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June 29, 2010

Local Government Energy Program
Energy Audit Report

Township of Middletown Housing Authority

Daniel Towers
1 Oakdale Drive
Middletown, NJ 07748

Project Number: LGEA59

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EXECUTIVE SUMMARY

Daniel Towers is a six-story senior citizen slab-on-grade residential development with a total conditioned floor area of 67,336 square feet. This residential development was built in 1974, and there have been several renovations since, including the addition of a garage area that was added on in 1990. 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	1,206,000	-	195,129	61.1	4,115
Proposed	1,057,191	-	169,611	53.6	3,607
Savings	148,809	-	25,518	7.5	508
% Savings	12	-	13	12	12

*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)
120,000	20,010	26,809	20.0	26	19,943

*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 $14,472 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 $61.1\frac{kBtu}{ft^2-yr}$ however; there is no national average for comparison 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	13,977	1.3	18,034	148,456
5-10 Year	6,585	7.8	51,520	68,730
>10 year	4,957	25.5	126,326	49,257
Solar PV	19,943	6.0	120,000	48,002
Total	45,461	6.9	315,880	314,444

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 26 cars from the roads each year or avoiding the need of 756 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**
    - Connect building to local gas service
    - Increase level of insulation at entire roof level
    - Increase level of insulation on lower roof
    - Separate security camera equipment from Main Office
    - Replace existing thru-wall AC units with high efficiency units
    - Domestic Hot Water feasibility study
    - Repair all water damaged sections of exterior walls

- **Operations and Maintenance**
    - Move vehicle idling area as well as outdoor smoking area
    - Install low flow aerators at sinks and low flow showerheads
    - Maintain roofs
    - Provide weather-stripping/air-sealing
    - Repair/seal wall cracks and penetrations
    - Remove all mold and overgrown vegetation from exterior walls
    - Always purchase 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 $3,056.75.

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 G 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 measures related to the HVAC system, such as installing programmable thermostats, replacing the rooftop packaged unit and retro-commissioning are addressed first. These measures will have the largest impact on the building and will also address other issues non-related to energy such as comfort complaints and supply air ventilation. 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 20kW 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 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 no 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 1 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.

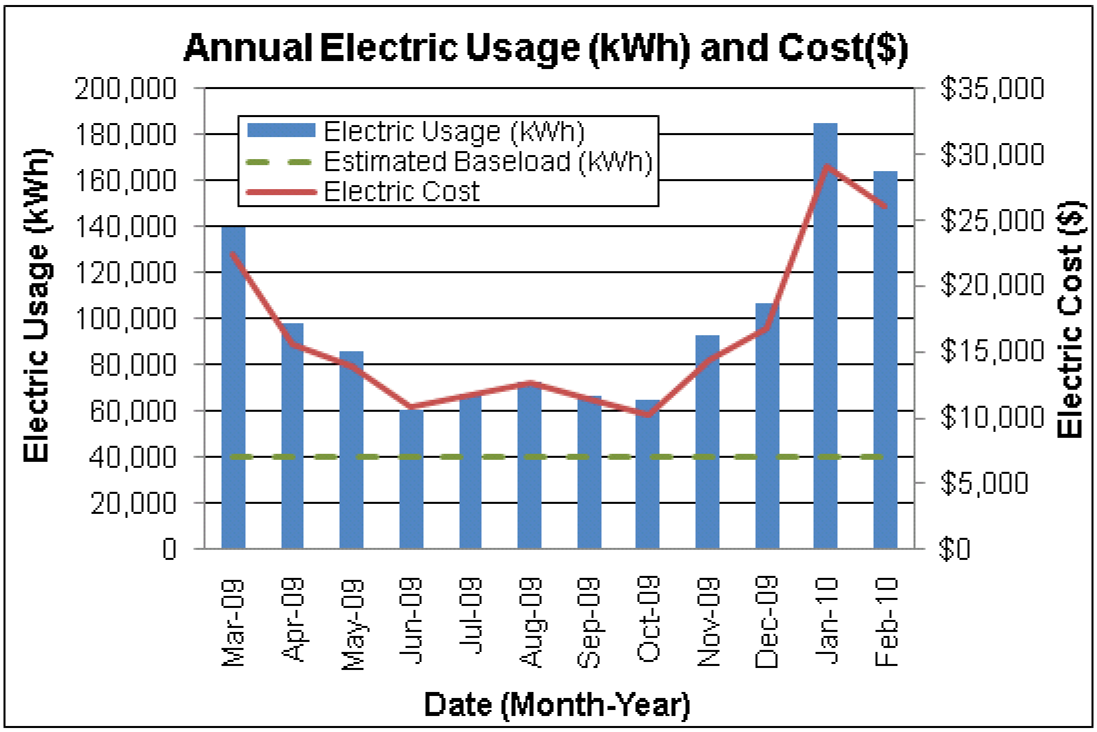
The goal of this Local Government Energy Audit (LGEA) is to provide sufficient information to the Middletown Housing Authority to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the residential complex.

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 electricity. A 12 month period of analysis from March 2009 through February 2010 was used for all calculations and for purposes of benchmarking the building.

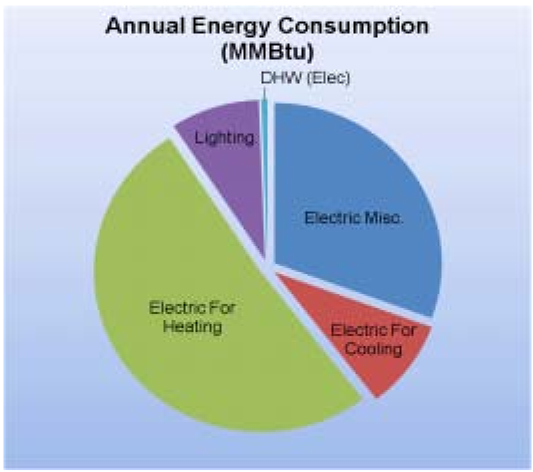
Electricity - The residential complex is currently served by one electric meter. The residential complex currently buys electricity from JCP&L at **an average aggregated rate of $0.162/kWh**. The residential complex purchased **approximately 1,206,000 kWh, or $195,129 worth of electricity,** in the previous year. The average monthly demand was 295.7 kW and the annual peak demand was 343.2 kW.

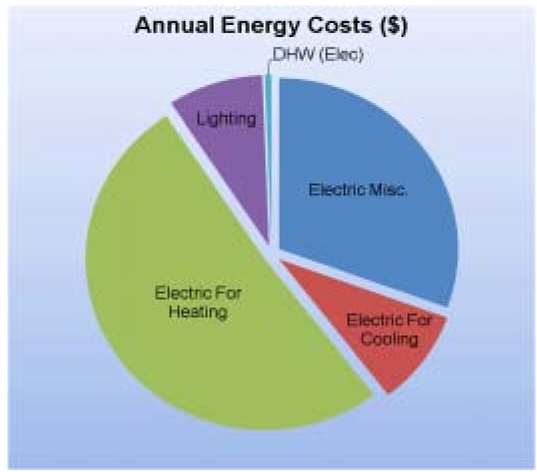


In the above chart, electric usage increases during the winter when electric heating equipment is used. The estimated baseload is formed primarily by electric domestic hot water, lighting and appliances within the building.

The following graphs, pie charts, and table show energy use for the residential complex based on utility bills for the 12 month period.

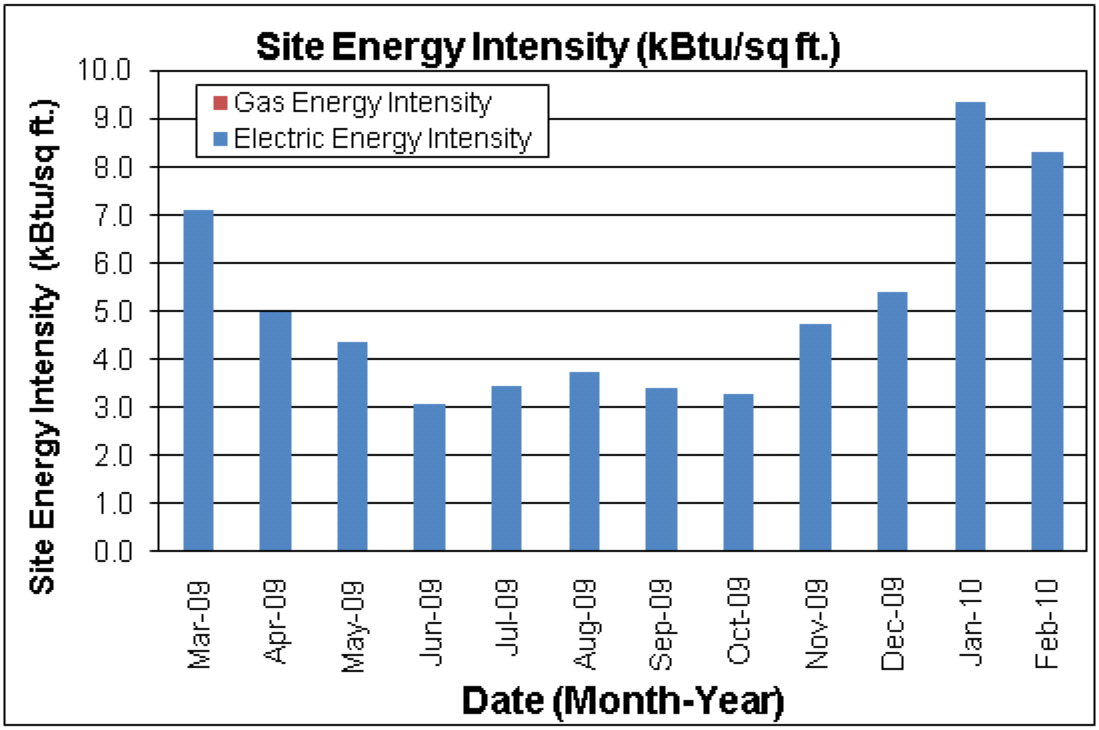
March 2009 - February 2010 Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	1,258	31%	$59,667	31%	47
Electric For Cooling	370	9%	$17,539	9%	47
Electric For Heating	2,107	51%	$99,927	51%	47
Lighting	355	9%	$16,821	9%	47
Domestic Hot Water (Elec)	25	1%	$1,176	1%	47
Totals	4,115	100%	$195,129	100%	
Total Electric Usage	4,115	100%	$195,129	100%	47
Totals	4,115	100%	$195,129	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 61.3$\frac{kBtu}{ft^2-yr}$ however; a national average for comparison 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 Middletown Housing Authority (user name of "MiddletownHA" with a password of "*Middletown")* and TRC Solutions.

Tariff analysis

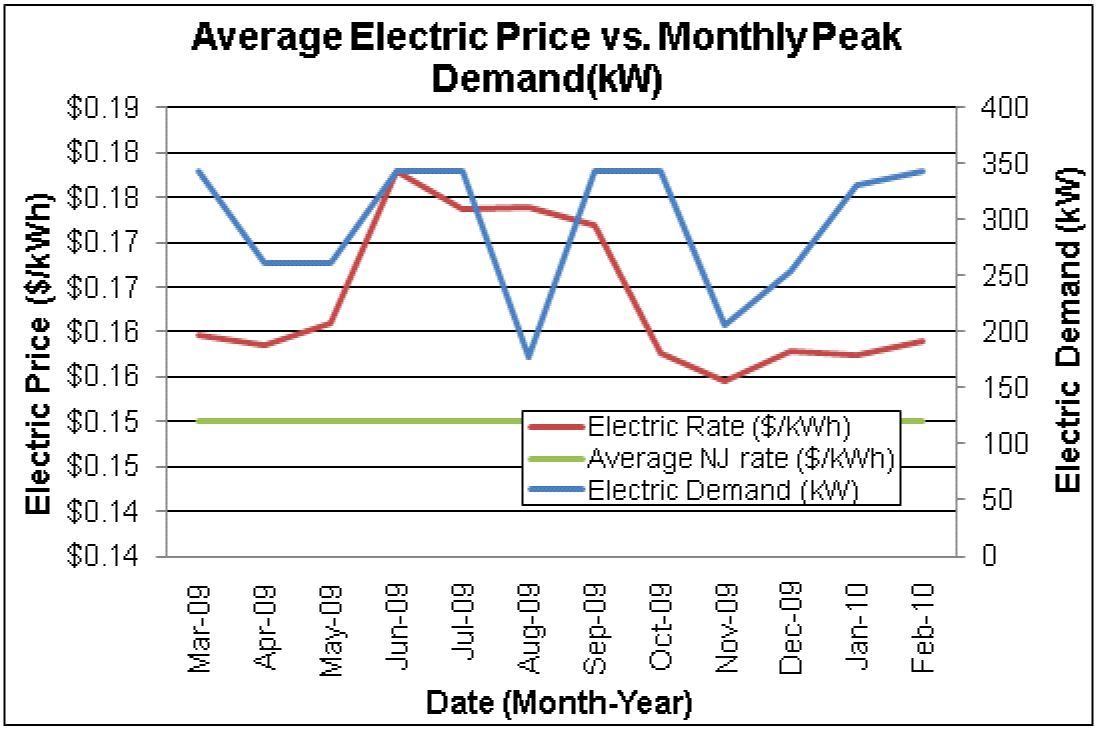
As part of the utility bill analysis, SWA evaluated the current utility rates and tariffs. Tariffs are typically assigned to buildings based on size and building type.

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 electricity. Typically, electricity prices also increase during the cooling months when electricity is used by the air conditioning units.

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. There 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 $0.162/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 $14,472 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 13% 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.

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 Township of Middletown 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.
- Constructed in 1974 with several renovations since.
- Garage area was added in 1990
- Approximately 67,336 square feet of conditioned space
- The building houses dwelling units, a meeting room, a solarium, 6 laundry alcoves (1 per floor) 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 105 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 natural stone veneer over concrete block with no assumed insulation. There are also sections with a split-face concrete block over concrete block with no assumed insulation and EIFS (Exterior Insulation Finishing System) with a natural stone veneer base over 3-1/2" wood stud framing with no assumed insulation. The interior is mostly painted concrete block.

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

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:

Signs of water damage, mold growth, overgrown vegetation, damage from roof runoff and damaged exterior wall surface.

Roof

The building's roof is predominantly a flat and parapet type over steel decking, with a built-up asphalt finish. The roof was replaced in 2005 and has not been upgraded since. Two and a half inches of assumed attic/ceiling roof insulation were recorded.

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, age-appropriate condition, with only a few signs of uncontrolled moisture, air-leakage or other energy-compromising issues on the lower roof.

The following specific roof problem spots were identified:

Signs of water pooling on the lower roof

Base

The building's base is composed of a slab-on-grade floor with a perimeter footing with concrete block foundation walls and slab edge insulation.

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

The building's base and its perimeter were inspected for signs of uncontrolled moisture or water presence and other energy-compromising issues. Overall the base was reported to be in good condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues detected in some areas inside.

Windows

The building contains basically two different types of windows:

1. Fixed type windows with an insulated aluminum frame, tinted double glazing and no interior or exterior shading devices. The windows are located in the front entrance.

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 all are installed with window screens.

It was reported that the windows in the first floor office are forced to remain closed due drafts from idling motor vehicles and smoke from residents in a nearby vestibule. SWA recommends either a change in traffic pattern and smoking rules or the installation of a fresh air supply system.

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, frame damage and signs of water damage at the exterior.

Exterior doors

The building contains several different types of exterior doors:

1. Glass with aluminum frame type exterior doors. They are located in the rear of the building.

2. Overhead type paneled exterior doors. They are located in the rear of the building.

3. Solid metal type exterior door. They are located throughout the building.

4. Solid metal type exterior door with glass panel. They are located throughout the building.

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 Daniel Towers building is approaching 36 years old and much of the mechanical equipment has been replaced in phases on an as needed basis. The building is electrically heated using baseboard radiant heating and therefore has no central heating system.

Equipment

Common Areas - The common areas are provided fresh air and cooling from a rooftop Trane unit that contains a cooling coil. The cooling coil is connected to a York Stellar condensing unit located adjacent to the Trane unit. Both units were observed to have exceeded their expected useful lifetimes. Heating throughout the building is provided by electric baseboard heaters and therefore there is no central heating equipment.

Trane rooftop unit (L); York condensing unit (R)

Main Office and Community Room - The first floor Main Office and Community Room are provided cooling from the rooftop units and additional cooling by wall-mounted split AC systems. A Mitsubishi split AC system using R-22 refrigerant services the Main Office and a Fujitsu split AC system using R-410A refrigerant services the Community Room. Both of these units were observed to be in good condition and are well within their expected useful lifetimes. In addition to the split AC system, the Main Office also contains two thru-wall Fedders AC units, each with an efficiency of 9.5 EER. The Main Office currently contains a large unit used for security camera equipment that was recently installed in the past 2 years. This unit has a significant impact on the energy usage of the office due to the amount of heat that it allows to enter the space. Typically, units such as server or security camera equipment are installed in independent closets that are ventilated and cooled separately from the rest of the building. The security camera equipment reduces the heating load of the office during the winter but also greatly increases the cooling load of the office during the summer. In addition to affecting the heating loads of the office, the placement of the security camera equipment may have an impact on the life of the equipment itself. Typically, these units must be maintained at a lower temperature in order to operate efficiently and prevent the risk of overheating.

Evaporative Split AC units for Main Office (L); Community Room (R)


Security Camera Equipment

Apartments – Each apartment unit contains a number of electric baseboard heaters to meet the heating requirements of each unit. Based on tenant interviews, there were no issues with the heating equipment that resulted in comfort issues. On average, each Studio and 1 Bedroom apartment each contained 1 thru-wall AC unit, while larger 2 Bedroom apartments contained 2 thru-wall AC units. All AC units are tenant-owned and are not provided by the building. All AC units were observed to have efficiencies in the 9.4-10.0 EER range and are within the useful lifetime of the units. Each apartment contains two methods to remove stale air from the building. Each bathroom is fitted with a Nutone combination exhaust fan and light that are controlled by a common switch. When the light switch is activated in the bathroom, a local exhaust fan located within the light fixture is activated that helps draw stale air from the bathroom and exhaust it to a common stack. This common stack is topped with an exhaust fan that puts a negative pressure on the common stack in order to help draw air out of the building. Stale air is exhausted out of the apartment also through an exhaust grill located in each kitchen. The exhaust air grilled is connected to a common ventilation stack that moves air through a common exhaust fan located at the top. Ventilation testing revealed that both supply air and exhaust air ventilation was severely reduced at the lower levels of the building, causing a disturbance in air movement. Several residents complained of excessive smells traveling between apartments through the exhaust ductwork.

Corridors and Stairwells – Corridors and stairwells are heated using electric baseboards located on each level. Cooling and ventilation are provided to Corridors by the rooftop Trane unit.

Distribution Systems

Heating throughout the building is provided by electric baseboard heaters. Cooling and ventilation are provided to corridors and common areas through ductwork located on each floor. Measurements taken during field visits indicate that ventilation tapers to a minimum flow as you travel from the top floor to the bottom. Measurements taken at the supply air registers in the Main Office and corridors on the first floor indicate that there is little to no supply air reaching the first floor.

Controls

The building was observed to contain all manual controls for heating, cooling and ventilation. The apartment units contain electric baseboards and thru-wall AC units that are controlled using non-programmable thermostats for each unit. The corridor on each floor contains two non-programmable thermostats to control the electric baseboards on both the East and West portions of the corridors.

Domestic Hot Water

Domestic Hot Water – Domestic Hot Water (DHW) is provided throughout the entire building by two Hubbell electric hot water heaters with 600 gallons storage each. These units were installed in 2009 and are still in excellent condition.

Two Hubbell electric DHW water heaters

Field testing also indicated that there were issues with the DHW distribution system, despite new equipment installed in 2009. DHW water temperatures were tested in each apartment that was sampled. Apartments closest to the DHW heating plant had high temperatures and short wait times for hot water, while units furthest away from the DHW heating plant (ie., Apartment 6B) had temperatures below 100ºF and wait times of 1 minute or greater. The DHW system is currently not set up for re-circulation and therefore temperatures are not uniform throughout the building and may require longer wait times to receive hot water at the tap.

Apt. #	Kitchen Sink Flow (GPM)	Kitchen Sink Temperature (ºF)	Wait time for hot water (seconds)
1M	2.2	130	0
1E	2.2	122	0
2K	2.2	130	7
2D	2.2	130	15
3A	2.2	130	30
3T	2.2	129	5
4N	2.2	130	20
5T	2.2	140	30
5Q	2.2	130	45
5P	2.2	140	15

6G	2.2	130	45
6R	2.2	118	60
6B	2.2	90	90

Chart showing tested data in various apartment units

Orientation of building; arrow indicates North

The above chart shows different variables recorded during field testing at Daniel Towers. Apartments are labeled alphabetically from West to East, with the DHW heating plant located on the first floor on the East end of the building. Apartment units located furthest from the hot water equipment were observed to have lower temperatures and longer wait times, indicating that there is no hot water re-circulation for the DHW system.

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 incandescent fixtures which are common in the dwelling units and in a few common areas. Based on measurements of lighting levels for each space, there are no vastly over-illuminated areas. Occupancy sensors are recommended as they will reduce runtime of the light fixtures.

Exit Lights - Exit signs were found to be LED type and fluorescent. SWA recommends replacing the fluorescent exit signs with LED exit signs.

Exterior Lighting - The exterior lighting surveyed during the building audit was found to be a mix of CFL, 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 non-residential areas of the housing complex the following appliances were installed, three older model inefficient 17 cubic foot refrigerators, one older model vending machine 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 were newer model efficient or ENERGY STAR® labeled units. The following commercial laundry equipment was installed in the building six washing machines and six dryers all of which were manufactured by Maytag. One dryer and one washing machine are installed in an alcove in the hallway on every floor. The dryers are part of Maytag’s commercial equipment line, model # MDE17CSAYWO. Four of the washers are newer, ENERGY STAR® that were replaced in May 2009. The existing two older washing machines are not ENERGY STAR® that were installed in 2005 and 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 elevator.

Other electrical systems

There were no significant electrical systems or process equipment installed on the premises.

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.

3.1. Existing systems

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

3.2. 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, Daniel Towers is a good candidate for a 20 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 80% 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 operation 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 (102) new CFL lamps
2	Retrofit non-refrigerated vending machine with SnackMiser device
3	Install programmable thermostats in Common Areas and Apartments
4	Install (2) new LED exit signs
5	Retrofit refrigerated vending machine with VendingMiser device
6	Install (4) new Occupancy Sensors
7	Install (2) new Energy Star labeled washing machines
	Description of ECMs with 5-10 Year Payback
8	Install a 20kW Solar PV system
9	Install (19) new Pulse Start Metal Halide fixtures
10	Replace (3) Common Area refrigerators
11	Replace (80) apartment refrigerators with Energy Star units
	Description of ECMs with >10 Year Payback
12	Retro-commissioning of Supply and Exhaust air ventilation system
13	Install (13) new bi-level T8 fluorescent fixtures in stairwells
14	Replace rooftop Trane unit and York condenser with high efficiency units

ECM#1: Install 102 new CFL lamps

On the days of the site visits, SWA completed a lighting inventory of Daniel Towers (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 Fixtures (CFLs) which are capable of producing the same or better quality light while using a fraction of the energy.

Installation cost:

Estimated installed cost: $1,530 (includes $510 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	1,530	5,957	5.0	0	0.3	510	1,475	5	7,375	1.0	4	1	1	5,187	10,666

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 G for more information on Incentive Programs.

ECM #2: *Retrofit non-refrigerated vending machine with SnackMiser™ device*

A simple plug and play device, SnackMiser™ devices are compatible with non-refrigerated vending machines, such as those that dispense potato chips, cookies, etc. 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 non-refrigerated vending machine.

Installation cost:

Estimated installed cost: $99 (Includes $30 in labor cost)
Source of cost estimate: *Manufacturer and Store established costs*

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	99	532	0.1	0	0.0	0	86	5	431	1.1	3	1	1	293	953

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis aggregate utility rate.

Rebates/financial incentives:

- *None*

Please see Appendix G for more information on Incentive Programs.

ECM#3: Install programmable thermostats in Common Areas and Apartments

On the day of the site visit, SWA observed that heating and cooling are controlled using non-programmable thermostats. Each apartment is equipped with a 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 apartment in order to setback night time heating temperatures to a reasonable level. Each common corridor is heated using electric baseboards that are controlled by two non-programmable thermostats; one thermostat in each wing of the common corridor. SWA observed that many of these thermostats were turned up past 75ºF, even on a day when heating was unnecessary. SWA recommends installing programmable thermostats in order to create a schedule for the thermostats to operate at a uniform temperature during the day and then setback at night when corridors are used minimally. In addition to apartments and corridors, programmable thermostats should be installed in common areas such as the first floor meeting area, the men's and women's public restrooms and office space. All above mentioned areas were currently being controlled by manual thermostats that are adjusted by tenants or employees at will and constantly left at an unreasonable temperature.

Installation cost:

Estimated installed cost: $13,680 (includes $3,420 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	13,680	72,597	0.0	0	3.7	0	11,761	15	176,411	1.2	12	1	1	124,709	129,985

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumes savings based on a 10% reduction of total heating usage and a 10% reduction of Common Area cooling usage

Rebates/financial incentives:

- *None*

Please see Appendix G for more information on Incentive Programs.

ECM#4: Install 2 new LED exit signs

On the days of the site visits, SWA completed a lighting inventory of Daniel Towers (see Appendix B). The residential complex currently contains 2 fluorescent exit signs. SWA recommends replacing these fluorescent exit signs with newer, more efficient LED models. Exit signs present a good opportunity for savings since they are operated 24 hours per day.

Installation cost:

Estimated installed cost: $126 (includes $30 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	126	193	0.0	0	0.0	35	66	15	994	1.9	7	0	1	654	346

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 – LED Exit Signs ($20 per fixture)*

Please see Appendix G for more information on Incentive Programs

ECM #5: *Retrofit refrigerated vending machine with VendingMiser™ device*

Description:

A simple plug and play device, VendingMiser™ devices are compatible with refrigerated vending machines such as those that dispense sodas and sports drinks. 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 in labor cost)
Source of cost estimate: *Manufacturer and Store established costs*

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	555	0.1	0	0.0	0	90	5	450	2.2	1	0	0	210	994

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis aggregate utility rate.

Rebates/financial incentives:

- *None*

Please see Appendix G for more information on Incentive Programs.

ECM#6: Install 4 new Occupancy Sensors

On the days of the site visits, SWA completed a lighting inventory of Daniel Towers (see Appendix B). The residential complex currently contains 4 areas that could benefit from the installation of occupancy sensors. These areas consisted of common meeting and other shared office 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: $800 (includes $120 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	800	1,079	0.2	0	0.1	0	175	15	2,622	4.6	2	0	0	1,257	1,932

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 G for more information on Incentive Programs.

ECM#7: Install 2 new Energy Star labeled washing machines

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

Installation cost:

Estimated installed cost: $1,600 (includes $60 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	1,600	2,000	0.4	0	0.1	0	324	15	4,860	4.9	2	0	0	2,213	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 G for more information on Incentive Programs.

ECM#8: Install a 20kW Solar PV system

Currently, Daniel Towers 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 20,010W (20kW) PV system at Daniel Towers 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 20kW system needs approximately 87 panels, which would take up 1,523 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: $120,000 (includes $60,000 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	120,000	26,809	20.0	0	1.4	0	19,943	25	498,576	6.0	3	0	0	137,534	48,002

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. An annual SREC revenue of $15,600 has been factored into the annual savings for a period of 15 years. For every full MWh of generated per year (26,803 kWh per year will generate 26 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 G for more information on Incentive Programs.

ECM#9: Install 19 new Pulse Start Metal Halide fixtures

On the days of the site visits, SWA completed a lighting inventory of Daniel Towers (see Appendix B). The exterior lighting consists of a mix of 19 different CFL's, probe start metal halide fixtures 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) MH lamps, but minimize the disadvantages. They produce higher light 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: $7,945 (includes $1,900 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	7,945	5,186	1.1	0	0.3	366	1,206	15	18,092	6.6	1	0	0	6,248	9,286

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 – Metal Halide with Pulse Start ($25 per fixture)*

Please see Appendix G for more information on Incentive Programs.

ECM #10: *Replace 3 Common Area Refrigerators with Energy Star Models*

Description:

On the day of the site visit, SWA observed that there were three older 17 cu. ft. model inefficient refrigerators which were not Energy Star rated (using approximately 773 kWh/yr each). 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: $1,575 (Includes $60 in labor cost)
Source of cost estimate: *Manufacturer and Store established costs*

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	1,575	1,200	1.0	0	0.1	0	194	12	2,333	8.1	0	0	0	337	2,149

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis aggregate utility rate.

Rebates/financial incentives:

- *None*

Please see Appendix G for more information on Incentive Programs.

ECM #11: ***Replace 80 Dwelling Unit Refrigerators with Energy Star Models***

Description:

On the day of the site visit, SWA observed that there were approximately eighty older 17 cu. ft. model inefficient refrigerators which were not Energy Star rated (using approximately 773 kWh/yr each). 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: $42,000 (Includes $1,600 in labor cost)
Source of cost estimate: *Manufacturer and Store established costs*

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	42,000	32,000	6.7	0	1.6	0	5,184	12	62,208	8.1	0	0	0	8,991	57,296

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis aggregate utility rate.

Rebates/financial incentives:

- *None*

Please see Appendix G for more information on Incentive Programs.

ECM #12: ***Retro-commissioning of Supply and Exhaust air ventilation systems***

Description:

On the day of the site visit, SWA performed testing to establish the ventilation rates of air throughout the building for both supply and exhaust air. Testing revealed that the bottom floors received poor ventilation, which reduced the amount of air that was both supplied and exhausted from the bottom floors. In addition, many residents on floors 3-5 complained of smells entering their apartment from kitchens located on both the floor directly above and below the reference floor. SWA recommends that the Middletown Housing Authority hire an HVAC contractor to perform retro-commissioning of the supply and exhaust air ventilation systems. Retro-commissioning should include testing ventilation rates at each return and supply grilled as well as testing pressure at each floor. Exhaust and supply fans should be balanced in order to provide appropriate levels of ventilation to each space within the building. SWA observed all fans working properly, however by adjusting the system for appropriate conditions, air will be distributed throughout the building more efficiently and will save on heating and cooling costs. This measure will also help to remedy tenant complaints.

Installation cost:

Estimated installed cost: $25,251 (Includes $25,251 in labor cost)
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	25,251	9,544	2.8	0	0.5	0	1,546	10	15,461	16.3	0	0	0	-12,196	17,089

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis aggregate utility rate.

Rebates/financial incentives:

- *None*

Please see Appendix G for more information on Incentive Programs.

ECM#13: *Install (13) new bi-level T8 fluorescent fixtures in stairwells*

On the day of the site visit, SWA completed a lighting inventory of the Daniel Towers building (see Appendix B). The residential complex currently contains 13 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. Daniel Towers 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: $1,950 (includes $560 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
13	1,950	615	0.1	0	0.0	0	100	15	1,494	19.6	0	0	0	-778	1,101

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 G for more information on Incentive Programs

ECM#14: Replace rooftop Trane unit and York condenser with high efficiency units

Daniel Towers contains one Trane rooftop packaged unit that provides supply air to the corridors common areas of the building. This Trane unit is connected to a York condenser that provides cooling. These units were observed to be older and no longer performing efficiently as designed. These units are responsible for supplying a large portion of the supply air to the building and are important for air distribution. SWA recommends that these units are replaced with high efficiency units. Replacing these units will reduce common area cooling costs as well as provide better ventilation and heat transfer throughout the common areas and apartment spaces of the building.

Installation cost:

Estimated installed cost: $4,907 (includes $342 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
14	99,125	17,351	12.3	0	0.9	500	3,311	25	82,772	29.9	0	0	0	-42,736	31,067

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. The unit did not contain nameplate information but was estimated at 25 tons in order to provide cost and incentive estimation.

Rebates/financial incentives:

- *NJ Clean Energy – SmartStart program – (up to $92/ton)*

Please see Appendix G 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:

- Connect building to local gas service – SWA recommends that metered gas service is considered for future use within the building. Middletown Housing Authority should contact the local gas company to inquire about gas service being connected to Daniel Towers. Natural gas is a cheaper form of fuel to use compared to electricity. Installing gas heating equipment for the entire building would not be cost effective at this time, based on the high retrofitting cost of replacing the current electric baseboard system. Also, due to the recent installation of new DHW equipment, gas service would not be cost-effective for water heating however it should be considered for future equipment replacements.

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

- Increase level of insulation on lower roof – Based on standing water and water damage at a 5th floor apartment, SWA recommends increasing the insulation level and properly sealing the partial roof at the 6th floor. This roof is a partial roof and experiences more water pooling than the main roof. Increasing insulation will not be cost-effective; however the lower roof takes a priority for roof replacement in order to help properly drain water away from the building. By increasing the level of rigid insulation at this roof, the contractor has the ability to create a steeper slope at the drainage plane, which in turns allows water to drain more efficiently away from the building.

- Separate security camera equipment from Main Office – Currently, there is a piece of security camera equipment, similar to a computer server, that has been installed in the Main Office. This piece of equipment gives of a significant portion of heat that interacts with the heating, cooling and ventilation of the Main Office. Typically, these units are installed in independent mechanical closets in order to minimize their impact on the existing HVAC system as well as to condition the equipment separately to extend the lifetime of the computer equipment. SWA recommends that this unit is removed from the Main Office and either re-located to a different location or that a separate equipment closet is created with a dedicated cooling system. A design professional should be consulted before changing equipment configuration. This equipment should be maintained at the manufacturer's suggested temperature, that may require the installation of a dedicated cooling system. Currently, the equipment creates an excessive heating load during the summer that interacts with the cooling abilities of the office cooling system.

- Replace existing tenant-owned thru-wall AC units 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. The existing thru-wall AC units are owned by tenants and are not the responsibility of Middletown Housing Authority, however the building is master-metered and Middletown Housing Authority pays for all tenant electric usage. If Middletown Housing Authority chooses to purchase thru-wall AC units in order to reduce the building's electric consumption, 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 9.4 EER. Newer, more efficient models are not available at efficiency values of 13.0 EER or greater.

- Domestic Hot Water feasibility study – SWA recommends that the Middletown Housing Authority explore the opportunity to have a qualifying engineering firm conduct a DHW feasibility study. The purpose of the feasibility would be to reduce operating costs for providing hot water service which may include re-configuring piping, installing a gas-fired heater while using current electric heaters as storage or adding recirculation to the building DHW loop. Based on site observations and testing, Domestic Hot Water is not reaching all apartments equally, causing temperatures less than the recommended 120ºF and longer wait times for hot water. As a result, partially-heated water is being wasted while tenants leave sinks on, waiting for hot water to reach a higher temperature.

- Repair all water damaged sections of exterior walls

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.

- Move vehicle idling area as well as outdoor smoking area – SWA observed that there is an indoor air quality (IAQ) issue in the Main Office because of the location of supply air intake. The Main Office is located in the front of the building, next to the traffic circle and the designated outdoor smoking area. Windows as well as thru-wall air conditioning units allow contaminated air from nearby idling vehicles and cigarette smoke to be sucked into the building space and enter the stream of the ventilation equipment. As a health and safety measure, SWA recommends that idling vehicles are moved forward away from the building and that a new smoking area is designated away from any air intake.

- 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, proper flashing, and sealing wall cracks and penetrations wherever necessary in order to keep insulation dry and effective.

- Remove all mold and overgrown vegetation from exterior walls

- Always purchase 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	Mitsubishi Electric, Mr. Slim evaporating unit for split AC system, 9.5 EER, 115V, 1ph, 60Hz, R-22, controlled by remote control - programmable thermostat	Management Offices	Mitsubishi Electric, Mr. Slim, Model #MS12NN2, Serial #0001575 T	Electric	Management Offices	2005	80%
Cooling	Mitsubishi Electric, Mr. Slim condensing unit for split AC system, 9.5 EER, 115V, 1ph, 60Hz, R-22, connected to above evaporative unit	Exterior, front of building	Mitsubishi Electric, Mr. Slim, Model #MU12NN2, Serial #0001105 T	Electric	Management Offices	2005	80%
Cooling	Fedders thru-wall AC unit, 10,000 cooling BTUH, 9.5 EER, 1,060W, 9.3A, R-22, sealed around perimeter with duct tape	Far Left Office, Management Offices	Fedders, Model #A7U10W2A-B, Serial #GS 333215 190 X	Electric	Management Offices	2003	72%
Cooling	Fedders thru-wall AC unit, 10,000 cooling BTUH, 9.4 EER, 1,060W, 9.3A, R-22, sealed around perimeter with duct tape	Middle Office, Management Offices	Fedders, Model #A7U10W2A-B, Serial #NA	Electric	Management Offices	2003	72%
Cooling	York Stellar condensing unit connected to rooftop air handling unit, 208V, 3ph, 60Hz, R-22 refrigerant, not working	Rooftop, upper roof	York, Stellar, Model #H1DB076S25A, Serial #EEEM185883	Electric	Common Areas, Hallways	1996	0%
Cooling	One (1) thru wall AC unit, no nameplate info	Maintenance office	No nameplate info	Electric	Maintenance Office	2004	76%
Cooling/ Ventilation	Trane rooftop unit, no nameplate, fresh air and cooling only	Rooftop, upper roof	Trane, no nameplate info	Electric	Common Areas, Hallways	1996	0%
Cooling	Fujitsu, Halcyon inverter, inside evaporative unit for split AC system, 10.0 EER, 208V, 1ph, 60Hz, R410A refrigerant	Community Room	Fujitsu, Halcyon inverter, Model #ASU36CLX, Serial #EBA014452	Electric	Community Room	2005	80%
Cooling	Fujitsu, Halcyon inverter, exterior, condensing unit for split AC system, 33,100 Btuh cooling capacity, 10.0 EER, 208V, 1ph, 60Hz, R410A refrigerant	Exterior, side of building near Community Room	Fujitsu, Halcyon inverter, Model #AOU36CLX, Serial #EBN 016776	Electric	Community Room	2005	80%
Ventilation	Eighteen (18) roof-mounted exhaust fans, no nameplate info	Rooftop, upper roof	No nameplate info	Electric	Apt. Bathrooms	1996	20%
Ventilation	Two (2) Airmaster Fan Company, power ventilator, sidewall mounted exhaust fans for stairwells, motor 1/2 HP, 115V, 1ph, 60Hz, 1 speed	Rooftop, Stairwell Penthouses	Airmaster Fan Company, Model #CDD550 B-2, Tag #6350FB 15	Electric	Stairwells	2003	30%
Ventilation	100 Nutone rangehood exhaust fans, 120V, 60 Hz, 1.0 amps, does not exhaust to outside, units wre replaced between 1998-2000	Apartment Kitchens	Nutone, Model #LL6200N	Electric	Apt. Kitchens	2000	50%
Ventilation	100 Nutone bathroom exhaust fixtures, contain exhaust fan and light for bathrooms, units were replaced between 2002-2003, 2 floors at a time	Apartment Bathrooms	Nutone, Model #9093N	Electric	Apt. Bathrooms	2003	65%

Domestic Hot Water	DHW-1; Hubbell electric water heater, 600 gallons storage, 65 kW, 181 amps, 208V, 3ph, 60Hz	Mechanical Room, First floor	Hubbell, Model #SH600-0-65SLR, Serial #H3298H	Electric	All Areas	2009	90%
Domestic Hot Water	DHW-2; Hubbell electric water heater, 600 gallons storage, 65 kW, 181 amps, 208V, 3ph, 60Hz	Mechanical Room, First floor	Hubbell, Model #SH600-0-65SLR, Serial #H3299H	Electric	All Areas	2009	90%
Domestic Hot Water	DHW circulation pump, Bell & Gossett AC motor, 1/6 HP, 1725RPM, 1ph, 115V, 1.9A, 134 degF supply temp	Mechanical Room, First floor	Bell & Gossett, Model #M74794, ID #M10711	Electric	All Areas	2009	90%
Trash Compactor	Trash Compactor motor, Baldor industrial motor, Standard-E, 3HP, 230V, 8.2A, 1750RPM, Frame 145TC, 3ph, 60Hz, NEMA nom. Efficiency 87.5%, PF=78%, enclosure TEFC, use is <1 hour per day	Trash Compactor Room in mechanical room, first floor	Baldor, industrial, Standard-E, Spec #35A002T098H2, Serial #F0210251051	Electric	Trash Compactor	2009	95%
Elevator	Two (2) hydraulic elevators, no nameplate information, 1 elevator motor was replaced in 2008 and the other in 2009	Elevator machine room in mechanical room, first floor	No nameplate info	Electric	All Areas	2009	97%
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

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	Office Area	Recessed	E	4'T8 U-Shaped	7	2	32	Sw	8	365	5	483	1,410	N/A	Recessed	4'T8 U-Shaped	E	Sw	7	2	32	8	365	5	483	1410	0	0	0
2	1	Lunch Room	Recessed	E	4'T8 U-Shaped	2	2	32	Sw	8	365	5	138	403	N/A	Recessed	4'T8 U-Shaped	E	Sw	2	2	32	8	365	5	138	403	0	0	0
3	1	Bathroom	Vanity	S	Inc	1	3	60	Sw	2	365	0	180	131	CFL	Vanity	CFL	S	Sw	1	3	20	2	365	0	60	44	88	0	88
4	1	Bathroom	Ceiling Mounted	S	Inc	1	1	60	Sw	2	365	0	60	44	CFL	Ceiling Mounted	CFL	S	Sw	1	1	20	2	365	0	20	15	29	0	29
5	1	Office Area	Recessed	E	4'T8 U-Shaped	8	2	32	Sw	8	365	5	552	1,612	N/A	Recessed	4'T8 U-Shaped	E	Sw	8	2	32	8	365	5	552	1612	0	0	0
6	1	Office	Recessed	E	4'T8 U-Shaped	6	2	32	Sw	8	365	5	414	1,209	C	Recessed	4'T8 U-Shaped	E	OS	6	2	32	6	365	5	414	907	0	302	302
7	1	Meeting Room	Ceiling Suspended	E	4'T8	1	2	32	Sw	8	365	5	69	201	N/A	Ceiling Suspended	4'T8	E	Sw	1	2	32	8	365	5	69	201	0	0	0
8	1	Meeting Room	Ceiling Suspended	E	4'T8	3	1	32	Sw	8	365	5	111	324	N/A	Ceiling Suspended	4'T8	E	Sw	3	1	32	8	365	5	111	324	0	0	0
9	1	Boiler Room	Ceiling Suspended	E	4'T8	2	1	32	Sw	2	365	5	74	54	N/A	Ceiling Suspended	4'T8	E	Sw	2	1	32	2	365	5	74	54	0	0	0
10	1	Elevator Mechanical Room	Ceiling Suspended	E	4'T8	1	1	32	Sw	2	365	5	37	27	N/A	Ceiling Suspended	4'T8	E	Sw	1	1	32	2	365	5	37	27	0	0	0
11	1	Vestibule	Ceiling Suspended	E	4'T8	1	2	32	N	24	365	5	69	604	N/A	Ceiling Suspended	4'T8	E	N	1	2	32	24	365	5	69	604	0	0	0
12	1	Electrical 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
13	1	Office - Superintendent	Parabolic Ceiling Mounted	E	4'T8	4	2	32	Sw	8	365	5	276	806	N/A	Parabolic Ceiling Mountec	4'T8	E	Sw	4	2	32	8	365	5	276	806	0	0	0
14	1	Garage Bay	Parabolic Ceiling Mounted	E	4'T8	4	2	32	Sw	2	365	5	276	201	N/A	Parabolic Ceiling Mountec	4'T8	E	Sw	4	2	32	2	365	5	276	201	0	0	0
15	1	Garage Bay	Ceiling Mounted	S	CFL	1	2	20	Sw	2	365	0	40	29	N/A	Ceiling Mounted	CFL	S	Sw	1	2	20	2	365	0	40	29	0	0	0
16	1	Laundry Vestibule	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
17	Str	Staircase	Ceiling Mounted	S	CFL	13	2	13	N	24	365	0	338	2,961	C	Ceiling Mounted	CFL	S	BL	13	2	13	24	365	0	338	2346	0	615	615
18	1	Hallway	Ceiling Mounted	E	4'T8	14	2	32	N	24	365	5	966	8,462	N/A	Ceiling Mounted	4'T8	E	N	14	2	32	24	365	5	966	8462	0	0	0
19	1	Hallway	Exit Sign	E	FL	2	1	15	N	24	365	2	33	289	LEDex	Exit Sign	LED	E	N	2	1	5	24	365	1	11	96	193	0	193
20	1	Meeting Room	Recessed	E	4'T8	8	4	32	Sw	8	365	5	1,064	3,107	C	Recessed	4'T8	E	OS	8	4	32	6	365	5	1064	2330	0	777	777
21	1	Meeting Room	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
22	1	Kitchen	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
23	1	Bathroom Men	Ceiling Mounted	E	4'T8	1	1	32	OS	2	365	5	37	27	N/A	Ceiling Mounted	4'T8	E	OS	1	1	32	2	365	5	37	27	0	0	0
24	1	Bathroom Women	Ceiling Mounted	E	4'T8	1	1	32	OS	2	365	5	37	27	N/A	Ceiling Mounted	4'T8	E	OS	1	1	32	2	365	5	37	27	0	0	0
25	1	Hallway	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
26	1	Vestibule	Ceiling Mounted	S	CFL	1	2	13	N	24	365	0	26	228	N/A	Ceiling Mounted	CFL	S	N	1	2	13	24	365	0	26	228	0	0	0
27	1	Main Entrance	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
28	5	Hallway	Ceiling Mounted	E	4'T8	12	2	32	N	24	365	5	828	7,253	N/A	Ceiling Mounted	4'T8	E	N	12	2	32	24	365	5	828	7253	0	0	0
29	5	Hallway	Exit Sign	S	LED	3	1	5	N	24	365	1	17	145	N/A	Exit Sign	LED	S	N	3	1	5	24	365	1	17	145	0	0	0
30	5	Laundry	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
31	5	Elevator	Wall Mounted	E	2'T8	4	1	17	N	24	365	2	76	666	N/A	Wall Mounted	2'T8	E	N	4	1	17	24	365	2	76	666	0	0	0
32	6	Hallway	Ceiling Mounted	E	4'T8	14	2	32	N	24	365	5	966	8,462	N/A	Ceiling Mounted	4'T8	E	N	14	2	32	24	365	5	966	8462	0	0	0
33	6	Hallway	Exit Sign	S	LED	3	1	5	N	24	365	1	17	145	N/A	Exit Sign	LED	S	N	3	1	5	24	365	1	17	145	0	0	0
34	6	Solarium	Ceiling Mounted	S	CFL	4	2	13	Sw	2	365	0	104	76	N/A	Ceiling Mounted	CFL	S	Sw	4	2	13	2	365	0	104	76	0	0	0
35	4	Hallway	Ceiling Mounted	E	4'T8	12	2	32	N	24	365	5	828	7,253	N/A	Ceiling Mounted	4'T8	E	N	12	2	32	24	365	5	828	7253	0	0	0
36	4	Hallway	Exit Sign	S	LED	3	1	5	N	24	365	1	17	145	N/A	Exit Sign	LED	S	N	3	1	5	24	365	1	17	145	0	0	0
37	4	Laundry	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
38	3	Hallway	Ceiling Mounted	E	4'T8	12	2	32	N	24	365	5	828	7,253	N/A	Ceiling Mounted	4'T8	E	N	12	2	32	24	365	5	828	7253	0	0	0
39	3	Hallway	Exit Sign	S	LED	3	1	5	N	24	365	1	17	145	N/A	Exit Sign	LED	S	N	3	1	5	24	365	1	17	145	0	0	0
40	3	Laundry	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	2	Hallway	Ceiling Mounted	E	4'T8	12	2	32	N	24	365	5	828	7,253	N/A	Ceiling Mounted	4'T8	E	N	12	2	32	24	365	5	828	7253	0	0	0
42	2	Hallway	Exit Sign	S	LED	3	1	5	N	24	365	1	17	145	N/A	Exit Sign	LED	S	N	3	1	5	24	365	1	17	145	0	0	0
43	2	Laundry	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
44	1	Typical apartment - vestibule	Sconce	S	CFL	100	2	13	Sw	4	365	0	2,600	3,796	N/A	Sconce	CFL	S	Sw	100	2	13	4	365	0	2600	3796	0	0	0
45	1	Typical apartment - kitchen	Ceiling Mounted	E	4'T8	100	4	32	Sw	2	365	5	13,300	9,709	N/A	Ceiling Mounted	4'T8	E	Sw	100	4	32	2	365	5	13300	9709	0	0	0
46	1	Typical apartment - bathroom	Vanity	S	CFL	100	2	13	Sw	2	365	0	2,600	1,898	N/A	Vanity	CFL	S	Sw	100	2	13	2	365	0	2600	1898	0	0	0
47	1	Typical apartment - bathroom	Ceiling Mounted	S	CFL	100	1	13	Sw	2	365	0	1,300	949	N/A	Ceiling Mounted	CFL	S	Sw	100	1	13	2	365	0	1300	949	0	0	0
48	1	Typical apartment - night light	Ceiling Mounted	S	Inc	100	1	60	Sw	4	365	0	6,000	8,760	CFL	Ceiling Mounted	CFL	S	Sw	100	1	20	4	365	0	2000	2920	5840	0	5840
49	Ext	Exterior	Flood	E	HPS	18	1	150	T	12	365	30	3,240	14,191	PSMH	Flood	PSMH	E	T	18	1	100	12	365	20	2160	9461	4730	0	4730
50	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
51	Ext	Exterior	Ceiling Mounted	S	CFL	1	2	13	T	12	365	0	26	114	N/A	Ceiling Mounted	CFL	S	T	1	2	13	12	365	0	26	114	0	0	0
52	Ext	Exterior	Wall Mounted	S	CFL	2	1	23	T	12	365	0	46	201	N/A	Wall Mounted	CFL	S	T	2	1	23	12	365	0	46	201	0	0	0
Totals:						701	90	1,661				236	39,921	103,961						701	90	1,406			196	34,555	90,932	11,335	1,694	13,029

Rows Highlighted 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

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 measure (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.

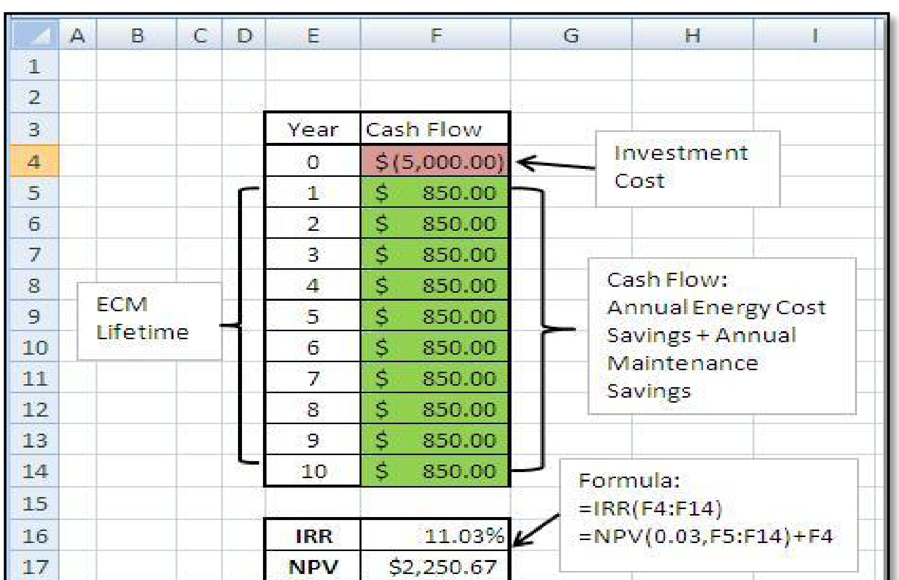
Calculation References

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™ and SnackMiser™ 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)	$0.162
Facility Occupied Hours per Week	40
Number of Cold Drink Vending Machines	1
Number of Non-refrigerated Snack Machines	1
Power Requirements of Cold Drink Machine (Watts; 400 typical)	100
Power Requirements of Snack Machine (Watts; 80 typical)	80
VendingMiser® Sale Price (for cold drink machines)	199
SnackMiser™ Sale Price (for snack machines)	99

Calculate Savings!

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

COLD DRINK MACHINES	Current	Projected	Total Savings	% Savings
kWh	874	319	555	63%
Cost of Operation	$141.52	$51.67	$89.86	63%

SNACK MACHINES	Current	Projected	Total Savings	% Savings
kWh	699	166	532	76%
Cost of Operation	$113.22	$26.96	$86.26	76%

Location's Total Annual Savings

	Current	Projected	Total Savings	% Savings
kWh	1572	485	1087	69%
Cost of Operation	$254.74	$78.62	$176.12	69%

Total Project Cost	Break Even (Months)
$298	20.30

Estimated Five Year Savings on ALL Machines = $880.59

APPENDIX F: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Township of Middletown Housing Authority - Daniel Towers

Building ID: 2265200
For 12-month Period Ending: February 28, 2010[1]
Date SEP becomes ineligible: N/A

Date SEP Generated: April 26, 2010

Facility	Facility Owner	Primary Contact for this Facility
Township of Middletown Housing Authority - Daniel Towers 1 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: 1974
Gross Floor Area (ft²): 67,336

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

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	4,114,872
Natural Gas - (kBtu)[4]	0
Total Energy (kBtu)	4,114,872
Energy Intensity[5]	
Site (kBtu/ft²/yr)	61
Source (kBtu/ft²/yr)	204
Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	627
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 Programs'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 102 new CFL lamps	RSMeans	1,530	0	1,530	5,957	5.0	0	0.3	510	1,475	5	7,375	1.0	4	1	1	5,187	10,666
2	Retrofit non-refrigerated vending machine with SnackMiser device	Manufacturer	99	0	99	532	0.1	0	0.0	0	86	5	431	1.1	3	1	1	293	953
3	Install programmable thermostats in Common Areas and Apartments	RSMeans	13,680	0	13,680	72,597	0.0	0	3.7	0	11,761	15	176,411	1.2	12	1	1	124,709	129,985
4	Install 2 new LED exit signs	RSMeans	166	40	126	193	0.0	0	0.0	35	66	15	994	1.9	7	0	1	654	346
5	Retrofit refrigerated vending machine with VendingMiser device	Manufacturer	199	0	199	555	0.1	0	0.0	0	90	5	450	2.2	1	0	0	210	994
6	Install 4 new Occupancy Sensors	RSMeans	880	80	800	1,079	0.2	0	0.1	0	175	15	2,622	4.6	2	0	0	1,257	1,932
7	Install 2 new Energy Star labeled washing machines	Manufacturer	1,600	0	1,600	2,000	0.4	0	0.1	0	324	15	4,860	4.9	2	0	0	2,213	3,581
8	Install a 20kW Solar PV system	Similar Projects	140,000	20,000	120,000	26,809	20.0	0	1.4	0	19,943	25	498,576	6.0	3	0	0	137,534	48,002
9	Install 19 new Pulse Start Metal Halide fixtures	RSMeans	8,420	475	7,945	5,186	1.1	0	0.3	366	1,206	15	18,092	6.6	1	0	0	6,248	9,286
10	Replace 3 Common Area refrigerators with Energy Star units	Manufacturer	1,575	0	1,575	1,200	1.0	0	0.1	0	194	12	2,333	8.1	0	0	0	337	2,149
11	Replace 80 apartment refrigerators with Energy Star units	Manufacturer	42,000	0	42,000	32,000	22.1	0	1.6	0	5,184	12	62,208	8.1	0	0	0	8,991	57,296
12	Retro-commissioning of Supply and Exhaust air ventilation system	Similar Projects	25,251	0	25,251	9,544	2.8	0	0.5	0	1,546	10	15,461	16.3	0	0	0	-12,196	17,089
13	Install 13 new bi-level T8 fluorescent fixtures in stairwells	RSMeans	2,145	195	1,950	615	0.1	0	0.0	0	100	15	1,494	19.6	0	0	0	-778	1,101
14	Replace rooftop Trane unit and York condenser with high efficiency units	RSMeans	101,425	2,300	99,125	17,351	12.3	0	0.9	500	3,311	25	82,772	29.9	0	0	0	-42,736	31,067
	TOTALS		**338,970**	**23,090**	**315,880**	**175,618**	**65.2**	**0**	**8.9**	**1,411**	**45,461**	**-**	**874,079**	**6.9**	**-**	**-**	**-**	**231,923**	**314,444**

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 - Daniel Towers
Report Date	5/18/2010 11:07:47 AM
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	0.162 ($/KWH)
Panel Make	Suntech Power
Panel Model	STP230D-24/VEC
Panel Count	87
DC Rate (per panel)	230.0 W
Total System Size	20,010.0 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: Energy Audit report

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

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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 0.162 ($/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	99.66%	3.36	1,711.90	1,715.00	1,715.00	$277.33	99.59 %	99.59 %	99.59 %
February	100.00%	4.28	1,949.00	1,949.00	1,949.00	$315.74	99.95 %	99.95 %	99.95 %
March	100.00%	5.07	2,512.00	2,512.00	2,512.00	$406.94	99.98 %	99.98 %	99.98 %
April	99.93%	5.17	2,347.00	2,347.00	2,347.00	$380.21	99.96 %	99.96 %	99.96 %
May	99.46%	5.19	2,385.14	2,386.00	2,386.00	$386.39	99.55 %	99.55 %	99.55 %
June	99.85%	5.66	2,441.85	2,442.00	2,442.00	$395.58	99.78 %	99.78 %	99.78 %
July	99.70%	5.80	2,563.74	2,564.00	2,564.00	$415.33	99.75 %	99.75 %	99.75 %
August	99.66%	5.88	2,606.00	2,606.00	2,606.00	$422.17	99.83 %	99.83 %	99.83 %
September	99.62%	5.10	2,232.51	2,234.00	2,234.00	$361.67	99.67 %	99.67 %	99.67 %
October	100.00%	4.83	2,306.00	2,308.00	2,308.00	$373.57	99.99 %	99.57 %	99.57 %
November	100.00%	4.31	2,046.00	2,046.00	2,046.00	$331.45	99.97 %	99.97 %	99.97 %
December	99.64%	3.39	1,707.40	1,708.00	1,708.00	$276.60	99.52 %	99.52 %	99.52 %
Totals	**99.79%** Unweighted Yearly Avg	**58.03** Effect: 99.74% Sun Hrs: 4.84	**26,808.53**	**26,817.00**	**26,817.00**	**$4,342.98**	**99.80 %** Unweighted Yearly Avg	**99.76 %** Unweighted Yearly Avg	**99.76 %** Unweighted Yearly Avg

Notes: Energy Audit report

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

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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.