed cost: $19,200 (includes $4,800 of labor)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
1	19,200	99,150	67.0	1,040	3.1	0	17,206	15	258,084	1.1	12	1	1	183,259	188,992

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumed savings based on 10% reduction in apartment and common area electric heating costs as well as common area natural gas heating costs.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs

ECM#2: *Install (8) new Occupancy Sensors*

On the day of the site visit, SWA completed a lighting inventory of the Tomaso Plaza building (see Appendix B). The residential complex currently contains 8 areas that could benefit from the installation of occupancy sensors. These areas consisted of office and common meeting spaces located on the first floor that are used sporadically throughout the day and could show energy savings by having the lights turn off after a period of no occupancy. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion is detected within a set time period. Advanced micro-phonic lighting sensors include sound detection as a means to controlling lighting operation.

Installation cost:

Estimated installed cost: $1,760 (includes $240 of labor)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
2	1,760	3,877	0.8	0	0.1	620	1,240	15	18,605	1.4	10	1	1	12,835	6,942

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

- *NJ Clean Energy – SmartStart – Wall-mounted Occupancy Sensors ($20 per control)*

Please see Appendix F for more information on Incentive Programs

ECM#3: *Install (152) new CFL fixtures*

On the day of the site visit, SWA completed a lighting inventory of the Tomaso Plaza building (see Appendix B). The residential complex currently contains 102 incandescent lamps, located mostly within the apartment units. Each apartment contained a night light, built into the wall of either the bedroom or living room area. SWA recommends replacing these lamps with Compact Fluorescent Lamps (CFLs) which are capable of producing the same or better quality light while using a fraction of the energy.

Installation cost:

Estimated installed cost: $2,280 (includes $760 of labor)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
3	2,280	4,438	0.9	0	0.1	689	1,399	5	6,995	1.6	2	0	1	4,091	7,946

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 5 hrs/yr to replace aging burnt out lamps vs. newly installed.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs

ECM#4: ***Install (48) new bi-level T8 fluorescent fixtures in stairwells***

On the day of the site visit, SWA completed a lighting inventory of the Tomaso Plaza building (see Appendix B). The residential complex currently contains 48 wall-mounted T8 fluorescent lighting fixtures that are operated 24 hours per day. New technology called bi-level lighting, combines fluorescent lighting fixtures with an occupancy sensor. These efficient light fixtures operate at a minimal light level in order to meet code and safety requirements and power up to a higher level when any motion is detected in the stairwells. Tomaso Plaza would be an appropriate application for these fixtures since the building is used for Senior Housing and very few people use the stairwells.

Installation cost:

Estimated installed cost: $7,200 (includes $1,440 of labor)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
4	7,200	12,110	2.5	0	0.3	1,938	3,876	15	58,134	1.9	7	0	1	38,404	21,683

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 5 hrs/yr to replace aging burnt out lamps vs. newly installed.

Rebates/financial incentives:

- *NJ Clean Energy – SmartStart – T8 fluorescent fixtures ($15 per fixture)*

Please see Appendix F for more information on Incentive Programs

ECM#5: *Retrofit (1) refrigerated vending machine with Vending Miser device*

A simply plug and play device, VendingMiser^{TM} devices are compatible with refrigerated vending machines. The device utilizes Passive Infrared Sensors (PIR) to help the unit save power during periods of no occupancy. This unit is to be installed on the existing refrigerated vending machine.

Installation cost:

Estimated installed cost: $199 (includes $30 of labor)
Source of cost estimate: Manufacturer

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
5	199	607	0.1	0	0.0	0	97	15	1,457	2.0	6	0	0	944	1,087

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs

ECM#6: *Install (3) new T8 fluorescent fixtures*

On the day of the site visit, SWA completed a lighting inventory of the Tomaso Plaza building (see Appendix B). The residential complex currently contains 3 fixtures in Elevator #2 that are older, T12 fluorescent fixtures. T12 fluorescent fixtures use magnetic ballasts and consume approximately 30% more energy than T8 fluorescent fixtures with electronic ballasts, while providing similar light output.

Installation cost:

Estimated installed cost: $412 (includes $90 of labor)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
6	412	604	0.1	0	0.0	105	202	15	3,025	2.0	6	0	0	1,961	1,081

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 5 hrs/yr to replace aging burnt out lamps vs. newly installed.

Rebates/financial incentives:

- *NJ Clean Energy – SmartStart – T8 fluorescent fixtures ($15 per fixture)*

Please see Appendix F for more information on Incentive Programs

ECM#7: *Replace (8) common area washing machines with Energy Star units*

On the day of the site visit, SWA observed that there were eight older model washing machines installed in the public laundry room. SWA recommends replacing these units with eight new ENERGY STAR® labeled washing machines.

Installation cost:

Estimated installed cost: $6,400 (includes $800 of labor)
Source of cost estimate: Manufacturer

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
7	6,400	8,000	0.2	0	0.2	0	1,280	15	19,200	5.0	2	0	0	8,662	14,324

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 5 hrs/yr to replace aging burnt out lamps vs. newly installed.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs

ECM#8: Install a 45kW Solar PV system

Currently, Tomaso Plaza does not use any renewable energy systems. Renewable energy systems, such as photovoltaic panels, can be mounted on the building roof facing south, and can offset a portion of the purchased electricity for the building. Power stations generally have two separate electrical charges: usage and demand. Usage is the amount of electricity in kilowatt-hours that a building uses from month to month. Demand is the amount of electrical power that a building uses at any given instance in a month period. During the summer periods, when electric demand at a power station is high due to the amount of air conditioners, lights, equipment, etc being used within the region, demand charges go up to offset the utility's cost to provide enough electricity at that given time. Photovoltaic systems not only offset the amount of electricity use by a building, but also reduce the building's electrical demand, resulting in a higher cost savings as well. SWA presents below the economics, and recommends at this time that Middletown Housing Authority review installing a 45,080 (45kW) PV system at Tomaso Plaza to offset electrical demand and reduce the annual net electric consumption for the building. Middletown Housing Authority should review guaranteed incentives from NJ rebates to justify the investment. Middletown Housing Authority may consider applying for a grant and/or engage a PV generator/leaser who would install the PV system and then sell the power at a reduced rate. JCP&L provides the ability to buy SRECs at $600/MWh or best market offer.

The size of the system was determined using the amount of roof surface area, as well as the facilities annual base load. Available roof surface area was determined by total available area minus mechanical equipment and area needed to maintain mechanical equipment. A commercial multi-crystalline 230 watt panel (17.2 volts, 7.16 amps) has 17.5 square feet of surface area (12.5 watts per square foot). A 45kW system needs approximately 196 panels, which would take up 3,430 square feet.

*It is important to note that the size of the recommended photovoltaic systems is based on maximum-sized systems. The recommended system sizes are based on maximum available area to mount a photovoltaic system and assumed that the entire available area will be used. SWA recommends that Middletown Housing Authority installs the largest system allowed within practical means and consideration for financial restraints. Roof-mounted systems require structural analysis before installation to ensure that the base structure is capable of supporting the entire weight of the system.

Installation cost:

Estimated installed cost: $270,000 (includes $135,000 of labor)
Source of cost estimate: Similar Projects

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
8	270,000	60,377	45.0	0	1.5	0	45,660	25	1,141,508	5.9	3	0	0	318,143	108,105

Assumptions: SWA estimated the cost and savings of the system based on past PV projects. SWA projected physical dimensions based on a typical Polycrystalline Solar Panel (230 Watts, Model STP230D-24/VEC). PV systems are sized based on Watts, and physical dimensions for an array will differ with the efficiency of a given solar panel (W/sq ft).

Rebates/financial incentives:

- *NJ Clean Energy – Renewable Energy Incentive Program (REIP) - $1/Watt installed*
- *Solar Renewable Energy Credit (SREC) program – Each time a solar electric system generates 1,000 kWh (1 MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The building must become net-metered in order to earn SRECs as well as sell power back to the electric grid. Annual SREC revenue of $27,000 has been factored into the annual savings for a period of 15 years. For every full MWh of generated per year (45,660 kWh per year will generate 45 SRECs), a market rate of $600/SREC has been calculated. SRECs are factored into the annual cost for a period of 15 years, which is the term limit of the SREC registration program. SRECs require proof of performance, application approval and negotiations with the utility.*

Please see Appendix F for more information on Incentive Programs.

ECM#9: *Install (30) new Pulse Start Metal Halide fixtures*

On the day of the site visit, SWA completed a lighting inventory of the Tomaso Plaza building (see Appendix B). The exterior lighting consists of a mix of at least 30 different probe start metal halide and high pressure sodium (HPS) fixtures. The metal halide and HPS fixtures should be replaced with pulse start metal halides. Pulse Start Metal Halide (MH) lamps offer the advantages of standard (probe-start) metal halide lamps, but minimize the disadvantages. They produce higher lit output both initially and over time, operate more efficiently, produce whiter light, and turn on and re-strike faster. Due to these characteristics, energy savings can be realized via one-to-one substitution of lower-wattage systems, or by taking advantage of higher light output and reducing the number of fixtures required in the space.

Installation cost:

Estimated installed cost: $15,794 (includes $3,000 of labor)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
9	15,794	9,259	1.9	0	0.2	677	2,158	15	32,377	7.3	1	0	0	9,604	16,578

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA also assumed an aggregated 5 hrs/yr to replace aging burnt out lamps vs. newly installed.

Rebates/financial incentives:

- *NJ Clean Energy – SmartStart – Metal Halide with Pulse Start ($25 per fixture)*

Please see Appendix F for more information on Incentive Programs

ECM#10: *Replace (5) common area refrigerators with Energy Star units*

On the day of the site visit, SWA observed that there were five older 17 cu. ft. model inefficient refrigerators which were not Energy Star rated (using approximately 773 kWh/yr each), and one newer 17 cu. ft. model efficient refrigerator in the building which was Energy Star rated. Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing older refrigerators with a 17 cu. ft. top freezer refrigerator ENERGY STAR®, or equivalent. Besides saving energy, the replacement will also keep their surroundings cooler. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

Installation cost:

Estimated installed cost: $2,625 (includes $100 of labor)
Source of cost estimate: Manufacturer

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
10	2,625	2,000	0.4	0	0.0	0	320	15	4,800	8.2	1	0	0	1,140	3,581

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs

ECM#11: *Replace (120) apartment refrigerators with Energy Star units*

On the day of the site visit, SWA observed that there were 120 older 17 cu. ft. model inefficient refrigerators in the apartment units which were not Energy Star rated (using approximately 773 kWh/yr each), and one newer 17 cu. ft. model efficient refrigerator in the building which was Energy Star rated. Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. SWA recommends the replacement of the existing older refrigerators with a 17 cu. ft. top freezer refrigerator ENERGY STAR®, or equivalent. Besides saving energy, the replacement will also keep their surroundings cooler. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: window air conditioners, refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

Installation cost:

Estimated installed cost: $63,000 (includes $12,000 of labor)
Source of cost estimate: Manufacturer

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
11	63,000	48,000	10.0	0	1.2	0	7,680	15	115,200	8.2	1	0	0	27,371	85,944

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs

ECM#12: *Replace existing West wing roof-mounted corridor exhaust fan with a direct-drive unit*

On the day of the site visit, SWA observed that the roof-mounted exhaust fan, located at the very end of the West facing wing of the building was older and not functioning correctly. This exhaust fan was operating inefficiently and at the time of the audit, was exhausting more air from the hallway than it was originally intended based on factory fan settings. Replacing this fan with a new unit containing a direct drive motor will allow the fan to be properly calibrated to the necessary levels and will also make it easier to re-adjust compared to a belt driven exhaust fan. Savings will be achieved by reducing the amount of conditioned air (heated and cooled) that is exhausted from the building.

Installation cost:

Estimated installed cost: $2,200 (includes $700 of labor)
Source of cost estimate: Similar Projects

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
12	2,200	639	0.0	121	0.1	0	258	25	6,458	8.5	2	0	0	840	2,478

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs

ECM#13: *Retro-commissioning of Common Area ventilation system*

The Tomaso Plaza building has a unique central ventilation system for common areas based on observations by SWA staff in the field. Building drawings are currently not available for reference and all recommendations are based on field observations. The building contains unit ventilators in the center of each corridor to provide heating or cooling to the corridors. These unit ventilators received outside air that passes through a heating ventilator in the basement. Based on this design, conditioned air is delivered to the center area of the building near the elevator bank. At the end of each corridor, there are exhaust air grills that are connected to common ductwork that connects to an exhaust fan on top of the roof. The exhaust fans are responsible for drawing air from the hallways in order to spread the conditioned air at the center of the building down each corridor. Based on this design, expensive and conditioned air is constantly being exhausted from the building. SWA recommends that Middletown Housing Authority hire a qualified contractor to re-evaluate the design of this system. It may be possible to removed unnecessary corridor exhaust fans to limit the amount of air that is exhausted from the building or it may be possible to install timers on the rooftop exhaust fans in order to limit the amount of air that is exhausted at night, when few people travel through the corridors.

Installation cost:

Estimated installed cost: $35,213 (includes $32,000 of labor)
Source of cost estimate: Similar Projects

Economics:

ECM #	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	Therms of Natural gas, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
13	35,213	3,300	0.6	2,700	2.0	0	4,011	10	40,110	8.8	0	0	0	-1,345	35,671

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Calculations were based on the most conservative option of installing a timer for the exhaust fans at night. This assumes that exhaust fans are not necessary between the hours of 10pm and 6am at night and results in a reduction of lost heated and cooled air.

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs

PROPOSED FURTHER RECOMMENDATIONS

Capital Improvements

Capital Improvements are recommendations for the building that may not be cost-effective at the current time, but that could yield a significant long-term payback. These recommendations should typically be considered as part of a long-term capital improvement plan. Capital improvements should be considered if additional funds are made available, or if the installed costs can be shared with other improvements, such as major building renovations. SWA recommends the following capital improvements for the residential complex building:

- Conduct a ventilation feasibility study – SWA recommends that Middletown Housing Authority hire a consultant to perform a detailed ventilation feasibility study. The ventilation system at Tomaso Plaza is unique and is negatively pressurized. The unit ventilators in the common corridors supply heating, cooling and ventilation to each floor, which is then drawn to the ends of each corridor through negative pressure and exhausted by one exhaust fan located at the end of each wing of the "Y" shaped building. A detailed ventilation study is not included in the scope of work of this audit, however SWA observed that there is large potential for cost savings. Exhaust air for corridors appears to be excessive and can be drastically reduced to achieve energy savings. There is also an issue stemming from the installation of the unit ventilators that involves excess moisture in the form of condensation on the cooling coils during hot and humid summer months. According to building staff, condensation drips from the cooling coils and causes water damage during hot and muggy days. This issue should be addressed during the ventilation study to prevent further damage to the units and nearby walls.

- Increase level of insulation at roof level – SWA recommends that when a roof replacement is considered, that increasing roof insulation levels to a minimum of R-30 is considered. In addition to preventing heat losses, increased insulation will also all the contractor to create a steeper slope for the roof drainage plane by increasing the pitch of the insulation, reducing the amount of standing water.

- Replace existing remaining thru-wall AC units that are not ENERGY STAR® rated with high efficiency units – Based on current usage, replacing thru-wall AC units with high efficiency units would not be justified on energy cost savings alone. Instead, SWA recommends that the Middletown Housing Authority replace each thru-wall AC unit as they fail or as capital funding appropriations become available. Currently, the existing units are estimated at an efficiency value of 9.5 EER. Newer, more efficient models are now available at efficiency values of 13.0 EER or greater.

- Replace existing chiller and unit ventilators with high efficiency units – Based on current usage and age of the equipment, replacing the existing chiller and unit ventilators with high efficiency units would not be justified on energy cost savings alone. Instead, SWA recommends that the Middletown Housing Authority replace each unit as they fail or as capital funding appropriations become available.

- Replace existing rooftop exhaust fans with direct-drive units – Currently, there are a few roof-mounted exhaust fans that have loose belts and are not performing as designed. SWA recommends installing direct-drive exhaust fans as the existing exhaust fans fail. Replacing exhaust fans will result in a minimal energy savings; however direct-drive exhaust fans can be re-calibrated easily and can result in reduced operating costs.

Operations and Maintenance

Operations and Maintenance measures consist of low/no cost measures that are within the capability of the current building staff to handle. These measures typically require little investment, and they yield a short payback period. These measures may address equipment settings or staff operations that, when addressed will reduce energy consumption or costs.

- Install low flow aerators at sinks and low flow showerheads – Based on field observations, every apartment contains a 2.2 GPM faucet in the bathroom and kitchen and a 2.5 GPM showerhead. The existing water appliances are not low flow and can lead to a large waste of both domestic cold water and domestic hot water. SWA recommends that Middletown Housing Authority install .5 GPM low flow aerators at all bathroom sinks, 1.5 GPM low flow aerators at all kitchen sinks and 1.5 GPM showerheads in all baths. Installing these low flow devices are a minimal cost, within the capability of the building staff and will result in significant water savings as well as electricity savings related to domestic hot water heating.

- Maintain roofs – SWA recommends regular maintenance to verify water is draining correctly.

- Provide weather-stripping/air-sealing - SWA observed that exterior door weather-stripping was beginning to deteriorate in places. Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. The perimeter of all window frames should also be regularly inspected, and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frames. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.

- Repair/seal wall cracks and penetrations - SWA recommends as part of the maintenance program installing weep holes, installing proper flashing and correct masonry efflorescence, and sealing wall cracks and penetrations wherever necessary in order to keep insulation dry and effective.

- Always purchase the most energy efficient appliances - SWA recommends that the building considers purchasing the most energy-efficient equipment, including Energy Star labeled appliances, when equipment is installed or replaced. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov.

- Use smart power electric strips - in conjunction with occupancy sensors to power down computer equipment when left unattended for extended periods of time.

- Create an energy educational program - that teaches how to minimize energy use. The U.S. Department of Energy offers free information for hosting energy efficiency educational programs and plans. For more information please visit: http://www1.eere.energy.gov/education/.

APPENDIX A: EQUIPMENT LIST

Inventory

Building System	Description	Location	Make/ Model	Fuel	Space Served	Date Installed	Estimated Remaining Useful Life %
Cooling	CH-1; Trane intellipak - air-cooled condensing liquid chiller - self-contained unit, 30 tons, 11.9 EER, 3 PH, 200V, 60 HZ, R-22 refrigerant, supplies chilled water at 58F	Rooftop	Trane, Model #CGAFC30EAEA1000D00000000T0W00, Serial #C01D47853	Electric	Common Areas; Hallways	2001	84%
Cooling	CHWS-P1; U.S electrical motors chilled water supply pump motor, 1 HP, 208V, 1745 RPM, 3PH, 60 Hz, Frame 143JM, NEMA design B, SF-1.25,NEMA nom. efficiency 80.0%	Rooftop	U.S Electrical Motors, Unimount 125, Model #F111, Type UT-4, Mfd. #P63C7W-3035, Mfg #M00 7	Electric	Common Areas; Hallways	2001	60%
Cooling	CHWS-P2; Marathon Electric motors chilled water supply pump motor, 1 HP, 208V, 1745 RPM, 3PH, Type TDR, 60 Hz, Frame 143JM, FLEF efficiency 77.0%, SF 1.15	Rooftop	Marathon Electric motor, Model #CVM 143TTDR5334AD P, Cat. No M302	Electric	Common Areas; Hallways	2001	60%
Heating	HV-1; Hastings heating ventilator, make-up air unit, Size CB-214, Blower data; 775 RPM, 1.25 SP, 7,000 CFM, Motor Specs; 3 HP, 3ph, 208V, 60Hz, 1740 RPM, Set for 60 degF	HVAC Room	Hastings, Model #EMU-7-E, Serial #7283	Electric/ Hot Water Loop	Serves Main Hallways	2001	60%
Heating	HV-2; Hastings heating ventilator, make-up air unit, Size CB-214, Blower data; 775 RPM, 1.25 SP, 7,000 CFM, Motor Specs; 3 HP, 3ph, 208V, 60Hz, 1740 RPM, Set for 60 degF	HVAC Room	Hastings, Model #EMU-7-E, Serial #7284	Electric/ Hot Water Loop	Serves Main Hallways	2001	60%
Heating	FCU-1; 208V, 60Hz, 3ph, 3 ton, Factory installed drive, 1,000-1,417 Fan RPM, with hot water coils, receives air from HV-2	HVAC Room	Trane, Model #BCHB0361EF0A1300B4G000000CC13-, Serial #T01D48791A	Electric/ Hot Water Loop	Common Areas; Hallways	2001	60%
Heating	B-1; Patterson-Kelly Thermific direct vent heating boiler, 1,200,000 BTUH input, 1,020, 000 BTUH output, 85% thermal efficiency	Mechanical Room	Patterson-Kelly, Thermific, Model #SN-1200, Serial #NB74133	Natural Gas	Common Areas; Hallways	2001	60%
Domestic Hot Water	DHW-1; AO Smith - Burkay, domestic hot water heater, direct vent, Legend 2000, 750,000 BTUH input, 675,000 BTUH output, hot water stored at 150 degF	Mechanical Room	AO Smith - Burkay, Model #990 LW 750, Serial #990 A02 66849, Part #LW 750 E22N000000	Natural Gas	All Areas	2002	47%
Heating	HHWS-P-1; US Motors, Type DF-4, Frame 145JM, 1.5 HP, NEMA nom. Efficiency 80.0%, 208V, 1ph, 1740 RPM, Encl. DP, from hot water tank to building, connected to no name, insulated est. 200 gallon tank	Mechanical Room	US Motors, Model #G152A, Catalog #DJ3252AMR	Electric	Common Areas; Hallways	2001	64%

Heating	HHWS-P-3; Century AC motor, Type SC, 1/2 HP, 1725 RPM, Encl. DP, Continous, 3ph, 60Hz	Mechanical Room	Century, Cat. #H358, Serial #127075M	Electric	Common Areas; Hallways	2001	20%
Heating	Dayton electric unit heater, no nameplate info available	Vestibule near maintenance office	Dayton, Model #NA, Serial #NA	Electric	Vestibule near maintenance office	2001	20%
Heating	HHWS-P-2; Bell & Gossett, 1/6 HP, 1725 RPM, 1ph, 60 Hz,	Mechanical Room	Bell & Gossett, ID#M10711	Electric	Common Areas; Hallways	1996	0%
Heating/ Cooling	Trane air handler with split AC system and electric heating, 15 tons, 6,000 CFM, 9.9 EER, 176,000 BTUH cooling capacity,	Mechanical Room through Maintenance Office	Trane, Odyssey, Model #TWE180B300CA, Serial #R302MJ56H	Electric	Common Areas; Hallways	2001	64%
Cooling	Trane condensor connected to Trane air handler, R-22 refrigerant, connected via underground piping 15' away from building	Outside, behind Mechanical Room through Maintenance Office	Trane, Odyssey, Model #TTA180B300DA, Serial #Z173PJ6AH	Electric	Common Areas; Hallways	2001	64%
Cooling	GE, Typical thru-wall AC unit, 9,900 cooling Btuh, 230V, 1 ph, 60 Hz, R-22 refrigerant, EER 9.5, 1,075W cooling	Mounted in exterior walls in Apartment units	GE, Model #AJCS10DCAM1, Serial #LA 606632	Electric	Apartment units	2001	64%
Ventilation	Two (2) Markel supply fans for corridor, 208V, AC motor, 60 Hz, 5,000W	6th floor Rooftop	Markel, Model #F3485	Electric	Corridors	2001	20%
Heating/ Cooling/ Ventilation	Six (6) Trane unit ventilators with hot/chilled water loops, 1,250 CFM, 9.2 EER, R-22, 9,900 cooling BTUH, 1,075 cooling Watts, 2-pipe CW/HW coil, 6th floor unit is slightly larger	Common hallways near elevator	Trane, Model #VUVC1251100AAABR0CF 51AA100-, Serial #W01ER261	Electric/ Hot Water/ Chilled Water	Corridors, Common Areas	1999	56%
Generator	Kohler Power Systems generator, diesel, 60Hz, 1, 800 RPM	Basement level, Generator Room	Kohler, Series 125, Model #125RE0ZJB, Serial #2023657, Spec. #GM31029-GA7	Diesel	All Areas	2004	80%
Garbage Compactor	Garbage Compactor, Arrow Steel	Basement level, Garbage Compactor Room	Arrow Steel, Model #NYC-2000, Serial #3090	Electricity	Garbage Chutes	2009	95%
Garbage Compactor	Garbage compactor motor, Baldor Industrial motor, 3 HP, 230V, 8.2 amps, 60 Hz, 1750 RPM, Frame 145TC, NEMA nom. Efficiency 87.5%, P.F 78%, Encl-TEFC	Basement level, Garbage Compactor Room	Baldor, Industrial, Spec. #35A002T098H2	Electricity	Garbage Compactor	2009	95%
Transformer	E-1; Hammond Transformer, 51.0 kVA, 3 PH, dry-type drive isolation transformer, Type K, Encl. Type - NEMA - 3R, 208V	Basement level, Elevator machine room	Hammond, Part #183566, Serial #ME07A-01	Electricity	Elevator 1	1978	20%
Transformer	E-2; Hammond, 51.0 kVA, 3 PH, dry-type drive isolation transformer, Type K, Encl. Type - NEMA - 3R, 208V	Ground level, Elevator machine room	Hammond, Part #183566, Serial #ME07A-02	Electricity	Elevator 2	1978	20%
Elevators	Two (2) Hammond hydraulic elevators	Ground level, Elevator machine room	Hammond, no nameplate info available	Electricity	All Areas	1978	20%
Lighting	See Appendix A	-	-	-	-	-	-

Note: The remaining useful life of a system (in %) is an estimate based on the system date of built and existing conditions derived from visual inspection.

Appendix B: Lighting Study – Alice V. Tomaso Plaza

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
1	1	Directors Office	Recessed	E	4'T8	2	4	32	Sw	8	365	5	266	777	N/A	Recessed	4'T8	E	Sw	2	4	32	8	365	5	266	777	0	0	0
2	1	Directors Office	Recessed	S	CFL	6	2	13	Sw	8	365	0	156	456	N/A	Recessed	CFL	S	Sw	6	2	13	8	365	0	156	456	0	0	0
3	1	Office Area	Recessed	E	4'T8	2	4	32	Sw	8	365	5	266	777	N/A	Recessed	4'T8	E	Sw	2	4	32	8	365	5	266	777	0	0	0
4	1	Copy Room	Recessed	E	4'T8	3	4	32	Sw	4	365	5	399	583	N/A	Recessed	4'T8	E	Sw	3	4	32	4	365	5	399	583	0	0	0
5	1	Office Area	Recessed	E	4'T8	6	4	32	Sw	8	365	5	798	2,330	N/A	Recessed	4'T8	E	Sw	6	4	32	8	365	5	798	2330	0	0	0
6	1	Meeting Room	Recessed	E	4'T8	8	4	32	Sw	4	365	5	1,064	1,553	C	Recessed	4'T8	E	OS	8	4	32	3	365	5	1064	1165	0	388	388
7	1	Storage Room	Recessed	E	4'T8	2	2	32	Sw	2	365	5	138	101	N/A	Recessed	4'T8	E	Sw	2	2	32	2	365	5	138	101	0	0	0
8	1	Bathroom	Ceiling Mounted	S	CFL	1	2	13	Sw	2	365	0	26	19	N/A	Ceiling Mounted	CFL	S	Sw	1	2	13	2	365	0	26	19	0	0	0
9	1	Hallway	Recessed	E	4'T8	3	4	32	N	24	365	5	399	3,495	N/A	Recessed	4'T8	E	N	3	4	32	24	365	5	399	3495	0	0	0
10	1	Storage Room	Ceiling Mounted	E	4'T8	1	2	32	Sw	2	365	5	69	50	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	2	365	5	69	50	0	0	0
11	1	Vestibule	Recessed	E	4'T8	1	3	32	N	24	365	5	101	885	N/A	Recessed	4'T8	E	N	1	3	32	24	365	5	101	885	0	0	0
12	1	Vestibule	Recessed	S	CFL	2	2	13	N	24	365	0	52	456	N/A	Recessed	CFL	S	N	2	2	13	24	365	0	52	456	0	0	0
13	1	Lobby	Recessed	E	4'T8	8	3	32	N	24	365	5	808	7,078	N/A	Recessed	4'T8	E	N	8	3	32	24	365	5	808	7078	0	0	0
14	1	Lobby	Exit Sign	S	LED	1	1	5	N	24	365	1	6	49	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	49	0	0	0
15	1	Hallway-A 104-110	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
16	1	Hallway-A 104-110	Recessed	E	4'T8	8	2	32	N	24	365	5	552	4,836	N/A	Recessed	4'T8	E	N	8	2	32	24	365	5	552	4836	0	0	0
17	1	Trash Chute	Ceiling Mounted	E	4'T8	1	2	32	N	24	365	5	69	604	N/A	Ceiling Mounted	4'T8	E	N	1	2	32	24	365	5	69	604	0	0	0
18	Str	Stairs-A	Wall Mounted	E	4'T8	12	2	32	N	24	365	5	828	7,253	C	Wall Mounted	4'T8	E	BL	12	2	32	0	365	5	828	4226	0	3027	3027
19	Str	Stairs-B	Wall Mounted	E	4'T8	12	2	32	N	24	365	5	828	7,253	C	Wall Mounted	4'T8	E	BL	12	2	32	0	365	5	828	4226	0	3027	3027
20	1	Hallway	Recessed	E	4'T8	5	2	32	N	24	365	5	345	3,022	N/A	Recessed	4'T8	E	N	5	2	32	24	365	5	345	3022	0	0	0
21	1	Hallway	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
22	1	Hallway	Recessed	S	CFL	1	2	13	N	24	365	0	26	228	N/A	Recessed	CFL	S	N	1	2	13	24	365	0	26	228	0	0	0
23	Str	Staircase - B	Wall Mounted	E	4'T8	12	2	32	N	24	365	5	828	7,253	C	Wall Mounted	4'T8	E	BL	12	2	32	0	365	5	828	4226	0	3027	3027
24	Str	Staircase - B	Exit Sign	S	LED	1	1	5	N	24	365	1	6	49	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	49	0	0	0
25	1	Hallway - C	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
26	1	Hallway - C	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
27	Str	Staircase-C	Wall Mounted	E	4'T8	12	2	32	N	24	365	5	828	7,253	C	Wall Mounted	4'T8	E	BL	12	2	32	0	365	5	828	4226	0	3027	3027
28	Str	Staircase-C	Exit Sign	S	LED	1	1	5	N	24	365	1	6	49	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	49	0	0	0
29	1	Elevator2	Ceiling Mounted	M	4'T12	3	2	40	N	24	365	12	276	2,418	T8	Ceiling Mounted	4'T8	E	N	3	2	32	24	365	5	207	1813	604	0	604
30	1	Elevator	Ceiling Mounted	E	4'T8	3	2	32	N	24	365	5	207	1,813	N/A	Ceiling Mounted	4'T8	E	N	3	2	32	24	365	5	207	1813	0	0	0
31	1	Elevator Lobby	Recessed	E	4'T8	3	2	32	N	24	365	5	207	1,813	N/A	Recessed	4'T8	E	N	3	2	32	24	365	5	207	1813	0	0	0
32	1	Hallway	Recessed	E	4'T8	5	2	32	N	24	365	5	345	3,022	N/A	Recessed	4'T8	E	N	5	2	32	24	365	5	345	3022	0	0	0
33	1	Hallway	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
34	Bsmt	Laundry	Recessed	E	4'T8	6	4	32	Sw	4	365	5	798	1,165	C	Recessed	4'T8	E	OS	6	4	32	3	365	5	798	874	0	291	291
35	Bsmt	Hallway	Recessed	E	4'T8	2	2	32	N	24	365	5	138	1,209	N/A	Recessed	4'T8	E	N	2	2	32	24	365	5	138	1209	0	0	0
36	Bsmt	Hallway	Exit Sign	S	LED	1	1	5	N	24	365	1	6	49	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	49	0	0	0
37	Bsmt	Kitchen	Recessed	E	4'T8	2	2	32	Sw	8	365	5	138	403	N/A	Recessed	4'T8	E	Sw	2	2	32	8	365	5	138	403	0	0	0
38	Bsmt	Meeting Room	Recessed	E	4'T8	18	4	32	Sw	8	365	5	2,394	6,990	C	Recessed	4'T8	E	OS	18	4	32	6	365	5	2394	5243	0	1748	1748
39	Bsmt	Meeting Room	Recessed	E	4'T8	4	2	32	Sw	8	365	5	276	806	C	Recessed	4'T8	E	OS	4	2	32	6	365	5	276	604	0	201	201
40	Bsmt	Meeting Room Closet	Ceiling Mounted	E	4'T8	1	2	32	Sw	2	365	5	69	50	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	2	365	5	69	50	0	0	0
41	Bsmt	Bathroom Women	Recessed	E	4'T8	2	2	32	OS	4	365	5	138	201	N/A	Recessed	4'T8	E	OS	2	2	32	4	365	5	138	201	0	0	0
42	Bsmt	Bathroom Men	Recessed	E	4'T8	2	2	32	OS	4	365	5	138	201	N/A	Recessed	4'T8	E	OS	2	2	32	4	365	5	138	201	0	0	0
43	Bsmt	Library	Recessed	E	4'T8	1	4	32	Sw	8	365	5	133	388	N/A	Recessed	4'T8	E	Sw	1	4	32	8	365	5	133	388	0	0	0
44	Bsmt	Office Area	Recessed	E	4'T8	3	4	32	Sw	8	365	5	399	1,165	C	Recessed	4'T8	E	OS	3	4	32	6	365	5	399	874	0	291	291
45	Bsmt	Vestibule	Recessed	S	4'T8	2	2	32	N	24	365	5	138	1,209	N/A	Recessed	4'T8	S	N	2	2	32	24	365	5	138	1209	0	0	0
46	Bsmt	Vestibule	Exit Sign	S	LED	1	1	5	N	24	365	1	6	49	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	49	0	0	0
47	Bsmt	Office - Maintenance	Recessed	E	4'T8	2	2	32	Sw	8	365	5	138	403	N/A	Recessed	4'T8	E	Sw	2	2	32	8	365	5	138	403	0	0	0
48	Bsmt	Office - Maintenance	Ceiling Suspended	E	4'T8	5	2	32	Sw	8	365	5	345	1,007	C	Ceiling Suspended	4'T8	E	OS	5	2	32	6	365	5	345	756	0	252	252
49	Bsmt	Storage Room	Ceiling Mounted	E	4'T8	1	2	32	Sw	2	365	5	69	50	N/A	Ceiling Mounted	4'T8	E	Sw	1	2	32	2	365	5	69	50	0	0	0
50	Bsmt	Electrical Room	Ceiling Suspended	E	4'T8	8	2	32	Sw	2	365	5	552	403	C	Ceiling Suspended	4'T8	E	OS	8	2	32	2	365	5	552	302	0	101	101

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
51	Bsmt	Hallway	Ceiling Suspended	E	4'T8	4	2	32	N	24	365	5	276	2,418	C	Ceiling Suspended	4'T8	E	OS	4	2	32	18	365	5	276	1813	0	604	604
52	BH	Boiler Room	Ceiling Suspended	E	4'T8	2	2	32	Sw	2	365	5	138	101	N/A	Ceiling Suspended	4'T8	E	Sw	2	2	32	2	365	5	138	101	0	0	0
53	BH	Boiler Room	Pendant	S	CFL	1	1	23	Sw	2	365	0	23	17	N/A	Pendant	CFL	S	Sw	1	1	23	2	365	0	23	17	0	0	0
54	BH	Elevator Mech. Room	Ceiling Mounted	E	4'T8	2	2	32	Sw	2	365	5	138	101	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	2	365	5	138	101	0	0	0
55	Bsmt	Hallway	Ceiling Suspended	E	4'T8	4	2	32	N	24	365	5	276	2,418	N/A	Ceiling Suspended	4'T8	E	N	4	2	32	24	365	5	276	2418	0	0	0
56	Bsmt	Mechanical Room	Ceiling Mounted	E	4'T8	5	2	32	Sw	2	365	5	345	252	N/A	Ceiling Mounted	4'T8	E	Sw	5	2	32	2	365	5	345	252	0	0	0
57	Bsmt	Compactor Room	Ceiling Mounted	E	4'T8	2	2	32	Sw	2	365	5	138	101	N/A	Ceiling Mounted	4'T8	E	Sw	2	2	32	2	365	5	138	101	0	0	0
58	Bsmt	Compactor Room	Ceiling Suspended	E	4'T8	1	2	32	Sw	2	365	5	69	50	N/A	Ceiling Suspended	4'T8	E	Sw	1	2	32	2	365	5	69	50	0	0	0
59	Bsmt	Storage Room	Ceiling Suspended	E	4'T8	1	2	32	Sw	2	365	5	69	50	N/A	Ceiling Suspended	4'T8	E	Sw	1	2	32	2	365	5	69	50	0	0	0
60	Bsmt	Records Room	Ceiling Mounted	E	4'T8	4	2	32	Sw	2	365	5	276	201	N/A	Ceiling Mounted	4'T8	E	Sw	4	2	32	2	365	5	276	201	0	0	0
61	2	Lobby	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
62	2	Lobby	Exit Sign	S	LED	1	1	5	N	24	365	1	6	48	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	48	0	0	0
63	2	Hallway - C	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
64	2	Hallway - C	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
65	2	Hallway-A	Recessed	E	4'T8	8	2	32	N	24	365	5	552	4,836	N/A	Recessed	4'T8	E	N	8	2	32	24	365	5	552	4836	0	0	0
66	2	Hallway-A	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
67	2	Trash Chute	Ceiling Mounted	E	4'T8	2	2	32	N	24	365	5	138	1,209	N/A	Ceiling Mounted	4'T8	E	N	2	2	32	24	365	5	138	1209	0	0	0
68	2	Hallway-B	recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
69	2	Hallway-B	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
70	3	Lobby	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
71	3	Lobby	Exit Sign	S	LED	1	1	5	N	24	365	1	6	48	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	48	0	0	0
72	3	Hallway - C	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
73	3	Hallway - C	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
74	3	Hallway-A	Recessed	E	4'T8	8	2	32	N	24	365	5	552	4,836	N/A	Recessed	4'T8	E	N	8	2	32	24	365	5	552	4836	0	0	0
75	3	Hallway-A	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
76	3	Trash Chute	Ceiling Mounted	E	4'T8	2	2	32	N	24	365	5	138	1,209	N/A	Ceiling Mounted	4'T8	E	N	2	2	32	24	365	5	138	1209	0	0	0
77	3	Hallway-B	recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
78	3	Hallway-B	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
79	4	Lobby	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
80	4	Lobby	Exit Sign	S	LED	1	1	5	N	24	365	1	6	48	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	48	0	0	0
81	4	Hallway - C	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
82	4	Hallway - C	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
83	4	Hallway-A	Recessed	E	4'T8	8	2	32	N	24	365	5	552	4,836	N/A	Recessed	4'T8	E	N	8	2	32	24	365	5	552	4836	0	0	0
84	4	Hallway-A	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
85	4	Trash Chute	Ceiling Mounted	E	4'T8	2	2	32	N	24	365	5	138	1,209	N/A	Ceiling Mounted	4'T8	E	N	2	2	32	24	365	5	138	1209	0	0	0
86	4	Hallway-B	recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
87	4	Hallway-B	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
88	5	Lobby	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
89	5	Lobby	Exit Sign	S	LED	1	1	5	N	24	365	1	6	48	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	48	0	0	0
90	5	Hallway - C	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
91	5	Hallway - C	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
92	5	Hallway-A	Recessed	E	4'T8	8	2	32	N	24	365	5	552	4,836	N/A	Recessed	4'T8	E	N	8	2	32	24	365	5	552	4836	0	0	0
93	5	Hallway-A	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
94	5	Trash Chute	Ceiling Mounted	E	4'T8	2	2	32	N	24	365	5	138	1,209	N/A	Ceiling Mounted	4'T8	E	N	2	2	32	24	365	5	138	1209	0	0	0
95	5	Hallway-B	recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
96	5	Hallway-B	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
97	6	Lobby	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
98	6	Lobby	Exit Sign	S	LED	1	1	5	N	24	365	1	6	48	N/A	Exit Sign	LED	S	N	1	1	5	24	365	1	6	48	0	0	0
99	6	Hallway - C	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
100	6	Hallway - C	Recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0

Location			Existing Fixture Information												Retrofit Information													Annual Savings		
Marker	Floor	Room Identification	Fixture Type	Ballast	Lamp Type	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Controls	Operational Hours per Day	Operational Days per Year	Ballast Wattage	Total Watts	Energy Use kWh/year	Category	Fixture Type	Lamp Type	Ballast	Controls	# of Fixtures	# of Lamps per Fixture	Watts per Lamp	Operational Hours per Day	Operational Days per Year	Ballast Watts	Total Watts	Energy Use kWh/year	Fixture Savings (kWh)	Controls Savings (kWh)	Total Savings (kWh)
101	6	Hallway-A	Recessed	E	4'T8	8	2	32	N	24	365	5	552	4,836	N/A	Recessed	4'T8	E	N	8	2	32	24	365	5	552	4836	0	0	0
102	6	Hallway-A	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
103	6	Trash Chute	Ceiling Mounted	E	4'T8	2	2	32	N	24	365	5	138	1,209	N/A	Ceiling Mounted	4'T8	E	N	2	2	32	24	365	5	138	1209	0	0	0
104	6	Hallway-B	recessed	E	4'T8	6	2	32	N	24	365	5	414	3,627	N/A	Recessed	4'T8	E	N	6	2	32	24	365	5	414	3627	0	0	0
105	6	Hallway-B	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
106	1	Dwelling Units	Chandelier	S	CFL	22	3	13	Sw	4	365	0	858	1,253	N/A	Chandelier	CFL	S	Sw	22	3	13	4	365	0	858	1253	0	0	0
107	1	Dwelling Units - Vestibule	Ceiling Mounted	S	CFL	22	2	13	Sw	8	365	0	572	1,670	N/A	Ceiling Mounted	CFL	S	Sw	22	2	13	8	365	0	572	1670	0	0	0
108	1	Dwelling Units - Kitchen	Ceiling Mounted	E	4'T8	22	2	32	Sw	4	365	5	1,518	2,216	N/A	Ceiling Mounted	4'T8	E	Sw	22	2	32	4	365	5	1518	2216	0	0	0
109	1	Dwelling Units - Night Light	Recessed	S	Inc	22	1	60	Sw	2	365	0	1,320	964	CFL	Recessed	CFL	S	Sw	22	1	20	2	365	0	440	321	642	0	642
110	1	Dwelling Units - Bathroom	Ceiling Mounted	S	CFL	22	2	13	Sw	8	365	0	572	1,670	N/A	Ceiling Mounted	CFL	S	Sw	22	2	13	8	365	0	572	1670	0	0	0
111	2	Dwelling Units	Chandelier	S	CFL	26	3	13	Sw	4	365	0	1,014	1,480	N/A	Chandelier	CFL	S	Sw	26	3	13	4	365	0	1014	1480	0	0	0
112	2	Dwelling Units - Vestibule	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
113	2	Dwelling Units - Kitchen	Ceiling Mounted	E	4'T8	26	2	32	Sw	4	365	5	1,794	2,619	N/A	Ceiling Mounted	4'T8	E	Sw	26	2	32	4	365	5	1794	2619	0	0	0
114	2	Dwelling Units - Night Light	Recessed	S	Inc	26	1	60	Sw	2	365	0	1,560	1,139	CFL	Recessed	CFL	S	Sw	26	1	20	2	365	0	520	380	759	0	759
115	2	Dwelling Units - Bathroom	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
116	3	Dwelling Units	Chandelier	S	CFL	26	3	13	Sw	4	365	0	1,014	1,480	N/A	Chandelier	CFL	S	Sw	26	3	13	4	365	0	1014	1480	0	0	0
117	3	Dwelling Units - Vestibule	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
118	3	Dwelling Units - Kitchen	Ceiling Mounted	E	4'T8	26	2	32	Sw	4	365	5	1,794	2,619	N/A	Ceiling Mounted	4'T8	E	Sw	26	2	32	4	365	5	1794	2619	0	0	0
119	3	Dwelling Units - Night Light	Recessed	S	Inc	26	1	60	Sw	2	365	0	1,560	1,139	CFL	Recessed	CFL	S	Sw	26	1	20	2	365	0	520	380	759	0	759
120	3	Dwelling Units - Bathroom	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
121	4	Dwelling Units	Chandelier	S	CFL	26	3	13	Sw	4	365	0	1,014	1,480	N/A	Chandelier	CFL	S	Sw	26	3	13	4	365	0	1014	1480	0	0	0
122	4	Dwelling Units - Vestibule	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
123	4	Dwelling Units - Kitchen	Ceiling Mounted	E	4'T8	26	2	32	Sw	4	365	5	1,794	2,619	N/A	Ceiling Mounted	4'T8	E	Sw	26	2	32	4	365	5	1794	2619	0	0	0
124	4	Dwelling Units - Night Light	Recessed	S	Inc	26	1	60	Sw	2	365	0	1,560	1,139	CFL	Recessed	CFL	S	Sw	26	1	20	2	365	0	520	380	759	0	759
125	4	Dwelling Units - Bathroom	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
126	5	Dwelling Units	Chandelier	S	CFL	26	3	13	Sw	4	365	0	1,014	1,480	N/A	Chandelier	CFL	S	Sw	26	3	13	4	365	0	1014	1480	0	0	0
127	5	Dwelling Units - Vestibule	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
128	5	Dwelling Units - Kitchen	Ceiling Mounted	E	4'T8	26	2	32	Sw	4	365	5	1,794	2,619	N/A	Ceiling Mounted	4'T8	E	Sw	26	2	32	4	365	5	1794	2619	0	0	0
129	5	Dwelling Units - Night Light	Recessed	S	Inc	26	1	60	Sw	2	365	0	1,560	1,139	CFL	Recessed	CFL	S	Sw	26	1	20	2	365	0	520	380	759	0	759
130	5	Dwelling Units - Bathroom	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
131	6	Dwelling Units	Chandelier	S	CFL	26	3	13	Sw	4	365	0	1,014	1,480	N/A	Chandelier	CFL	S	Sw	26	3	13	4	365	0	1014	1480	0	0	0
132	6	Dwelling Units - Vestibule	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
133	6	Dwelling Units - Kitchen	Ceiling Mounted	E	4'T8	26	2	32	Sw	4	365	5	1,794	2,619	N/A	Ceiling Mounted	4'T8	E	Sw	26	2	32	4	365	5	1794	2619	0	0	0
134	6	Dwelling Units - Night Light	Recessed	S	Inc	26	1	60	Sw	2	365	0	1,560	1,139	CFL	Recessed	CFL	S	Sw	26	1	20	2	365	0	520	380	759	0	759
135	6	Dwelling Units - Bathroom	Ceiling Mounted	S	CFL	26	2	13	Sw	8	365	0	676	1,974	N/A	Ceiling Mounted	CFL	S	Sw	26	2	13	8	365	0	676	1974	0	0	0
136	Ext	Exterior	Pole Mounted	E	MH	4	2	175	T	12	365	49	1,596	6,990	PSMH	Pole Mounted	PSMH	E	T	4	2	100	12	365	20	880	3854	3136	0	3136
137	Ext	Exterior	Pole Mounted	E	MH	5	1	175	T	12	365	49	1,120	4,906	PSMH	Pole Mounted	PSMH	E	T	5	1	100	12	365	20	600	2628	2278	0	2278
138	Ext	Exterior	Flood	E	MH	1	1	175	T	12	365	49	224	981	PSMH	Flood	PSMH	E	T	1	1	100	12	365	20	120	526	456	0	456
139	Ext	Exterior	Flood	E	MH	1	1	50	T	12	365	14	64	280	PSMH	Flood	PSMH	E	T	1	1	25	12	365	5	30	131	149	0	149
140	Ext	Exterior	Wallpack	E	HPS	3	1	150	T	12	365	30	540	2,365	PSMH	Wallpack	PSMH	E	T	3	1	100	12	365	20	360	1577	788	0	788
141	Ext	Exterior	Pole Mounted Off Building	E	MH	4	1	175	T	12	365	49	896	3,924	PSMH	Pole Mounted Off Building	PSMH	E	T	4	1	100	12	365	20	480	2102	1822	0	1822
142	Ext	Exterior	Ceiling Mounted	E	HPS	4	1	35	T	12	365	7	168	736	PSMH	Ceiling Mounted	PSMH	E	T	4	1	25	12	365	5	120	526	210	0	210
143	Ext	Exterior	Wall Mounted	E	HPS	8	1	35	T	12	365	7	336	1,472	PSMH	Wall Mounted	PSMH	E	T	8	1	25	12	365	5	240	1051	420	0	420
Totals:						1,191	271	4,256				661	66,214	252,610						1,191	271	3,613			515	57,951	222,321	14,302	15,987	30,289
Rows Highlighed Yellow Indicate an Energy Conservation Measure is recommended for that space																														

Legend:

Fixture Type	Lamp Type	Control Type	Ballast Type	Retrofit Category
Exit Sign	LED	N (None)	N/A (None)	N/A (None)
Screw-in	Inc (Incandescent)	S (Switch)	E (Electronic)	T8 (Installl new T8)
Pin	1'T5	OS (Occupancy Sensor)	M (Magnetic)	T5 (Install new T5)
Parabolic	2'T5	T (Timer)		CFL (Install new CFL)
Recessed	3'T5	PC (Photocell)		LEDex (Install new LED Exit)
2'U-shape	4'T5	D (Dimming)		LED (Install new LED)
Circiline	2'T8	DL (Daylight Sensor)		D (Delamping)
Exterior	3'T8	M (Microphonic Sensor)		C (Controls Only)
HID (High Intensity Discharge)	4'T8			
	6'T8			
	8'T8			
	2'T12			
	3'T12			
	4'T12			
	6'T12			
	8'T12			
	CFL (Compact Fluorescent Lightbulb)			
	MR16			
	Halogen			
	MV (Mercury Vapor)			
	MH (Metal Halide)			
	HPS (High Pressure Sodium			
	LPS (Low Pressure Sodium)			

APPENDIX C: THIRD PARTY ENERGY SUPPLIERS

http://www.state.nj.us/bpu/commercial/shopping.html

Third Party Electric Suppliers for JCPL Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
BOC Energy Services, Inc. 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 www.boc.com
Commerce Energy, Inc. 4400 Route 9 South, Suite 100 Freehold, NJ 07728	(800) 556-8457 www.commerceenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 www.newenergy.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
FirstEnergy Solutions 300 Madison Avenue Morristown, NJ 07926	(800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640	(877) 569-2841 www.glacialenergy.com
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com
Liberty Power Delaware, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Liberty Power Holdings, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(800) 363-7499 www.libertypowercorp.com
Pepco Energy Services, Inc. 112 Main St. Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.semprasolutions.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Suez Energy Resources NA, Inc. 333 Thornall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com

Third Party Gas Suppliers for NJNG Service Territory	Telephone & Web Site
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109	(800) 628-9427 www.cooperativenet.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 www.gesc.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
Intelligent Energy 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024	(800) 724-1880 www.intelligentenergy.org
Metromedia Energy, Inc. 6 Industrial Way Eatontown, NJ 07724	(877) 750-7046 www.metromediaenergy.com
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 08837	(800) 375-1277 www.mxenergy.com
NATGASCO (Mitchell Supreme) 532 Freeman Street Orange, NJ 07050	(800) 840-4427 www.natgasco.com
NJ Gas & Electric 1 Bridge Plaza, Fl. 2 Fort Lee, NJ 07024	(866) 568-0290 www.NewJerseyGasElectric.com
Pepco Energy Services, Inc. 112 Main Street Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Woodruff Energy 73 Water Street Bridgeton, NJ 08302	(800) 557-1121 www.woodruffenergy.com

APPENDIX D: GLOSSARY AND METHOD OF CALCULATIONS

Glossary of ECM Terms

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Net ECM Cost: The net ECM cost is the cost experienced by the customer, which is typically the total cost (materials + labor) of installing the measure minus any available incentives. Both the total cost and the incentive amounts are expressed in the summary for each ECM.

Annual Energy Cost Savings (AECS): This value is determined by the audit firm based on the calculated energy savings (kWh or Therm) of each ECM and the calculated energy costs of the building.

Lifetime Energy Cost Savings (LECS): This measure estimates the energy cost savings over the lifetime of the ECM. It can be a simple estimation based on fixed energy costs. If desired, this value can factor in an annual increase in energy costs as long as the source is provided.

Simple Payback: This is a simple measure that displays how long the ECM will take to break-even based on the annual energy and maintenance savings of the measure.

ECM Lifetime: This is included with each ECM so that the owner can see how long the ECM will be in place and whether or not it will exceed the simple payback period. Additional guidance for calculating ECM lifetimes can be found below. This value can come from manufacturer's rated lifetime or warranty, the ASHRAE rated lifetime, or any other valid source.

Operating Cost Savings (OCS): This calculation is an annual operating savings for the ECM. It is the difference in the operating, maintenance, and / or equipment replacement costs of the existing case versus the ECM. In the case where an ECM lifetime will be longer than the existing measures (such as LED lighting versus fluorescent) the operating savings will factor in the cost of replacing the units to match the lifetime of the ECM. In this case or in one where one-time repairs are made, the total replacement / repair sum is averaged over the lifetime of the ECM.

Return on Investment (ROI): The ROI is expresses the percentage return of the investment based on the lifetime cost savings of the ECM. This value can be included as an annual or lifetime value, or both.

Net Present Value (NPV): The NPV calculates the present value of an investment's future cash flows based on the time value of money, which is accounted for by a discount rate (assumes bond rate of 3.2%).

Internal Rate of Return (IRR): The IRR expresses an annual rate that results in a break-even point for the investment. If the owner is currently experiencing a lower return on their capital than the IRR, the project is financially advantageous. This measure also allows the owner to compare ECMs against each other to determine the most appealing choices.

Gas Rate and Electric Rate ($/therm and $/kWh): The gas rate and electric rate used in the financial analysis is the total annual energy cost divided by the total annual energy usage for the 12 month billing period studied. The graphs of the monthly gas and electric rates reflect the total monthly energy costs divided by the monthly usage, and display how the average rate fluctuates throughout the year. The average annual rate is the only rate used in energy savings calculations.

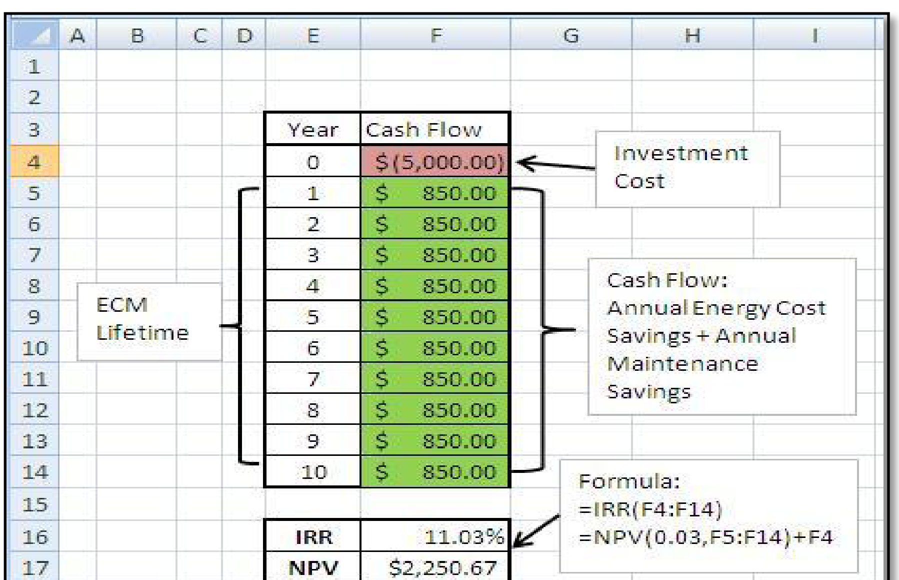
Calculation References

Term	Definition
ECM	Energy Conservation Measure
AOCS	Annual Operating Cost Savings
AECS	Annual Energy Cost Savings
LOCS*	Lifetime Operating Cost Savings
LECS	Lifetime Energy Cost Savings
LCS	Lifetime Cost Savings
NPV	Net Present Value
IRR	Internal Rate of Return
DR	Discount Rate
Net ECM Cost	Total ECM Cost – Incentive
LECS	AECS X ECM Lifetime
AOCS	LOCS / ECM Lifetime
LCS	LOCS+LECS
Simple Payback	Net ECM Cost / (AECS + AOCS)
Lifetime ROI	(LECS + LOCS – Net ECM Cost) / Net ECM Cost
Annual ROI	(Lifetime ROI / Lifetime) = [(AECS + OCS) / Net ECM Cost – (1 / Lifetime)]

* The lifetime operating cost savings are all avoided operating, maintenance, and/or component replacement costs over the lifetime of the ECM. This can be the sum of any annual operating savings, recurring or bulk (i.e. one-time repairs) maintenance savings, or the savings that comes from avoiding equipment replacement needed for the existing measure to meet the lifetime of the ECM (e.g. lighting change outs).

Excel NPV and IRR Calculation

In Excel, function =IRR (values) and =NPV (rate, values) are used to quickly calculate the IRR and NPV of a series of annual cash flows. The investment cost will typically be a negative cash flow at year 0 (total cost - incentive) with years 1 through the lifetime receiving a positive cash flow from the annual energy cost savings and annual maintenance savings. The calculations in the example below are for an ECM that saves $850 annually in energy and maintenance costs (over a 10 year lifetime) and takes $5,000 to purchase and install after incentives:



Solar PV ECM Calculation

There are several components to the calculation:

Costs:	Material of PV system including panels, mounting and net-metering + Labor
Energy Savings:	Reduction of kWh electric cost for life of panel, 25 years
Incentive 1:	NJ Renewable Energy Incentive Program (REIP), for systems of size 50kW or less, $1/Watt incentive subtracted from installation cost
Incentive 2:	Solar Renewable Energy Credits (SRECs) – Market-rate incentive. Calculations assume $600/Megawatt hour consumed per year for a maximum of 15 years; added to annual energy cost savings for a period of 15 years. (Megawatt hour used is rounded to nearest 1,000 kWh)
Assumptions:	A Solar Pathfinder device is used to analyze site shading for the building and determine maximum amount of full load operation based on available sunlight. When the Solar Pathfinder device is not implemented, amount of full load operation based on available sunlight is assumed to be 1,180 hours in New Jersey.

Total lifetime PV energy cost savings =
kWh produced by panel * [$/kWh cost * 25 years + $600/Megawatt hour /1000 * 15 years]

ECM and Equipment Lifetimes

Determining a lifetime for equipment and ECM's can sometimes be difficult. The following table contains a list of lifetimes that the NJCEP uses in its commercial and industrial programs. Other valid sources are also used to determine lifetimes, such as the DOE, ASHRAE, or the manufacturer's warranty.

Lighting is typically the most difficult lifetime to calculate because the fixture, ballast, and bulb can all have different lifetimes. Essentially the ECM analysis will have different operating cost savings (avoided equipment replacement) depending on which lifetime is used.

When the bulb lifetime is used (rated burn hours / annual burn hours), the operating cost savings is just reflecting the theoretical cost of replacing the existing case bulb and ballast over the life of the recommended bulb. Dividing by the bulb lifetime will give an annual operating cost savings.

When a fixture lifetime is used (e.g. 15 years) the operating cost savings reflects the avoided bulb and ballast replacement cost of the existing case over 15 years minus the projected bulb and ballast replacement cost of the proposed case over 15 years. This will give the difference of the equipment replacement costs between the proposed and existing cases and when divided by 15 years will give the annual operating cost savings.

New Jersey Clean Energy Program Commercial & Industrial Lifetimes

Measure	Life Span
Commercial Lighting — New	15
Commercial Lighting — Remodel/Replacement	15
Commercial Custom — New	18
Commercial Chiller Optimization	18
Commercial Unitary HVAC — New - Tier 1	15
Commercial Unitary HVAC — Replacement - Tier 1	15
Commercial Unitary HVAC — New - Tier 2	15
Commercial Unitary HVAC — Replacement Tier 2	15
Commercial Chillers — New	25
Commercial Chillers — Replacement	25
Commercial Small Motors (1-10 HP) — New or Replacement	20
Commercial Medium Motors (11-75 HP) — New or Replacement	20
Commercial Large Motors (76-200 HP) — New or Replacement	20
Commercial VSDs — New	15
Commercial VSDs — Retrofit	15
Commercial Comprehensive New Construction Design	18
Commercial Custom — Replacement	18
Industrial Lighting — New	15
Industrial Lighting — Remodel/Replacement	15
Industrial Unitary HVAC — New - Tier 1	15
Industrial Unitary HVAC — Replacement - Tier 1	15
Industrial Unitary HVAC — New - Tier 2	15
Industrial Unitary HVAC — Replacement Tier 2	15
Industrial Chillers — New	25
Industrial Chillers — Replacement	25
Industrial Small Motors (1-10 HP) — New or Replacement	20
Industrial Medium Motors (11-75 HP) — New or Replacement	20
Industrial Large Motors (76-200 HP) — New or Replacement	20
Industrial VSDs — New	15
Industrial VSDs — Retrofit	15
Industrial Custom — Non-Process	18
Industrial Custom — Process	10
Small Commercial Gas Furnace — New or Replacement	20
Small Commercial Gas Boiler — New or Replacement	20
Small Commercial Gas DHW — New or Replacement	10
C&I Gas Absorption Chiller — New or Replacement	25
C&I Gas Custom — New or Replacement (Engine Driven Chiller)	25
C&I Gas Custom — New or Replacement (Gas Efficiency Measures)	18
O&M savings	3
Compressed Air (GWh participant)	8

APPENDIX E: VendingMiser™ Energy Savings Calculator

EnergyMisers

VendingMiser® CoolerMiser™ SnackMiser™ PlugMiser™ VM2iQ® CM2iQ®

Savings Calculator

Please replace the default values in the table below with your location's unique information and then click on the "calculate savings" button.
Note: To calculate for CoolerMiser, use the equivalent VendingMiser results. To calculate for PlugMiser, use the equivalent SnackMiser results.

Energy Costs ($0.000 per kWh)	.16
Facility Occupied Hours per Week	56
Number of Cold Drink Vending Machines	1
Number of Non-refrigerated Snack Machines	0
Power Requirements of Cold Drink Machine (Watts; 400 typical)	125
Power Requirements of Snack Machine (Watts; 80 typical)	0
VendingMiser® Sale Price (for cold drink machines)	199
SnackMiser™ Sale Price (for snack machines)	0

Calculate Savings!

Results of your location's projected savings with VendingMiser® installed:

COLD DRINK MACHINES	Current	Projected	Total Savings	% Savings
kWh	1092	485	607	56%
Cost of Operation	$174.72	$77.65	$97.07	56%

SNACK MACHINES	Current	Projected	Total Savings	% Savings
kWh	0	0	0	NaN%
Cost of Operation	$0	$0	$0	NaN%

Location's Total Annual Savings

	Current	Projected	Total Savings	% Savings
kWh	1092	485	607	56%
Cost of Operation	$174.72	$77.65	$97.07	56%

Total Project Cost	Break Even (Months)
$199	24.60

Estimated Five Year Savings on ALL Machines = $485.33

APPENDIX F: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Township of Middletown Housing Authority - Alice V. Tomaso Plaza

Building ID: 2265232
For 12-month Period Ending: February 28, 2010[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: April 22, 2010

Facility	Facility Owner	Primary Contact for this Facility
Township of Middletown Housing Authority - Alice V. Tomaso Plaza 2 Oakdale Drive Middletown, NJ 07748	Township of Middletown Housing Authority 2 Oakdale Drive Middletown, NJ 07748	Joseph M. Billy Jr. 2 Oakdale Drive Middletown, NJ 07748

Year Built: 1978
Gross Floor Area (ft²): 140,853

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	7,615,014
Natural Gas (kBtu)[4]	2,844,844
Total Energy (kBtu)	10,459,858
Energy Intensity[5]	
Site (kBtu/ft²/yr)	74
Source (kBtu/ft²/yr)	202
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	1,311
Electric Distribution Utility	
FirstEnergy - Jersey Central Power & Lt Co	
National Average Comparison	
National Average Site EUI	
National Average Source EUI	
% Difference from National Average Source EUI	
Building Type	Multifamily Housing

Stamp of Certifying Professional

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

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

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

Certifying Professional
N/A

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

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

EPA Form 5900-16

APPENDIX G: INCENTIVE PROGRAMS

New Jersey Clean Energy Pay for Performance

The NJ Clean Energy Pay for Performance (P4P) Program relies on a network of Partners who provide technical services to clients. LGEA participating clients who are not receiving Direct Energy Efficiency and Conservation Block Grants are eligible for P4P. SWA is an eligible Partner and can develop an Energy Reduction Plan for each project with a whole-building traditional energy audit, a financial plan for funding the energy measures and an installation construction schedule.

The Energy Reduction Plan must define a comprehensive package of measures capable of reducing a building's energy consumption by 15+%. P4P incentives are awarded upon the satisfactory completion of three program milestones: submittal of an Energy Reduction Plan prepared by an approved Program Partner, installation of the recommended measures and completion of a Post-Construction Benchmarking Report. The incentives for electricity and natural gas savings will be paid based on actual savings, provided that the minimum 15%performance threshold savings has been achieved.

For further information, please see: http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance/existing-buildings .

Direct Install 2010 Program

Direct Install is a division of the New Jersey Clean Energy Program's Smart Start Buildings. It is a turn-key program for small to mid-sized facilities to aid in upgrading equipment to more efficient types. It is designed to cut overall energy costs by upgrading lighting, HVAC and other equipment with energy efficient alternatives. The program pays **up to 80%** of the retrofit costs, including equipment cost and installation costs.

Eligibility:

- Existing small and mid-sized commercial and industrial facilities with peak electrical demand **below 200 kW** within 12 months of applying
- Must be located in New Jersey
- Must be served by one of the state's public, regulated or natural gas companies
    - Electric: Atlantic City Electric, Jersey Central Power & Light, Orange Rockland Electric, PSE&G
    - Natural Gas: Elizabethtown Gas, New Jersey Natural Gas, PSE&G, South Jersey Gas

For the most up to date information on contractors in New Jersey who participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

Smart Start

New Jersey's SmartStart Building Program is administered by New Jersey's Office of Clean Energy. The program also offers design support for larger projects and technical assistance for smaller projects. If your project specifications do not fit into anything defined by the program, there are even incentives available for custom projects.

There are a number of improvement options for commercial, industrial, institutional, government, and agricultural projects throughout New Jersey. Alternatives are designed to enhance quality while building in energy efficiency to save money. Project categories included in this program are New

Construction and Additions, Renovations, Remodeling and Equipment Replacement.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings.

Renewable Energy Incentive Program

The Renewable Energy Incentive Program (REIP) provides incentives that reduce the upfront cost of installing renewable energy systems, including solar, wind, and sustainable biomass. Incentives vary depending upon technology, system size, and building type. Current incentive levels, participation information, and application forms can be found at the website listed below.

Solar Renewable Energy Credits (SRECs) represent all the clean energy benefits of electricity generated from a solar energy system. SRECs can be sold or traded separately from the power, providing owners a source of revenue to help offset the cost of installation. All solar project owners in New Jersey with electric distribution grid-connected systems are eligible to generate SRECs. Each time a system generates 1,000 kWh of electricity an SREC is earned and placed in the customer's account on the web-based SREC tracking system.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/renewable-energy/home/home.

Utility Sponsored Programs

Check with your local utility companies for further opportunities that may be available.

Federal and State Sponsored Programs

Other federal and state sponsored funding opportunities may be available, including BLOCK and R&D grant funding. For more information, please check http://www.dsireusa.org/.

APPENDIX H: ENERGY CONSERVATION MEASURES

Energy Conservation Measures

ECM #	ECM description	Cost Source	Est. installed cost, $	Est. incentives, $	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
1	Install (160) programmable thermostats	RS Means	19,200	0	19,200	99,150	67.0	1,040	3.1	0	17,206	15	258,084	1.1	12	1	1	183,259	188,992
2	Install (8) new occupancy sensors	RS Means	1,760	0	1,760	3,877	0.8	0	0.1	620	1,240	15	18,605	1.4	10	1	1	12,835	6,942
3	Install (152) new CFL fixtures	RS Means	2,280	0	2,280	4,438	0.9	0	0.1	689	1,399	5	6,995	1.6	2	0	1	4,091	7,946
4	Install (48) new bi-level T8 fluorescent fixtures in stairwells	RS Means	7,920	720	7,200	12,110	2.5	0	0.3	1,938	3,876	15	58,134	1.9	7	0	1	38,404	21,683
5	Retrofit (1) refrigerated vending machine with Vending Miser device	Manufacturer	199	0	199	607	0.1	0	0.0	0	97	15	1,457	2.0	6	0	0	944	1,087
6	Install (3) new T8 fluorescent fixtures	RS Means	457	45	412	604	0.1	0	0.0	105	202	15	3,025	2.0	6	0	0	1,961	1,081
7	Replace (8) common area washing machines with Energy Star units	Manufacturer	6,400	0	6,400	8,000	0.2	0	0.2	0	1,280	15	19,200	5.0	2	0	0	8,662	14,324
8	Install a 45kW Solar PV system	Similar Projects	315,000	45,000	270,000	60,377	45.0	0	1.5	0	45,660	25	1,141,508	5.9	3	0	0	318,143	108,105
9	Install (30) new Pulse Start Metal Halide fixtures	RS Means	16,544	750	15,794	9,259	1.9	0	0.2	677	2,158	15	32,377	7.3	1	0	0	9,604	16,578
10	Replace (5) common area refrigerators with Energy Star units	Manufacturer	2,625	0	2,625	2,000	0.4	0	0.0	0	320	15	4,800	8.2	1	0	0	1,140	3,581
11	Replace (120) apartment refrigerators with Energy Star units	Manufacturer	63,000	0	63,000	48,000	10.0	0	1.2	0	7,680	15	115,200	8.2	1	0	0	27,371	85,944
12	Replace existing West wing roof-mounted corridor exhaust fan with a direct drive unit	Similar Projects	2,200	0	2,200	639	0.0	121	0.1	0	258	25	6,458	8.5	2	0	0	840	2,478
13	Retro-commissioning of Common Area ventilation system	Similar Projects	35,213	0	35,213	3,300	0.6	2,700	2.0	0	4,011	10	40,110	8.8	0	0	0	-1,345	35,671
	TOTALS		**472,798**	**46,515**	**426,283**	**252,361**	**129.5**	**3,861**	**8.9**	**4,029**	**85,387**	**-**	**1,705,952**	**5.0**	**-**	**-**	**-**	**605,909**	**494,412**

Assumptions: Discount Rate: 3.2%; Energy Price Escalation Rate: 0%

Note: A 0.0 electrical demand reduction/month indicates that it is very low/negligible

APPENDIX I: SOLAR SHADING ANALYSIS

Site Report

Report Name	Middletown Housing Authority - Tomaso Plaza
Report Date	5/18/2010 2:02:04 PM
Declination	-12d 53m
Location	MIDDLETOWN, NJ 07748
Lat/Long	40.401 / -74.145
Weather Station	Belmar-Monmouth County AP, NJ, Elevation: 85 Feet, (40.183/-74.067)
Site distance	16 Miles
Report Type	PV
Array Type	Fixed
Tilt Angle	40.40 deg
Ideal Tilt Angle	40.40 deg
Azimuth	180.00 deg
Ideal Azimuth	180.00 deg
Electric Cost	0.16 ($/KWH)
Panel Make	Suntech Power
Panel Model	STP230D-24/VEC
Panel Count	196
DC Rate (per panel)	230.0 W
Total System Size	45,080.0 W
Inverter Make	<not specified>
Inverter Model	<not specified>
Inverter Count	1
Derate Method	System Setting
Derate Factor	0.800
Layout Configuration	SinglePicture
Layout Point Count	1

Notes: LGEA energy audit

Report generated by SolarPathfinder Assistant Version 4.1.27.0. http://www.solarpathfinder.com

Page: 1/2

Summary Report

Solar Obstruction Data

Month	Unshaded % of Ideal Site Azimuth=180 Tilt=40.4	Actual Solar Rad w/ Shading Azimuth=180.0 Tilt=40.4 KWH/m^2 /day	Actual AC Energy (KWH) w/ shading Azimuth=180.00 Tilt=40.40	Actual AC Energy (KWH) w/o shading Azimuth=180.0 Tilt=40.40	Ideal AC Energy (KWH) w/o shading Azimuth=180.0 Tilt=40.40	Solar Cost Savings 0.16 ($/KWH)	PVWatts Unshaded % Actual Site Azimuth=180.0 Tilt=40.40	Actual Site Efficiency % Azimuth=180.0 Tilt=40.40	Ideal Site Efficiency % Azimuth=180.0 Tilt=40.40
January	99.39%	3.35	3,851.10	3,865.00	3,865.00	$616.18	99.34 %	99.34 %	99.34 %
February	99.60%	4.26	4,375.80	4,391.00	4,391.00	$700.13	99.57 %	99.57 %	99.57 %
March	100.00%	5.07	5,658.00	5,658.00	5,658.00	$905.28	99.98 %	99.98 %	99.98 %
April	99.92%	5.17	5,292.00	5,292.00	5,292.00	$846.72	99.95 %	99.95 %	99.95 %
May	99.45%	5.19	5,371.49	5,373.00	5,373.00	$859.44	99.54 %	99.54 %	99.54 %
June	99.78%	5.65	5,504.58	5,505.00	5,505.00	$880.73	99.71 %	99.71 %	99.71 %
July	99.64%	5.79	5,771.00	5,772.00	5,772.00	$923.36	99.69 %	99.69 %	99.69 %
August	99.67%	5.88	5,871.00	5,871.00	5,871.00	$939.36	99.85 %	99.85 %	99.85 %
September	99.63%	5.10	5,031.97	5,034.00	5,034.00	$805.12	99.70 %	99.70 %	99.70 %
October	100.00%	4.83	5,195.00	5,199.00	5,199.00	$831.20	99.99 %	99.57 %	99.57 %
November	100.00%	4.31	4,607.00	4,607.00	4,607.00	$737.12	99.97 %	99.97 %	99.97 %
December	99.60%	3.39	3,848.20	3,850.00	3,850.00	$615.71	99.49 %	99.49 %	99.49 %
Totals	**99.72%**	**57.99**	**60,377.14**	**60,417.00**	**60,417.00**	**$9,660.34**	**99.73 %**	**99.70 %**	**99.70 %**
	Unweighted Yearly Avg	**Effect: 99.69% Sun Hrs: 4.83**					**Unweighted Yearly Avg**	**Unweighted Yearly Avg**	**Unweighted Yearly Avg**

Notes: LGEA energy audit

Report generated by SolarPathfinder Assistant Version 4.1.27.0. http://www.solarpathfinder.com

Page: 2/2

APPENDIX J: METHOD OF ANALYSIS

Assumptions and tools

Energy modeling tool:	Established/standard industry assumptions, eQUEST
Cost estimates:	RS Means 2009 (Facilities Maintenance & Repair Cost Data) RS Means 2009 (Building Construction Cost Data) RS Means 2009 (Mechanical Cost Data) Published and established specialized equipment material and labor costs Cost estimates also based on utility bill analysis and prior experience with similar projects

Disclaimer

This engineering audit was prepared using the most current and accurate fuel consumption data available for the site. The estimates that it projects are intended to help guide the owner toward best energy choices. The costs and savings are subject to fluctuations in weather, variations in quality of maintenance, changes in prices of fuel, materials, and labor, and other factors. Although we cannot guarantee savings or costs, we suggest that you use this report for economic analysis of the building and as a means to estimate future cash flow.

THE RECOMMENDATIONS PRESENTED IN THIS REPORT ARE BASED ON THE RESULTS OF ANALYSIS, INSPECTION, AND PERFORMANCE TESTING OF A SAMPLE OF COMPONENTS OF THE BUILDING SITE. ALTHOUGH CODE-RELATED ISSUES MAY BE NOTED, SWA STAFF HAVE NOT COMPLETED A COMPREHENSIVE EVALUATION FOR CODE-COMPLIANCE OR HEALTH AND SAFETY ISSUES. THE OWNER(S) AND MANAGER(S) OF THE BUILDING(S) CONTAINED IN THIS REPORT ARE REMINDED THAT ANY IMPROVEMENTS SUGGESTED IN THIS SCOPE OF WORK MUST BE PERFORMED IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL LAWS AND REGULATIONS THAT APPLY TO SAID WORK. PARTICULAR ATTENTION MUST BE PAID TO ANY WORK WHICH INVOLVES HEATING AND AIR MOVEMENT SYSTEMS, AND ANY WORK WHICH WILL INVOLVE THE DISTURBANCE OF PRODUCTS CONTAINING MOLD, ASBESTOS, OR LEAD.