



**Steven Winter Associates, Inc.**  
Building Systems Consultants  
www.swinter.com

293 Route 18, Suite 330  
East Brunswick, NJ 08816

Telephone (866) 676-1972  
Facsimile (203) 852-0741

June 28, 2010

**Local Government Energy Program  
Energy Audit Final Report**

***Borough of Chatham  
Public Works and Water Plant  
446 Main Street  
Chatham, NJ 07928***

***Project Number: LGEA64***



***West Facing View***



***East Facing View***

1. TABLE OF CONTENTS

2. EXECUTIVE SUMMARY ..... 3

3. INTRODUCTION..... 5

4. HISTORICAL ENERGY CONSUMPTION ..... 6

5. EXISTING FACILITY AND SYSTEMS DESCRIPTION ..... 13

6. RENEWABLE AND DISTRIBUTED ENERGY MEASURES ..... 37

7. PROPOSED ENERGY CONSERVATION MEASURES..... 38

8. PROPOSED FURTHER RECOMMENDATIONS ..... 41

9. APPENDIX A: EQUIPMENT LIST..... 52

10. APPENDIX B: LIGHTING STUDY ..... 56

11. APPENDIX C: THIRD PARTY ENERGY SUPPLIERS..... 58

12. APPENDIX D: GLOSSARY AND METHOD OF CALCULATIONS..... 61

13. APPENDIX E: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR® ... 65

14. APPENDIX F: INCENTIVE PROGRAMS ..... 66

15. APPENDIX G: ENERGY CONSERVATION MEASURES..... 68

16. APPENDIX H: METHOD OF ANALYSIS ..... 70

## EXECUTIVE SUMMARY

The Public Works and Water Plant is a seven building facility comprising a total floor area of 20,010 square feet. The original structure was built in 1898 with renovations/ additions in the 1950s, 1980s, 1995 and 2003. 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	Fuel Oil usage, gal/yr	Current Annual Cost of Energy, \$	Site Energy Use Intensity, kBtu/sq ft yr	Joint Energy Consumption, MMBtu/yr
Current	688,000	4,533	343	124,077	139.0	2,849
Proposed	639,061	4,469	343	115,633	130.3	2,676
Savings	48,939	64	0	8,444	8.7	173
% Savings	7%	1%	0%	7%	6%	6%

There may be energy procurement opportunities for the Public Works and Water Plant to reduce annual electrical utility costs, which are \$14,663 higher, when compared to the average estimated NJ commercial utility rates.

SWA has also entered energy information about the Public Works and Water Plant in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. This mixed use facility is comprised of non-eligible ("Other") space type. The resulting usage is 139.0 kBtu/sq ft yr, which is higher than the average comparable building by 33.7%. The main reason for the high electric usage is three big water pumps supplying the Borough with water 24 hr/7days.

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

**Table 2: Energy Conservation Measure Recommendations**

ECMs	First Year Savings (\$)	Simple Payback Period (years)	Initial Investment, \$	CO2 Savings, lbs/yr
0-5 Year	4,139	2.7	11,212	24,596
5-10 Year	110	6.8	750	627
>10 year	26,657	12.7	337,872	62,786
Total	30,906	11.3	349,834	88,009

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 7 cars from the roads each year or avoiding the need of 214 trees to absorb the annual CO<sub>2</sub> generated.

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

## **Further Recommendations:**

SWA recommends that the Public Works and Water Plant further explore the following:

- Capital Improvements
  - Install NEMA Premium motors when replacements are required
  - Install gas-fired infrared heaters (approximate 8 infrared heaters total) in Garages
  - Install a premium efficiency motor on the sewage ejector pump - Main Office and Garage
  - Replace the DHW heater in the Main Office and Garage Building with a condensing model
  - Replace heating terminal units - such as perimeter hot water radiators in the Main Office
  - Consider adding emergency generator for well pump #2
  - Add insulation to ineffective and under-insulated ceiling sections
  - Replace all original, single-glazed windows and frames with low-E, double glazed type
  - Install CO detectors/alarms in garages and nearby working spaces and chlorine detectors/alarms in the Pump/Well Houses
  
- Operations and Maintenance
  - Re-point deteriorated mortar joints to prevent possible water/moisture penetration into walls
  - Investigate cause of efflorescence-coated brick and masonry
  - Install footing drains and slope perimeter grade away from the buildings
  - Install and maintain weather-stripping around all exterior doors and roof hatches
  - Maintain roofs - SWA recommends regular maintenance to verify water is draining correctly
  - Maintain downspouts and cap flashing - Repair/install missing downspouts and cap flashing
  - Repair/seal wall cracks and penetrations
  - Provide water-efficient fixtures and controls
  - Purchase ENERGY STAR® labeled appliances, when equipment is installed or replaced
  - Use smart power electric strips
  - Create an energy educational program
  - Insulate un-insulated heating piping
  - Check water levels in the expansion tanks and the integrity of the tank bladders
  - Tighten belts on exhaust fans
  - Change filters in air handling units monthly

## **Financial Incentives and Other Program Opportunities**

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

SWA recommends that the Borough of Chatham implement the ECMs as listed in increasing order of simple payback with the majority of measures consisting of lighting (apply for Direct Install option), thermostats, an HVAC split system, a refrigerator and a Solar PV installation. SWA also encourages installation of Infra Red heaters in the garages.

## **INTRODUCTION**

Launched in 2008, the Local Government Energy Audit (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 Energy Services to administer the Program.

Steven Winter Associates, Inc. (SWA) is a 38-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 Public Works and Water Plant at 446 Main Street. The process of the audit included facility visits on April 7, 12 and 22, 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 is to provide sufficient information to the Borough of Chatham to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the Public Works and Water Plant.

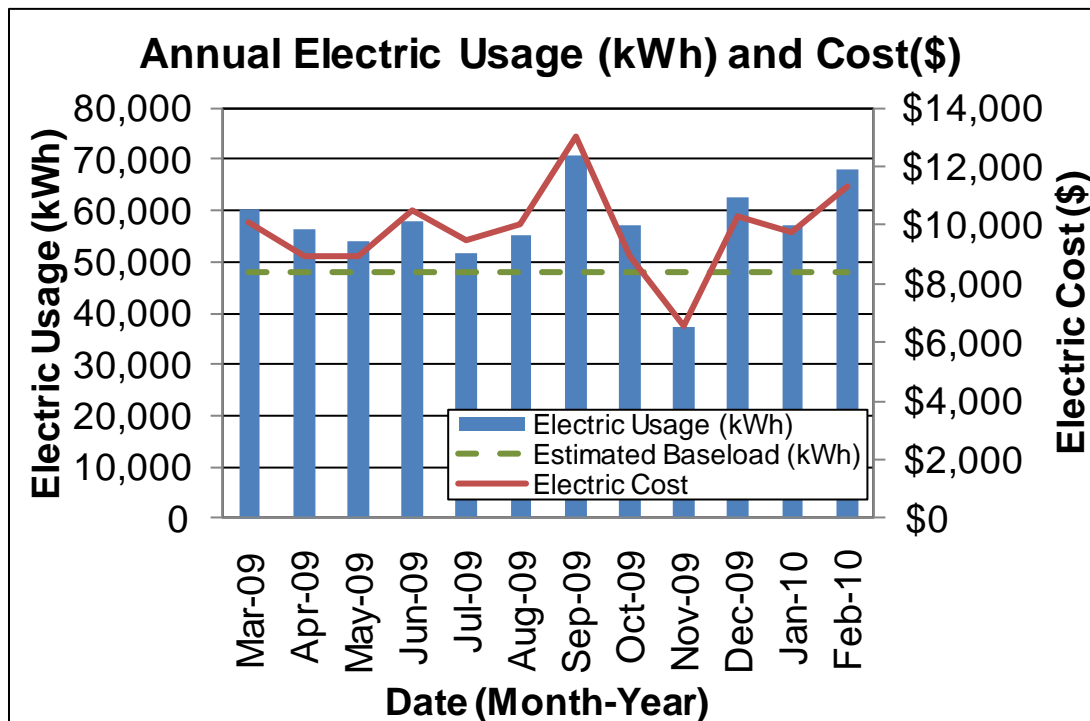
## HISTORICAL ENERGY CONSUMPTION

### 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 Public Works and Water Plant with electric and natural gas. A 12 month period of analysis from March 2009 through February 2010 was used for all calculations and for purposes of benchmarking the building.

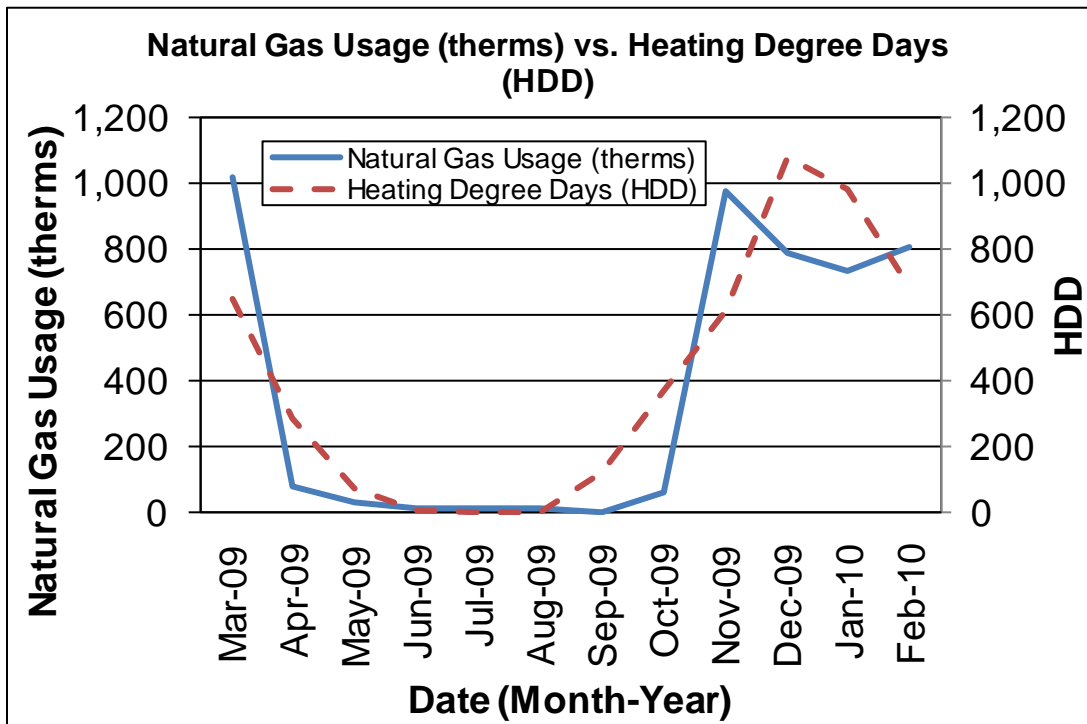
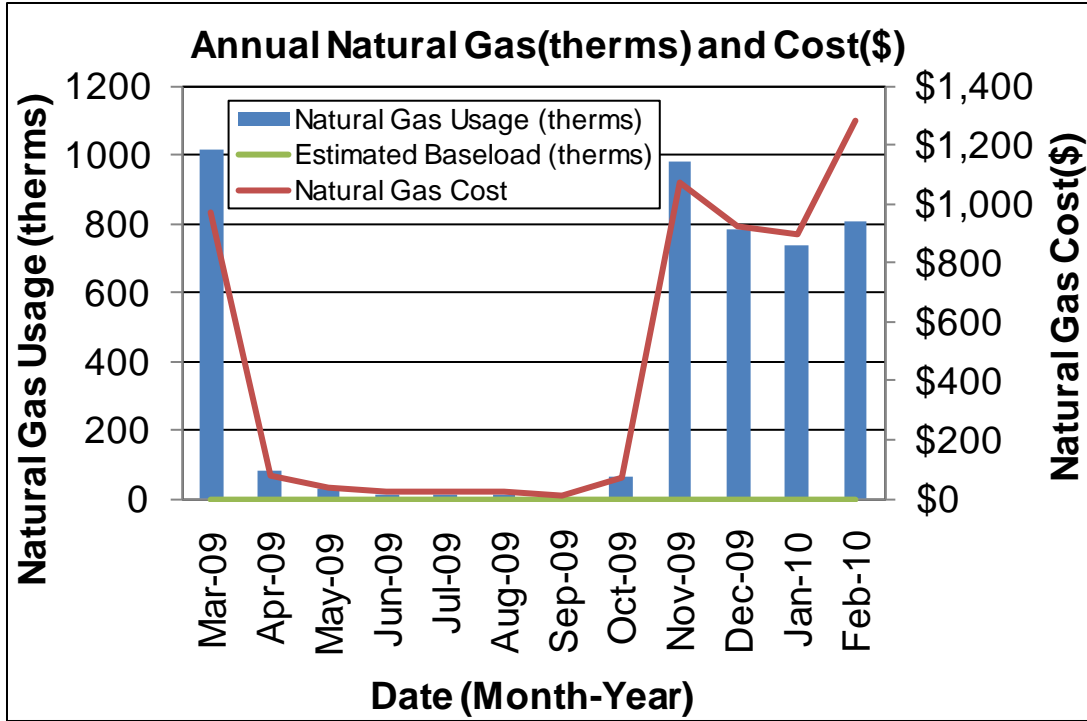
Electricity - The Public Works and Water Plant is currently served by one electric meter. The Public Works and Water Plant currently buys electricity from JCP&L at **an average aggregated rate of \$0.171/kWh**. The Public Works and Water Plant purchased **approximately 688,000 kWh, or \$117,863 worth of electricity**, in the previous year. The average monthly demand was 217 kW and the annual peak demand was 298 kW.

The chart below shows the monthly electric usage and costs. The dashed green line represents the approximate baseload or minimum electric usage required to operate the Public Works and Water Plant.



Natural gas - The Public Works and Water Plant is currently served by one meter for natural gas. The Public Works and Water Plant currently buys natural gas from PSE&G at **an average aggregated rate of \$1.193/therm**. The Public Works and Water Plant purchased **approximately 4,533 therms, or \$5,408 worth of natural gas**, in the previous year.

The chart below shows the monthly natural gas usage and costs. The green line represents the approximate baseload or minimum natural gas usage required to operate the Public Works and Water Plant.

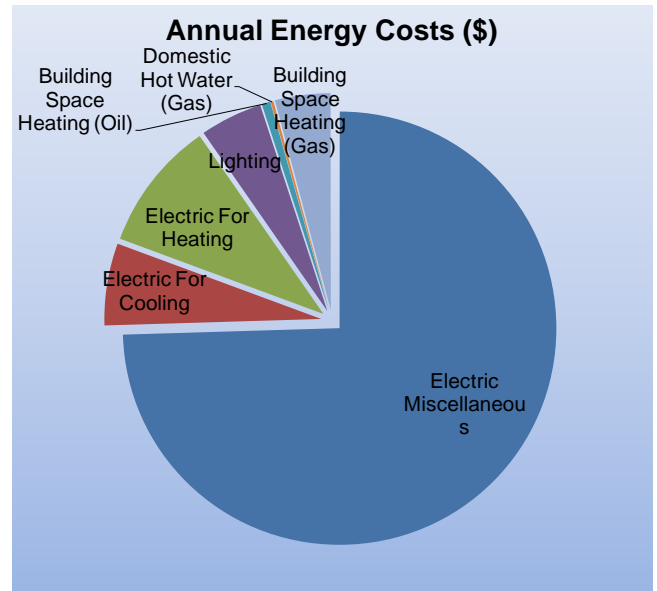
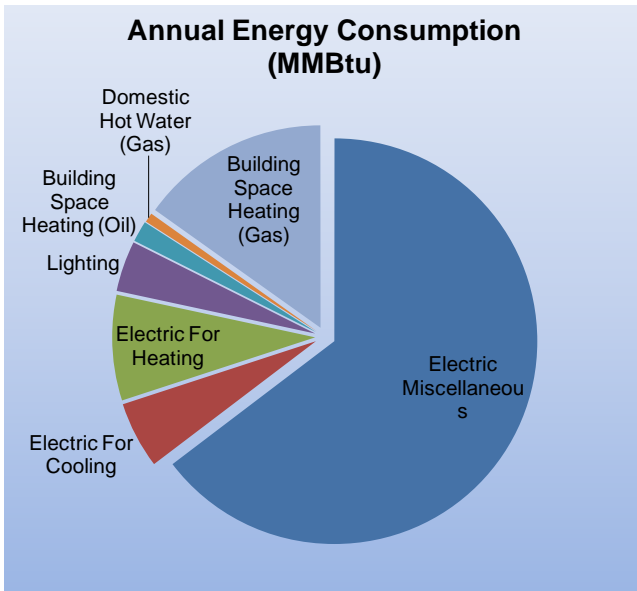


The chart above shows the monthly natural gas usage along with the heating degree days or HDD. Heating degree days is the difference of the average daily temperature and a base temperature, on a particular day. The heating degree days are zero for the days when the average temperature exceeds the base temperature. SWA's analysis used a base temperature of 65 degrees Fahrenheit.

The Main Office and Garage Building is partly heated by a fuel oil fired hot water boiler, supplied with fuel oil from an outdoor 500 gal tank. The Public Works and Water Plant currently buys fuel oil from Crown Oil Co. at **an average aggregated rate of \$2.350/gal**. The Public Works and Water Plant purchased **approximately 343 gals, or \$806 worth of fuel oil**, in the previous year.

The following graphs, pie charts, and table show energy use for the Public Works and Water Plant based on utility bills for the 12 month period. Note: electrical cost at \$50/MMBtu of energy is more than 4 times as expensive as natural gas at \$12/MMBtu

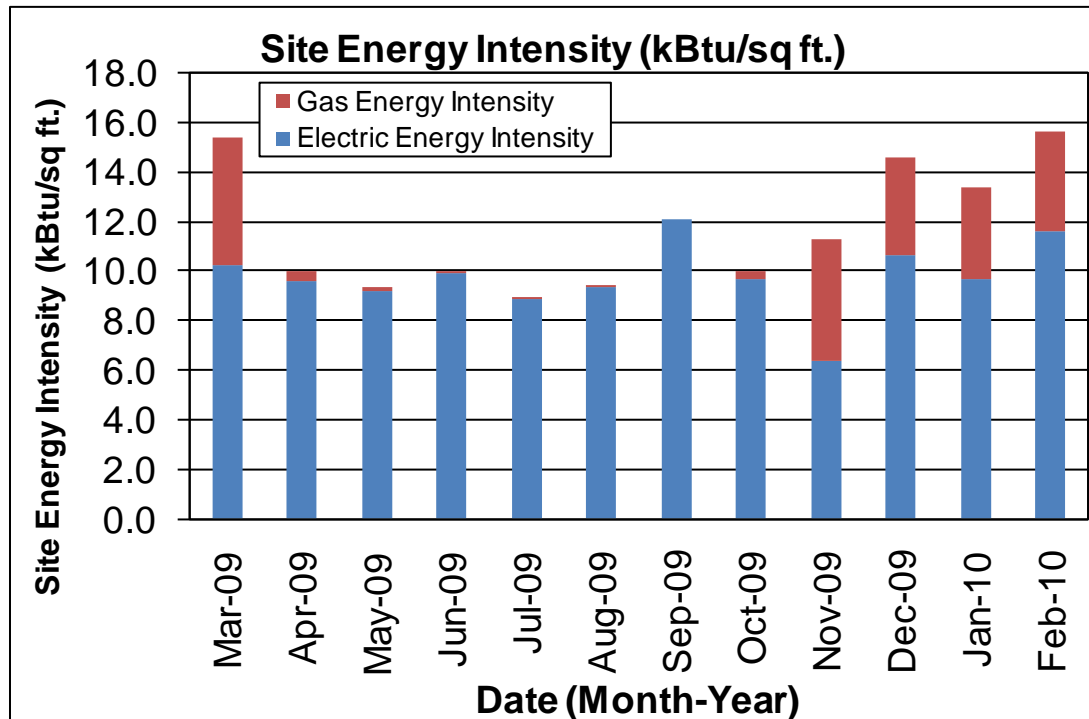
Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	\$	% \$	\$/MMBtu
Electric Miscellaneous	1,842	65%	\$92,458	75%	50
Electric For Cooling	151	5%	\$7,602	6%	50
Electric For Heating	239	8%	\$12,024	10%	50
Lighting	115	4%	\$5,779	5%	50
Building Space Heating (Oil)	48	2%	\$806	1%	17
Domestic Hot Water (Gas)	21	1%	\$256	0%	12
Building Space Heating (Gas)	432	15%	\$5,152	4%	12
<b>Totals</b>	<b>2,849</b>	<b>100%</b>	<b>\$124,077</b>	<b>100%</b>	
<b>Total Oil Usage</b>	<b>48</b>	<b>2%</b>	<b>\$806</b>	<b>1%</b>	<b>17</b>
<b>Total Electric Usage</b>	<b>2,348</b>	<b>82%</b>	<b>\$117,863</b>	<b>95%</b>	<b>50</b>
<b>Total Gas Usage</b>	<b>453</b>	<b>16%</b>	<b>\$5,408</b>	<b>4%</b>	<b>12</b>
<b>Totals</b>	<b>2,849</b>	<b>100%</b>	<b>\$124,077</b>	<b>100%</b>	



## Energy benchmarking

SWA has entered energy information about the Public Works and Water Plant in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. This mixed use facility is categorized as a non-eligible ("Other") space type. Because it is an "Other" space type, there is no rating available. Consequently, the Public Works and Water Plant is not eligible to receive a national energy performance rating at this time. The Site Energy Use Intensity is 139.0 kBtu/ft<sup>2</sup>-yr compared to the national average of other type buildings consuming 104 kBtu/ft<sup>2</sup>-yr. See ECM section for guidance on how to improve the building's rating.

Due to the nature of its calculation based upon a survey of existing buildings of varying usage, the national average for "Other" space types is very subjective, and is not an absolute bellwether for gauging performance. The main reason for the high electric usage is three big water pumps supplying the Borough with water 24 hr/7days. Additionally, should the Borough of Chatham desire to reach this average there are other large scale and financially less advantageous improvements that can be made, such as envelope window, door and insulation upgrades that would help the building reach this goal.



Per the LGEA program requirements, SWA has assisted the Borough of Chatham to create an *ENERGY STAR® Portfolio Manager* account and share the Public Works and Water Plant facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager account information with the Borough of Chatham (user name of "chathamborough" with a password of "CHATHAMBOROUGH" and TRC Energy Services (user name of "TRC-LGEA").

## **Tariff analysis**

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

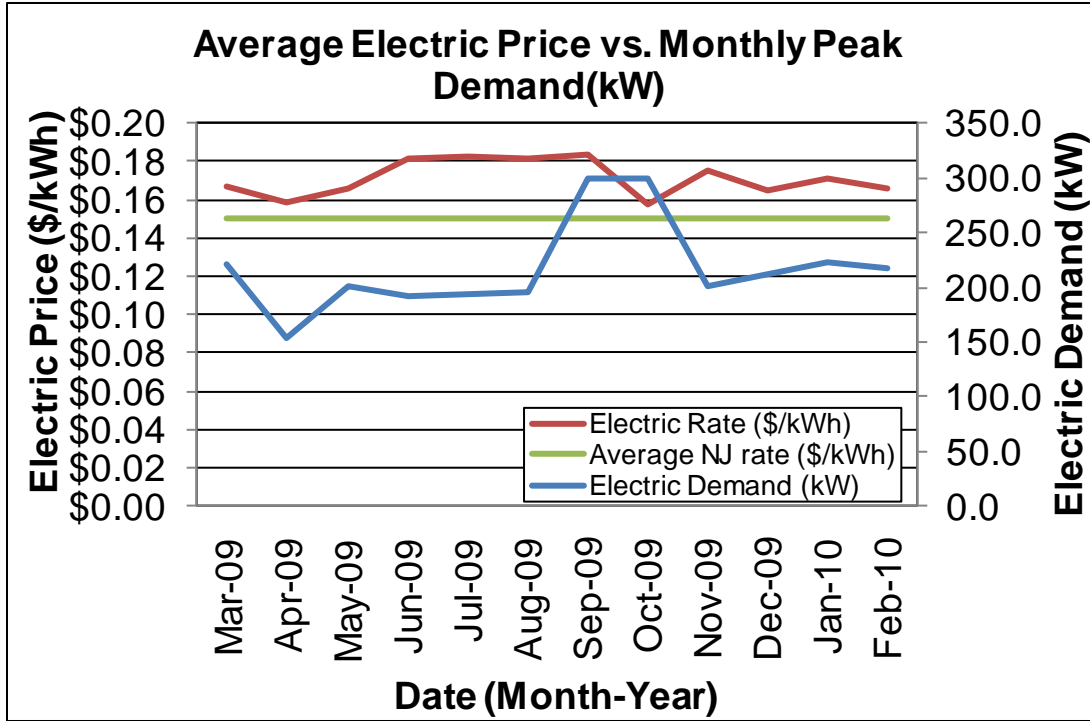
Tariff analysis is performed to determine if the rate that a municipality is contracted to pay with each utility provider is the best rate possible resulting in the lowest costs for electric and gas provision. Typically, the natural gas prices increase during the heating months when natural gas is used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

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

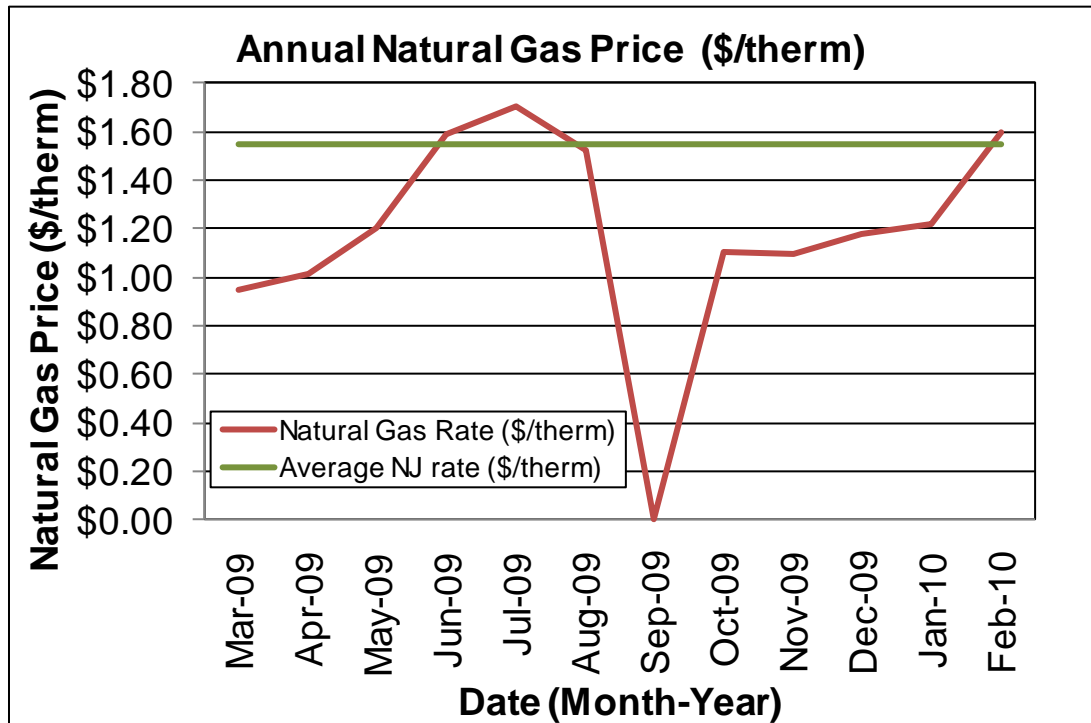
## **Energy Procurement strategies**

Billing analysis is conducted using an average aggregated rate that is estimated based on the total cost divided by the total energy usage per utility per 12 month period. Average aggregated rates do not separate demand charges from usage, and instead provide a metric of inclusive cost per unit of energy. Average aggregated rates are used in order to equitably compare building utility rates to average utility rates throughout the state of New Jersey.

The average estimated NJ commercial utility rates for electric are \$0.150/kWh, while Public Works and Water Plant pays a rate of \$0.171/kWh. The Public Works and Water Plant's annual electric utility costs are \$14,663 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 14% over the most recent 12 month period.



The average estimated NJ commercial utility rates for gas are \$1.550/therm, while the Public Works and Water Plant pays a rate of \$1.193/therm. Natural gas bill analysis shows fluctuations up to 44% over the most recent 12 month period.



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

summer month rates are high due to very low gas use and fixed meter charges (some have been left out from the previous chart).

SWA recommends that the Public Works and Water Plant further explore opportunities of purchasing fuel oil, natural gas and electricity from third-party suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Public Works and Water Plant. Appendix C contains a complete list of third-party energy suppliers for the Borough of Chatham 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 visits on April 7, 12 and 22, 2010, the following data was collected and analyzed.

### Public Works and Water Plant - Main Office and Garage

#### Building Characteristics - Public Works and Water Plant - Main Office and Garage

The single-story, (slab on grade with partial basement), 5,900 square feet Public Works and Water Plant Main Office and Garage Building was originally constructed in 1898 with additions/alterations, last completed in 1995. It houses two truck bays, a lunch room, a locker room, a DPW office area, a woodshop, a mechanical room and Water Department area and office.



Front and Side Façade



Left Side Façade



Right Side Façade



Front Façade

#### Building Occupancy Profiles - Public Works and Water Plant - Main Office and Garage

Its occupancy is approximately 1 to 5 employees intermittently throughout the day, mostly occupied during inclement weather.

## Building Envelope - Public Works and Water Plant - Main Office and Garage

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/outside and no/low wind), no exterior envelope infrared (IR) images were taken during the field audit.

### Exterior Walls

The exterior wall envelope of the front garage area is constructed of brick veneer, over concrete block with wood clapboard shingle accents on the side of the building, which houses the lunch room and no detectable insulation. The office area of the building is constructed of solid brick throughout with an unconfirmed level of insulation in the walls. The interior is a combination of painted brick and painted CMU (concrete masonry unit).

Note: Wall insulation levels could visually be verified in the field by non-destructive methods.

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall poor condition with some signs of uncontrolled moisture, air-leakage and other energy-compromising issues.

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



Cracked/deteriorated bricks and mortar joints



Cracked/deteriorated bricks and mortar joints



Damaged/cracking exterior wall finishes



Fan not properly installed on wall surface



Efflorescence on brick and masonry walls indicate moisture presence within the wall cavity.

## Roof

The garage roof is a gambrel type over a wood structure, with an asphalt shingle finish, installed more than 30 years ago. There is only ceiling insulation in the garage drop ceiling, with 4 inches of R-13 fiberglass batt insulation. The water department roof is EPDM membrane on top of glued urethane foam panels. The back office area roof is a low-pitched gable type over wood structure, with an asphalt shingle finish and without ceiling or roof insulation.

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

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

The following specific roof problem spots were identified:



Signs of mold/water damage on roof shingles



Severely clogged gutters



Insect nesting in roof cracks and cavities

## Base

The building's base is composed of a slab-on-grade floor (with partial basement) with a perimeter foundation and no detectable slab edge/perimeter 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.

## Windows

The building contains basically one type of window.

1. There are over six double-hung type windows with a vinyl frame, clear double glazing and no interior or exterior shading devices. The windows are located throughout the building and are original.

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 no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific window problem spots were identified:



Cracked or aged caulk around frame/sill on the exterior

## Exterior doors

The building contains several different types of exterior man-doors.

1. Three are metal type exterior doors. They are located throughout the building and were replaced approximately 20 years ago.
2. There are two metal type foam-filled garage doors. They are located in the front and side of the building and were replaced recently.

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 acceptable condition.

The main garage overhead door has foam filled insulation and was replaced in 2009.

## 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 - Public Works and Water Plant - Main Office and Garage**

### **Heating Ventilation Air Conditioning**

There were no comfort issues expressed by the Department of Public Works employees at the time of the field visit. Based on the occupancy and use of the building, the existing HVAC systems provide adequate conditioning for the seven separate buildings of the complex.

### **Equipment**

The Main Office and Garage building is conditioned by a heating and cooling split system, a cooling only split system, radiant electric baseboards, as well as hot water radiant baseboards and three hot water unit heaters served by (1) gas-fired hot water boiler and (1) oil-fired hot water boiler.



Heating & Cooling Split System Air Handling Unit in Attic Above Locker Room

The gas-fired heating and cooling split system air handling unit contains a natural gas burner for heating and a direct expansion (DX) system for cooling, made up of an evaporator, a separate condensing unit located on grade, and refrigeration loop. In heating mode, the burner provides heat to the passing air through the combustion of natural gas. In cooling mode, the refrigerant absorbs heat from the passing air in the evaporator coil and transfers the heat to the atmosphere in the condenser. The heating and cooling split system is near the end of its expected service life of 15 years and should be replaced with a more modern system, which will achieve energy savings. The cooling only split system air handler includes only the DX system and functions in the same manner as described above. This system is about halfway through its expected service life and is in good condition.



Separate Air-cooled Condensing Unit Located on Grade

A gas-fired hot water boiler and an oil-fired hot water boiler provide heating hot water to radiant heaters throughout the Main Office and Garage building, as well as three hot water unit heaters hung from the ceiling of the two garage bays in the Main Office building. The different zones receiving heating hot water via the gas-fired boiler are served by three pipe-mounted pumps, all of which were installed in 2003. The oil-fired boiler provides heating hot water to its associated equipment via a single pipe-mounted pump also installed in 2003. All pumps are fractional horsepower and are in very good condition.



Gas-fired Boiler in Front Garage (Left) and Oil-fired Boiler in Side Garage

## Distribution Systems

A typical split system unit arrangement draws in fresh air and brings it into a mixing box, where it is combined with return air from the building. A small portion of the return air is purged and vented outside prior to entering the mixing box. The air inside the air handler is sent through a filter before passing through the evaporator or direct expansion (DX) coil. The air handler fan then pushes the air through the furnace section before the conditioned air is distributed into the building spaces. The furnace is only active in the heating season and the DX system is only active in the cooling season. In between these seasons neither system may operate and only the blower will be active to provide fresh air to the building.

The ductwork in this building is well insulated and appears to be in very good condition.

## Controls

The heating and cooling equipment is controlled by manual thermostats in several rooms throughout the building. The thermostats are in good condition and appear to be working satisfactorily. Use of programmable thermostats in place of manual models would ensure proper scheduling such as night setback, which provides energy savings. However, with little knowledge of the diligence of the staff in setpoint adjustment, it is hard to quantify energy savings and provide a simple payback.



Example of Manual Thermostat, Located in the Main Office and Garage Building

## Domestic Hot Water

The domestic hot water (DHW) for the Main Office and Garage building is provided by one gas-fired Bradford White water heater with 40 gallon storage capacity located in the boiler room area in the front garage. This heater serves the toilet rooms of the building. The heater was installed in 1998 and is at the end of its expected lifespan. No other water heaters were observed in the other buildings.



*Gas-fired Domestic Water Heater in Front Garage*

## **Electrical systems - Public Works and Water Plant - Main Office and Garage**

### **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 Public Works and Water Plant currently contains mostly T12 fixtures with sporadic use of Incandescent lights. Based on measurements of lighting levels for each space, there are no vastly over-illuminated areas.

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

*Exterior Lighting* - The exterior lighting surveyed during the building audit was found to be a mix of incandescent and Metal Halide fixtures. Exterior lighting is controlled by photocells.

### **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.

### **Elevators**

The Public Works and Water Plant Main Office and Garage do not have an installed elevator.

### **Other electrical systems**

There are two sewage ejector pumps in the Main Office and Garage building. The larger, 1 HP pump is from the 1960s and is beyond its expected useful life. The second is a smaller 1/3 HP pump installed over 10 years ago. Separately, the Garage building has a sump with submersible sump pumps.



Submersible Sump Pump In Garage

## **Public Works and Water Plant Main Garages**

### **Building Characteristics - Public Works and Water Plant - Main Garages**

The single-story, (slab on grade), 10,100 square feet Public Works and Water Plant Garages were originally constructed in the 1950's, with each section added several years apart. There are three garage areas and a Mechanics' Bay: the Left Garage has three bays, the Middle Garage is not used frequently and has three bays and the last, the Right Garage has three bays, see Front Façade photo below. The Mechanics' shop tacked to the Right Garage is two bays. Each section is connected by interior doors. They are used as truck bays, storage areas and mechanics shops.



Front Façade



Front Façade



Right Side Façade



Rear Façade

### **Building Occupancy Profiles - Public Works and Water Plant - Main Garages**

The Mechanics' Bays are the only ones with regular occupancy, which is approximately 1 to 5 employees daily from 7:30 am to 4:00 pm. Occupancy increases during inclement weather.

### **Building Envelope - Public Works and Water Plant - Main Garages**

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/outside and no/low wind), no exterior envelope infrared (IR) images were taken during the field audit.

## Exterior Walls

The exterior wall envelope of the garage areas is constructed of brick veneer, over concrete block with stucco accents in some locations and no detectable insulation. The interior is mostly painted CMU (Concrete Masonry Unit).

Note: Wall insulation levels could visually be verified in the field by non-destructive methods.

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall good condition with no signs of uncontrolled moisture, air-leakage or other energy-compromising issues.

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



Cracked/deteriorated bricks and mortar joints

## Roof

The building's roofs are predominantly a flat and parapet type over steel and wood decking and rafters, with a dark-colored EPDM single membrane finish. Some of the roofs have been redone recently. There were eight inches of foil fiberglass batt ceiling insulation visible between wood ceiling rafters of the Mechanics' Garage, no to sparse insulation in the other garage ceilings, and eight inches of fiberglass batt insulation with vinyl lining between ceiling rafters in the Left Garage.

Note: Roof insulation levels could visually be verified in the field by non-destructive methods.

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

The following specific roof problem spots were identified:



Sections of missing ceiling insulation found, Mechanics Garage



No insulation at all despite being a conditioned space, Middle Garage



Uneven attic insulation found in some areas, Left Garage

## Base

The building's base is composed of a slab-on-grade floor with a perimeter foundation and no detectable slab edge/perimeter 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.

The following specific base problem spots were identified:



Vegetation growth at base

## Windows

The building contains basically one type of window.

1. There are three double-hung type windows with a metal frame, clear single glazing and no interior or exterior shading devices. The windows are located on the outside wall of the Mechanics' Garage and are original.

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 no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific window problem spots were identified:



Single-glazed window with ineffective frame

## Exterior doors

The building contains several different types of exterior doors.

1. There are eight aluminum type garage doors with four glass lights in each. They are located on each garage section and were replaced in 2000.
2. There is one aluminum type, painted exterior door located on the right side of the Mechanics' Garage, and is original.

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 acceptable condition.

The following specific door problem spots were identified:



Exterior aluminum door not properly sealed, Mechanics Garage



Garage door not properly sealed, Middle Garage

## 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 - Public Works and Water Plant - Main Garages

### Heating Ventilation Air Conditioning

There were no comfort issues expressed by the Department of Public Works employees at the time of the field visit. Based on the occupancy and use of the building, the existing HVAC systems provide adequate conditioning for the Main Garages.

## Equipment

The Main Garage is broken down into 4 adjoining sections: three 3-truck bays and a 2-bay mechanical shop. Each of the sections is heated by a pair of gas-fired unit heaters hung in the back corners. Four (4) of the unit heaters are beyond their expected service lives, and the other heaters are in the last half of their service lives. A small office in the mechanical bay is cooled by a thru-the-wall air conditioning unit which is in fair condition. A comprehensive equipment list for the entire complex can be found in Appendix A.



Typical Gas-fired Unit Heater in the Corner of Each Main Garage Section

The various sections of the Main Garage are primarily ventilated by natural ventilation via the large garage bay overhead doors that remain open during the work day. This condition leads to significant heat loss while the unit heaters are operating. SWA recommends the use of gas-fired infrared heaters in lieu of the current unit heaters. Infrared heaters heat objects such as people and the floor slab without heating the air. Heat will continue to radiate from the slab even after the heaters stop operating. Use of an infrared heating system in this type of facility typically results in significant energy savings.

In addition to the natural ventilation, the Mechanics' Bay of the Main Garage Building utilizes an Airmation air filter unit.

## Distribution Systems

Due to the nature of the equipment in the Main Garage there are no distribution systems required to provide the heating to the various spaces.

## Controls

The heating equipment is controlled by internal thermostats in the individual pieces of equipment that will turn on, and turn off, the equipment as the temperature presets are met.

## **Domestic Hot Water**

No hot water heaters were observed in the Main Garage.

## **Electrical systems - Public Works and Water Plant - Main Garages**

### **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 Public Works and Water Plant Main Garages currently contain mostly T12 fixtures, with sporadic use of Metal Halide fixtures. Based on measurements of lighting levels for each space, there are no vastly over-illuminated areas.

*Exit Lights* - Exit signs were found to be Incandescent type which SWA recommends to be upgraded to LED.

*Exterior Lighting* - The exterior lighting surveyed during the building audit was found to be a mix of Metal Halide lamps and Incandescent fixtures. Exterior lighting is controlled by photocells.

### **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.

### **Elevators**

The Public Works and Water Plant Main Garage does not have an installed elevator.

### **Other electrical systems**

The Main Garage building has an air compressor located in the third bay and an auto lift in the Mechanics’ Bay. Use of these pieces of equipment is minimal and thus do not make a major impact on the energy usage for the building.

## Public Works and Water Plant - Salt Dome, Well Houses and Steel Garage

### **Building Characteristics - Public Works and Water Plant - Salt Dome, Well Houses and Steel Garage**

#### Salt Dome

The single-story, (slab on grade), 1,300 square feet Salt Dome building was originally constructed in 2003 and is used for salt storage.



Front Façade Salt Dome



Side Façade Salt Dome

#### Well House # 1, 2 & 3

The three Well Houses are single-story, (slab on grade), 270 square feet each. Well House #1 and #3 were originally constructed in the early 1900's, and Well House # 2 was built in the 1950's. They house well pumps to distribute city water to a remote storage tank.



Well House (typ.)



Side Façade Well House (typ.)

#### Steel Garage

The single-story, (slab on grade), 1,900 square feet Steel Garage was originally constructed in the 1980's. The garage has four truck bays and storage areas along the wall.



Front Façade Steel Garage

### **Building Occupancy Profiles - Public Works and Water Plant - Salt Dome, Well Houses and Steel Garage**

There are no occupants for the Well Houses or the Salt Dome. The Well House is visited periodically for pump maintenance. The Salt Dome is accessed intermittently when salt is needed for inclement weather. The Steel Garage occupancy is also sporadic with approximately 1 or 2 employees weekly bringing in/taking out storage materials.

### **Building Envelope - Public Works and Water Plant - Salt Dome, Well Houses and Steel Garage**

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/outside), no exterior envelope infrared (IR) images were taken during the field audit.

#### **Exterior Walls**

The wall envelope of the Salt Dome is a precast concrete panel system with no insulation.

The Well Houses are constructed of solid brick with no insulation.

The Steel Garage envelope is a steel wall panels with no insulation.

Note: Wall insulation levels could visually be verified in the field by non-destructive methods.

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 on the Well Houses.

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



Well House Wall Water Damage and Infiltration

### Roof

The Salt Dome roof is predominantly a dome shape over a wood structure, with a asphalt shingle finish, with no ceiling or roof insulation.

The Well Houses have a flat and parapet type over steel decking, with a dark-colored EPDM single membrane finish and no ceiling or roof insulation.

The Steel Garage a low-pitch gable type over metal decking, with a metal panel finish and no roof or ceiling insulation. There is an opening in interior ceiling along the center seam of the building for roof ventilation.

Note: Roof insulation levels could visually be verified in the field by non-destructive methods.

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

### Base

The Salt Dome base is a slab-on-grade floor with a perimeter foundation and no detectable slab edge/perimeter insulation.

The Well House base's are slab-on-grade floor with a perimeter foundation and no detectable slab edge/perimeter insulation.

The Steel Garage base is a slab-on-grade floor with a perimeter foundation and no detectable slab edge/perimeter 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.

## **Windows**

The building contains several different types of windows.

1. Salt Dome has five round skylight type windows at the center of the ceiling.
2. Well Houses each has four or five double-hung type windows with a non-insulated aluminum frame, clear double glazing and no interior or exterior shading devices.
3. The Steel Garage has no windows.

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 on the Well Houses.

The following specific window problem spots were identified:



Exterior mold/water damage signs on areas around windows

## **Exterior doors**

The buildings contain several different types of exterior doors.

1. The Salt Dome has a wood sliding door with a synthetic wood wall panel finish type exterior and is original to the building.
2. The Well Houses each have an aluminum type exterior door which is original.
3. The Steel Garage has four sheet metal type garage doors with a light glass vision panels which are original.

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.

### **Building air-tightness**

Overall the field auditors found the building to be reasonably air-tight, considering the building's infrequent use and sporadic 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 - Public Works and Water Plant - Salt Dome, Well Houses and Steel Garage**

### **Heating Ventilation Air Conditioning**

There were no comfort issues expressed by the Department of Public Works employees at the time of the field visit. Based on the occupancy and use of the building, the existing HVAC systems provide adequate conditioning for these buildings.

### **Equipment**

The Steel Garage is heated by a brand new waste oil burner. The three small Pump/Well Houses located within the complex are heated by small electric unit heaters, one per building. The final building of the complex is the Salt Dome, which receives no heating or cooling. A comprehensive equipment list for the entire complex can be found in Appendix A.

The Steel Garage is primarily ventilated by natural ventilation via the large garage bay overhead doors that remain open during the work day. The pump houses are ventilated by louvered exhaust fans mounted over the doorway of each building. The Salt Dome is naturally ventilated by louvers in the domed roof of the structure.



Typical Louvered Exhaust Fan Above Pump House Door

## **Distribution Systems**

Due to the nature of the equipment in the Steel Garage and Pump Houses there are no distribution systems required to provide the heating to the various spaces.

## **Controls**

The heating equipment is controlled by internal thermostats in the individual pieces of equipment that will turn on, and turn off, the equipment as the temperature presets are met.

## **Domestic Hot Water**

No hot water heaters were observed in the Steel Garage, Salt Dome or Pump Houses.

## **Electrical systems - Public Works and Water Plant - Salt Dome, Well Houses and Steel Garage**

### **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 Public Works and Water Plant buildings currently contain mostly T12, incandescent and metal halide fixtures. Based on measurements of lighting levels for each space, there are no vastly over-illuminated areas.



T12 Fixture

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

*Exterior Lighting* - The exterior lighting surveyed during the building audit was found to be a mix of Metal Halide lamp and Incandescent fixtures. Exterior lighting is controlled by photocells.

### **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.

### **Elevators**

The Public Works and Water Plant buildings do not have installed elevators.

### **Other electrical systems**

#### **Emergency Power**

Two of the Pump/Well Houses (1 & 3) have back-up power diesel generators. The generator for Pump House #1 is inside the structure, and the generator for Pump House # 3 is a self contained unit located behind the Steel Garage.

#### **Process Equipment & Pumps**

Each of the Pump Houses contains a large water pump used to distribute water throughout the township. Pump Houses #1 & #3 have 150 HP pumps and Pump House #2 (back-up) has a 75 HP pump. All water pumps are listed as premium efficiency on their nameplates.

## **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 at this complex.

### **3.2 Evaluated Systems**

#### **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, the Public Works and Water Plant are a good candidate for a 49.7 kW Solar Panel installation. See ECM#8 for details.

#### **Solar Thermal Collectors**

Solar thermal collectors are not cost-effective for these buildings 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 Public Works and Water Plant buildings are not a good candidate for geothermal installation since the system cost would be prohibitive as compared to the minimal usage and savings.

## Combined Heat and Power

The Public Works and Water Plant buildings are not a good candidate for CHP installation and would not be cost-effective due to the size and operations of the building. Typically, CHP is best suited for buildings with a high electrical baseload to accommodate the electricity generated, as well as a means for using waste heat generated. Typical applications include buildings with an absorption chiller or high domestic water load, 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#	0-5 Year Payback ECMs
1	Upgrade 4 of thermostats to programmable type in the offices and garages
2	Replace 1 incandescent Exit sign with LED type
3	Upgrade 37 incandescent fixtures to CFLs
4	Install 1 beverage and 1 Snacks vending machine energy misers in break room
5	Upgrade 8 Metal Halide (MH) fixtures to T5
6	Upgrade 63 T12 fixtures to T8 fixtures
ECM#	5-10 Year Payback ECMs
7	Replace 1 old Break room refrigerator with 18 cu ft Energy Star model
ECM#	>10 Year Payback (End of Life)
8	Install 49.7 kW PV rooftop system with incentives
9	Replace gas-fired heating/electric cooling split HVAC system with a high efficiency 14 SEER system

## ECM#1: Upgrade 4 of thermostats to programmable type in the offices and garages

During the field audit, SWA completed a building HVAC controls analysis and observed spaces in the buildings where temperature is manually controlled without setbacks to reduce energy consumption during unoccupied periods of time, such as evenings and weekends. Programmable thermostats offer an easy way to save energy when correctly used. By turning the thermostat setback 10-15 degrees F for eight hours at a stretch (at night), the heating bill can be reduced substantially (by a minimum of 10% per year). In the summer, the cooling bill can be reduced by keeping the conditioned space warmer when unoccupied, and cooling it down only when using the space. The savings from using a programmable thermostat is greater in milder climates than in more extreme climates. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor. The four spaces addressed in this ECM are offices and garages that currently have wall mounted thermostats.

### Installation cost:

Estimated installed cost: \$668 (includes \$301 of labor)

Source of cost estimate: RS Means; Published and established costs; Similar projects

est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
668	none at this time	668	573	0.2	22	0.2	1,167	1,290	12	15,484	0.5	2218	185	193	11,652	1,264

**Assumptions:** SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. SWA assumed a conservative 1/2% savings of heating/cooling loads and on the average 40 min/wk operational savings when systems are operating per pre-agreed settings vs. the need to make more frequent adjustments.

### Rebates/financial incentives:

- There is no incentive available for this measure at this time.

Please see Appendix F for more information on Incentive Programs.

## ECM#2: Replace 1 incandescent Exit sign with LED type

During the field audit, SWA completed a building lighting inventory (see Appendix B). SWA observed that the buildings contain an incandescent Exit sign. SWA recommends replacing this with LED type. Replacing existing Exit sign with LED Exit sign can result in lower kilowatt-hour consumption, as well as lower maintenance costs. Since Exit signs operate 24 hours per day, they can consume large amounts of energy. In addition, older Exit signs require frequent maintenance due to the short life span of the lamps that light them. LED Exit sign lamps last at least 5 years. In addition, LED Exit signs offer better fire code compliance because they are maintenance free in excess of 10 years. LED Exit signs are usually brighter than comparable incandescent or fluorescent signs, and have a greater contrast with their background due to the monochromatic nature of the light that LEDs emit. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

### Installation cost:

Estimated installed cost: \$130 (includes \$65 of labor)

Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
150	20	130	477	0.2	0	0.1	18	99	15	1,486	1.3	1,043	70	76	1,004	854

**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 1/2 hr/yr to replace aging burnt out lamps vs. newly installed.

### Rebates/financial incentives:

- NJ Clean Energy - Replace Incandescent Exit with LED - \$20 per fixture

Please see Appendix F for more information on Incentive Programs.

### ECM#3: Upgrade 37 incandescent fixtures to CFLs

During the field audit, SWA completed a building lighting inventory (see Appendix B). The existing lighting also contains inefficient incandescent lamps. SWA recommends that each incandescent lamp is replaced with a more efficient, Compact Fluorescent Lamp (CFL). CFLs are capable of providing equivalent or better light output while using less power when compared to incandescent, halogen and Metal Halide fixtures. CFL bulbs produce the same lumen output with less wattage than incandescent bulbs and last up to five times longer. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

#### Installation cost:

Estimated installed cost: \$1,295 (includes \$777 of labor)

Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
1,295	none at this time	1,295	3,548	1.1	0	0.6	175	782	5	3,909	1.7	202	40	53	2,194	6,353

**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 at this time

Please see Appendix F for more information on Incentive Programs.

**ECM#4: Install 1 beverage and 1 Snacks vending machine energy misers in break room**

Energy vending miser devices are now available for conserving energy used by beverage vending machines and coolers. There isn't a need to purchase new machines to reduce operating costs and greenhouse gas emissions. When equipped with the vending miser devices, refrigerated beverage vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines. Vending miser devices incorporate innovative energy-saving technology into small plug-and-play devices that installs in minutes, either on the wall or on the vending machine. Vending miser devices use a Passive Infrared Sensor (PIR) to: Power down the machine when the surrounding area is vacant; Monitor the room's temperature; Automatically repower the cooling system at one- to three-hour intervals, independent of sales; Ensure the product stays cold.

Snack vending miser devices can be used on snack vending machines to achieve maximum energy savings that result in reduced operating costs and decreased greenhouse gas emissions with existing machines. Snack vending miser devices also use a Passive Infrared Sensor (PIR) to determine if there is anyone within 25 feet of the machine. It waits for 15 minutes of vacancy, then powers down the machine. If a customer approaches the machine while powered down, the snacks vending miser will sense the presence and immediately power up.

**Installation cost:**

Estimated installed cost: \$404 (includes \$141of labor)

Source of cost estimate: www.usatech.com and established costs

est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
404	none at this time	404	1,400	0.4	0	0.2	0	239	12	2,873	1.7	611	51	59	1,890	2,507

**Assumptions:** SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis. SWA assumes energy savings based on modeling calculator found at www.usatech.com or [http://www.usatech.com/energy\\_management/energy\\_calculator.php](http://www.usatech.com/energy_management/energy_calculator.php) .

**Rebates/financial incentives:**

- None at this time

Please see Appendix F for more information on Incentive Programs.

### ECM#5: Upgrade 8 Metal Halide (MH) fixtures to T5

During the field audit, SWA completed a building interior as well as exterior lighting inventory (see Appendix B). The existing lighting contains standard probe start Metal Halide (MH) lamps in some of the garage areas. SWA recommends replacing the higher wattage MH fixtures with ceiling suspended T5 fixtures which 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 a one to two substitution, replacing each MH fixture with a 4 ft T5, 2 lamp fixture. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

#### Installation cost:

Estimated installed cost: \$840 (includes \$420 of labor)

Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
1,000	160	840	711	0.2	0	0.1	113	234	15	3,511	3.6	318	21	27	1,855	1,273

**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 1.5 hrs/yr to replace aging burnt out lamps vs. newly installed.

#### Rebates/financial incentives:

- NJ Clean Energy - MH to T5 (\$20 per fixture) - Maximum incentive amount - \$160

Please see Appendix F for more information on Incentive Programs.

### ECM#6: Upgrade 63 T12 fixtures to T8 fixtures

During the field audit, SWA completed a building lighting inventory (see Appendix B). The existing lighting contains over 60 inefficient T12 fluorescent fixtures with magnetic ballasts. SWA recommends replacing each existing fixture with more efficient, T8 fluorescent fixtures with electronic ballasts. T8 fixtures with electronic ballasts provide equivalent or better light output while reducing energy consumption by 30% when compared to T12 fixtures with magnetic ballasts. T8 fixtures also provide better lumens for less wattage when compared to incandescent, halogen and Metal Halide fixtures. The labor for the recommended installations is evaluated using prevailing electrical contractor wages. The building owner may decide to perform this work with in-house resources from the Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor.

#### Installation cost:

Estimated installed cost: \$6,895 (includes \$3,938 of labor)

Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
9,450	1,575	7,875	6,895	2.2	0	1.2	315	1,494	15	22,411	5.3	185	12	17	9,405	12,345

**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 9 hrs/yr to replace aging burnt out lamps vs. newly installed.

#### Rebates/financial incentives:

- NJ Clean Energy - T12 to T8 (\$25 per fixture) - Maximum incentive amount - \$1,575

Please see Appendix F for more information on Incentive Programs.

**ECM#7: Replace 1 old Break room refrigerator with 18 cu ft Energy Star model**

During the field audit, SWA inspected old refrigerators which were not Energy Star rated (using approximately 775 kWh/yr). 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 existing old refrigerators with 18 cu. ft. top freezer refrigerators ENERGY STAR®, using approximately 425 kWh/yr, or equivalent. Besides saving energy, the replacement will also keep the surrounding area 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>.

On April 28, 2008, the ENERGY STAR criteria changed for all full-size refrigerators. All refrigerators greater than 7.75 cubic feet must be at least 20% more efficient than the federal standard. Before April 28, 2008, refrigerators needed to be at least 15% more efficient than the federal standard. The criteria for freezers and compact refrigerators and freezers did not change.

**Installation cost:**

Estimated installed cost: \$750 (includes \$70 of labor)

Source of cost estimate: RS Means; Published and established costs, NJ Clean Energy Program

est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
Replace 1 old Break room refrigerator in kind																
700	0	700	50	0.0	0	0.0	50	59	12	703	12.0	0	0	0	-120	90
Incremental difference to replace 1 old Break room refrigerator with 18 cu ft Energy Star model																
50	0	50	300	0.1	0	0.1	0	51	12	616	1.0	1131	94	103	441	537
<b>Replace 1 old Break room refrigerator with 18 cu ft Energy Star model</b>																
<b>750</b>	<b>0</b>	<b>750</b>	<b>350</b>	<b>0.1</b>	<b>0</b>	<b>0.1</b>	<b>50</b>	<b>110</b>	<b>12</b>	<b>1,318</b>	<b>6.8</b>	<b>76</b>	<b>6</b>	<b>10</b>	<b>320</b>	<b>627</b>

**Assumptions:** SWA calculated the savings for this measure using measurements taken during the field audit and using the billing analysis. SWA assumed annual labor and parts insurance for old refrigerators.

**Rebates/financial incentives:**

- None at this time

Please see Appendix F for more information on Incentive Programs.

## **ECM#8: Install 49.7 kW PV rooftop system with incentives**

Currently the Public Works and Water Plant do not use any renewable energy systems. Renewable energy systems such as photovoltaic panels can be mounted on the building roofs facing south, which 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's period. During the summer periods, electric demand at a power station is high due to the amount of air conditioners, lights, and other equipment being used within the region. Demand charges increase to offset the utility's cost to provide enough electricity at that given time. Installing a PV system will offset electrical demand and reduce the annual electric consumption for the building, while utilizing available state incentives. PV systems are modular and readily allow for future expansion.

The size of the system was determined considering the available roof surface area, without compromising service space for roof equipment and safety, as well as the facility's annual base load and mode of operation. A PV system could be installed on a portion of the roof with panels facing south. The Main Garage building has four (4) flat roof sections for portions of a 49.7 kW PV installation on the building roof. A commercial crystalline 230 watt panel has 17.5 square feet of surface area (13.1 watts per square foot). A 49.7 kW system needs approximately 216 panels which would take up 3,780 square feet.

A PV system would reduce the buildings' electric load and allow more capacity for surrounding buildings as well as serve as an example of energy efficiency for the community. The building is not eligible for a residential 30% federal tax credit. The Public Works and Water Plant 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 SREC's at \$600/MWh or best market offer.

Please note that this analysis did not consider the structural capability of the existing building to support the above recommended system. SWA recommends that the Borough of Chatham contract with a structural engineer to determine if additional building structure is required to support the recommended system and what costs would be associated with incorporating the additional supports prior to system installation. Should additional costs be identified, the Township should include these costs in the financial analysis of the project.

### **Installation cost:**

Estimated installed cost: \$332,865 (including \$133,142 total labor cost)

Source of cost estimate: Similar projects

**Economics (with incentives):**

est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime energy cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
372,600	39,744	332,856	34,163	49.7	0	5.8	0	26,340	25	453,514	12.6	36	1	3	7,595	61,169

**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 #ND-U230C1). 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, Incentive based on \$.80 / watt Solar PV application for systems 50 kW or less. Incentive amount for this application is \$39,744 for the proposed option.

<http://www.njcleanenergy.com/renewable-energy/programs/renewable-energy-incentive-program>

NJ Clean Energy - Solar Renewable Energy Certificate Program. Each time a solar electric system generates 1,000kWh (1MWh) of electricity, a SREC is issued which can then be sold or traded separately from the power. The buildings must also become net-metered in order to earn SRECs as well as sell power back to the electric grid. A total annual SREC credit of \$20,400 has been incorporated in the above costs; however it requires proof of performance, application approval and negotiations with the utility.

**Options for funding ECM:**

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

<http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings>

**ECM#9: Replace gas-fired heating/electric cooling split HVAC system with a high efficiency 14 SEER system**

The main offices and locker room areas of the Public Works and Water Plant - Main Office and Garage building are heated and cooled by a gas-fired furnace with split system DX cooling, with condensing unit located on grade. This system should be replaced. This equipment was installed in 1997 and is nearing the end of its expected service life of 15 years. SWA recommends replacement of this split system air handling unit and condensing unit to gain increase in operating efficiency. This measure cannot be justified by energy savings alone, but should be considered as an end-of-life energy savings opportunity.

The current equipment is operating with a cooling Seasonal Energy Efficiency Ratio (SEER) of approximately 10. The new equipment should have a minimum 14.0 SEER rating. The higher SEER will involve increased cost for the equipment over units with lower SEER. The equipment shall be Energy Star certified and ASHRAE 90.1 compliant. The equipment shall utilize R-410A refrigerant.

**Installation cost:**

Estimated installed cost: \$5,016 (including \$1,254 total labor cost)  
 Source of cost estimate: Manufacturer's data and similar projects

**Economics (with incentives):**

est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
<b>Scenario #1: Replacement of Existing 10.0 SEER Split System with 12.0 SEER System</b>																
4,500	0	4,500	480	0.1	0	0.1	0	144	15	2,153	31.4	-52	-3	-8	-2,787	658
<b>Scenario #2: Incremental Cost of Replacing with 14.0 SEER System Over 12.0 SEER System</b>																
1,000	484	516	342	0.1	42	0.3	0	174	15	2,611	3.0	406	27	33	1,562	960
<b>Scenario #3: Replacement of Existing 10.0 SEER Split System with 14.0 SEER System</b>																
5,500	484	5,016	822	0.2	42	0.4	0	318	15	4,764	15.8	-5	0	-1	-1,225	1,618

**Assumptions:** SWA calculated the savings for this measure using nameplate data taken on the days of the field visits and using the billing analysis, and by estimating the total of 1,200 cooling hours for one year using weather bin data for Newark, NJ.

**Rebates/financial incentives:**

NJ Clean Energy - Gas Heating < 300 MBH (\$2.00 per MBH, minimum \$300 per unit)  
 Unitary HVAC <5.4 tons and Min. 14.0 SEER (\$92/ton) - Maximum incentive amount is \$484.

**Options for funding ECM:**

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation. <http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings>

## PROPOSED FURTHER RECOMMENDATIONS

### Capital Improvements

Capital Improvements are recommendations for the buildings 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 Public Works and Water Plant:

- Install premium motors when replacements are required - Select NEMA Premium motors when replacing motors that have reached the end of their useful operating lives.
- The various sections of the Main Garage are primarily ventilated by natural ventilation via the large garage bay overhead doors that remain open during the work day. This condition leads to significant heat loss while the unit heaters are operating. SWA recommends the use of gas-fired infrared heaters (approximate 8 infrared heaters total) in lieu of the current unit heaters with burners the current locations of the unit heater, to save on gas piping. Use of an infrared heating system in this type of facility typically results in significant energy savings. It is estimated that this measure will save approximately 850 therms, or \$1,005 per year. The estimated cost for this measure is \$24,000, and the simple payback is 23.9 years.
- Install a premium efficiency motor on the 1 horsepower sewage ejector pump in the Main Office and Garage Building. Due to the low operating hours, the estimated simple payback is 36.0 years. The estimated cost for this measure is \$360.
- Replace the domestic hot water heater in the Main Office and Garage Building with a direct vent condensing model. Due to the low domestic hot water usage in this facility, the estimated simple payback is 25.9 years. The estimated cost for this measure is \$1,500.
- Replace heating terminal units - such as perimeter hot water radiators in the Main Office and hydronic unit heaters in the Main Office Garage areas. This equipment is in fair to poor condition and is beyond its expected service life. Age and wear have reduced the heat transfer capacity. This equipment should be replaced with more modern equipment suited for the intended use. These changes cannot be justified based on energy savings alone. However, replacement is strongly recommended to improve the overall efficiency of the heating system. This is a replacement in kind recommendation which offers negligible energy savings.
- Consider adding emergency generator for well pump #2 to serve the water pump similar to that for well pumps #1 and #3. The estimated installation cost is \$15,000.
- Add insulation to ineffective and under-insulated ceiling sections. SWA suggests applying closed-cell spray-foam (R-13 min.) to the underside of the metal decking.
- Replace all original, single-glazed windows and frames with historically and architecturally accurate low-E, double glazed type.

- Install CO detectors/alarms in garages and nearby working spaces and chlorine detectors/alarms in the Pump/Well Houses. Connect high level signals to nearby exhaust fans wherever possible.

## **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.

- Re-point deteriorated mortar joints soon to prevent possible water/moisture penetration into cavity walls.
- Efflorescence-coated brick and masonry materials need to dry out, and possible cause of water infiltration into wall cavities should be investigated.
- Install footing drains and slope perimeter grade away from the building. SWA suggests investigating interior footing drain option.
- Install and maintain weather-stripping around all exterior doors and roof hatches.
- Maintain roofs - SWA recommends regular maintenance to verify water is draining correctly.
- Maintain downspouts and cap flashing - Repair/install missing downspouts and cap flashing as needed to prevent water/moisture infiltration and insulation damage. SWA recommends round downspout elbows to minimize clogging.
- Repair/seal wall cracks and penetrations - SWA recommends as part of the maintenance program installing weep holes, installing proper flashing and correct masonry efflorescence, and sealing wall cracks and penetrations wherever necessary in order to keep insulation dry and effective.
- Provide water-efficient fixtures and controls - Adding controlled on/off timers on all lavatory faucets is a cost-effective way to reduce domestic hot water demand and save water. Building staff can also easily install faucet aerators and/or low-flow fixtures to reduce water consumption. There are many retrofit options, which can be installed now or incorporated as equipment is replaced. Routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy. Retrofitting with more efficient water-consumption fixtures/appliances will reduce energy consumption for water heating, while also decreasing water/sewer bills.
- 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/>.
- Boiler and building piping insulation - Insulate un-insulated heating piping in the garage area of the Main Office building and throughout the building to efficiently deliver heat where required and provide personnel protection.
- Water levels in the expansion tanks and the integrity of the tank bladders should be checked to confirm proper operation.
- Tighten belts on exhaust fans - tightening belts on belt-driven exhaust fans can maximize overall efficiency of the equipment.
- Change filters in air handling units monthly to ensure efficient operation of the fan, ensure adequate air delivery to the space and avoid overheating of the air handler's heat exchanger, which can cause cracking and require replacement.

## APPENDIX A: EQUIPMENT LIST

### Inventory

Building System	Description	Model #	Fuel	Location	Space Served	Date Installed	Estimated Remaining Useful Life %
Heating	Reznor Waste Oil Burner – Est. 80% efficiency	RA150 S# 272755	Waste Oil	Steel Garage	Steel Garage	2008	90%
Heating	(2) Modine High Efficiency Unit Heaters – 80% efficiency	PV100AE1030 S# 39011042402-5914 Input 100 MBH Output 80 MBH 115V 1ph 3.7A	Natural Gas	Mech Garage	Mech Garage	2002	40%
Misc	Baldor Auto Lift Motor	Spec - 35M377-5560G1 S# F994 115/230V 24/12A 3HP	Elec	Mech Garage	Mech Garage	1994	10%
Cooling	Carrier thru-wall Air Conditioner	(no nameplate)	Elec	Mech Garage Office	Mech Garage Office	Pre-2000	0%
Ventilation	Airmation Air Filter	AMAR302D S# AM302061D04 38 230V, 7.5A Blower #5C198	Elec	Mech Garage	Mech Garage	2001	65%
Heating	(2) Modine Unit Heaters – 90% efficiency	PD150AE0130 S# 05011014200-3427 S# 05011010701-9623 Input 150 MBH Output 135 MBH	Natural Gas	Garage #3	Garage #3	2000 2001	25%
Misc	Air Compressor	Baldor Motor Cat# M3311T 7.5HP, 208-230/460 21.7-20/10A, 1750 RPM	Elec	Garage #3	Garage #3	1994	20%
Heating	(2) Bryant Unit Heaters – 80% efficiency	125-342 Series A-2B S# 27648 Input 125 MBH Output 100 MBH	Natural Gas	Garage #2	Garage #2	1972	0%
Continued on the next page							

Continued from previous page

Building System	Description	Model #	Fuel	Location	Space Served	Date Installed	Estimated Remaining Useful Life %
Heating	(2) Reznor Unit Heaters – 80% efficiency	F165 S# AUB31K6N715 11 Input 165 MBH Output 132 MBH	Natural Gas	Garage #1	Garage #1	1995	0%
Cooling	American Standard Cooling Only Air Handling Unit – 10 SEER	TWE024C140 BD S# 2165M8T2V 1/4 HP 200- 230V	Electric	Attic of main office	Main Offices	2002	50%
Heating	Radiant Electric Baseboard	Info not available	Electric	Main Offices	Main Offices	circa 1995	0%
Cooling	American Standard Cooling Air-cooled Condensing Unit – 10 SEER	Allegiance 10 Model #7A0024A100 A2 S# 2201WF24F 1PH, MCA 15, MOCP 20 4lbs 3oz	Electric	Rear Exterior of Office	Main Offices	2002	60%
Cooling	Lennox Air-cooled Condensing Unit – 10 SEER	HS25-311-1P S# 5895L35584	Electric	Front Exterior of Office	Main Offices	1997	15%
Misc.	Yeomans Bros Sewage Ejector	1 HP, 115V	Electric	Basement of Main Offices	Main Offices	circa 1960	0%
Misc.	Sump Pump	.3 HP	Electric	Basement of Main Offices	Main Offices	1998	40%
Heating	Weil-McLain Oil Boiler – 85.0% AFUE	P-W90-5 Series #3 Beckett Motor 21805 K37MYBKN- 597 S# R7184P1064	Electric / Oil	Main Office - Garage	Main Offices/Garage	2003	75%
Heating	Boiler Pump	Bell & Gossett NRF-22 103251620 115V, 1PH, .8A	Electric	Main Office - Garage	Main Offices/Garage	2003	65%
Heating	Hydronic Radiators	Info not available	Hydronic	Main Office	Main Offices	1970s-80s	0%

Continued on next page

Continued from previous page

Building System	Description	Model #	Fuel	Location	Space Served	Date Installed	Estimated Remaining Useful Life %
Heating	(2) Hydronic Unit Heaters - Trane	Info not available	Hydronic	Main Office - Back Garage	Main Office Garage	1970s-80s	0%
Cooling	Coronet Window A/C Unit	Info not available	Electric	Main Office	Main Offices	Circa 1980	0%
Emergency Power	Emergency Generator	General Motors PTA114144 S# 383495	Diesel	Pump House #1	Pump House #1	Circa 1985	15%
Heating	Dayton Unit Heater	Info not available	Electric	Pump House #1	Pump House #1	2005	60%
Ventilation	Dayton Fan - Above Door	Direct Drive 9K953A 1/4 HP, 1PH, 115V, 4.5A	Electric	Pump House #1	Pump House #1	2005	70%
Process	Process Pump – NEMA 95.6% efficiency	CF01 NEMA Premium 150hp, 1730 rpm 460V, 164A	Electric	Pump House #1	Pump House #1	2009	95%
Heating	Dimplex Unit Heater	Info not available	Electric	Pump House #2	Pump House #2	2005	60%
Process	Process Pump – NEMA 94.1% efficiency	US ELEC MOTORS Premium Efficiency High Thrust Motor 75HP 3ph 1770 rpm	Electric	Pump House #2	Pump House #2	2009	95%
Ventilation	Dayton Fan - Above Door	Direct Drive 9K953A 1/4 HP, 1PH, 115V, 4.5A	Electric	Pump House #2	Pump House #2	2005	70%
Heating	Dimplex Unit Heater	Info not available	Electric	Pump House #3	Pump House #3	2005	60%
Process	Process Pump: Emerson Motor – NEMA 95.8% efficiency	CF01 NEMA Premium 150hp, 1780 rpm 460V, 164A	Electric	Pump House #3	Pump House #3	2009	95%
Ventilation	Dayton Fan - Above Door	Direct Drive 9K953A 1/4 HP, 1PH, 115V, 4.5A	Electric	Pump House #3	Pump House #3	2005	70%

Continued on next page

Continued from previous page

Building System	Description	Model #	Fuel	Location	Space Served	Date Installed	Estimated Remaining Useful Life %
Emergency Power	Emergency Generator	Onan DE-FA-4487613 S# I000151068 SPEC L, 150KW	Diesel	Behind Steel Garage	Pump House #3	2000	65%
Domestic Hot Water	Water Heater: Bradford White – Est. 75% eff.	MI403T6LN12 S#PK0139183-131E0221 40000 BTUH	Natural Gas	Main Office - Garage	Main Offices	1998	0%
Heating	Boiler: Crown – 90.4% AFUE	AWI195SNSTI PSU S# CROWN0003 62388 Input 195,000 Output 159,000 (Trane hydronic UH in garage)	Natural Gas	Main Office - Garage	Main Offices	2004	80%
Heating	(3) Taco Circulator Pumps	007-F5 1/25 HP	Natural Gas	Main Office - Garage	Main Offices	2004	70%
Heating	Hydronic Unit Heater - Trane	Info not available	Hydronic	Main Office - Garage	Main Offices - Garage	1970s-80s	0%
Heating / Cooling	Lennox Air Handling Unit – 10 SEER	28K6201 Coil - CH23-31-1 R-22	Natural Gas	Main Office - Locker Room	Main Office - Locker Room	1997	15%
Ventilation	Ceiling Mounted Exhaust Fan	Info not available	Electric	Main Office - Locker Room	Main Office - Locker Room	1995	25%
Lighting	See Details – Appendix B	-	Electric	See Details - Appendix B	Buildings	varies	avg is 15%

**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	Building	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	Public Works - Garage	Ext	Exterior	Wall Mounted	S	MH	2	1	75	PC	12	365	21	192	841	N/A	Wall Mounted	MH	S	PC	2	1	75	12	365	21	192	841	0	0	0
2	Public Works - Garage	Ext	Exterior	Wall Mounted	S	Inc	8	1	60	PC	12	365	0	480	2,102	CFL	Wall Mounted	CFL	S	PC	8	1	20	12	365	0	160	701	1402	0	1402
3	Public Works - Garage (Left)	1	Garage	Parabolic Ceiling Mounted	M	8T12	6	2	80	Sw	12	260	20	1,080	3,370	T8	Parabolic Ceiling Mounted	8T8	E	Sw	6	2	59	12	260	7	750	2340	1030	0	1030
4	Public Works - Garage (Left)	1	Storage Rm	Parabolic Ceiling Mounted	M	4T12	1	2	40	Sw	12	260	12	92	287	T8	Parabolic Ceiling Mounted	4T8	E	Sw	1	2	32	12	260	5	69	215	72	0	72
5	Public Works - Garage (Left)	1	Storage Rm	Parabolic Ceiling Mounted	M	8T12	1	2	80	Sw	12	260	20	180	562	T8	Parabolic Ceiling Mounted	8T8	E	Sw	1	2	59	12	260	7	125	390	172	0	172
6	Public Works - Garage (Left)	1	Storage Rm	Parabolic Ceiling Suspended	S	MH	2	1	75	Sw	2	260	21	192	100	T5	Parabolic Ceiling Suspended	4T5	E	Sw	2	2	28	2	260	4	120	62	37	0	37
7	Public Works - Garage (Left)	1	Garage	Parabolic Ceiling Suspended	S	MH	6	1	75	Sw	12	260	21	576	1,797	T5	Parabolic Ceiling Suspended	4T5	E	Sw	6	2	28	12	260	4	360	1123	674	0	674
8	Public Works - Garage (Left)	1	Garage	Exit Sign	S	Inc	1	1	60	N	24	365	0	60	526	LEDex	Exit Sign	LED	S	N	1	1	5	24	365	1	6	48	477	0	477
9	Public Works - Garage (Mid)	1	Garage	Parabolic Ceiling Mounted	M	8T12	6	2	80	Sw	12	260	20	1,080	3,370	T8	Parabolic Ceiling Mounted	8T8	E	Sw	6	2	59	12	260	7	750	2340	1030	0	1030
10	Public Works - Garage (Right)	1	Garage	Parabolic Ceiling Suspended	M	8T12	10	2	80	Sw	8	260	20	1,800	3,744	T8	Parabolic Ceiling Suspended	8T8	E	Sw	10	2	59	8	260	7	1250	2600	1144	0	1144
11	Public Works - Garage (Right)	1	Office	Parabolic Ceiling Mounted	M	4T12	1	2	40	Sw	9	260	12	92	215	T8	Parabolic Ceiling Mounted	4T8	E	Sw	1	2	32	9	260	5	69	161	54	0	54
12	Public Works - Garage (Right)	1	Shop Area	Parabolic Ceiling Mounted	M	8T12	1	2	80	Sw	8	260	20	180	374	T8	Parabolic Ceiling Mounted	8T8	E	Sw	1	2	59	8	260	7	125	260	114	0	114
13	Public Works - Garage (Right)	1	Storage Rm	Parabolic Ceiling Mounted	M	8T12	1	2	80	Sw	2	260	20	180	94	T8	Parabolic Ceiling Mounted	8T8	E	Sw	1	2	59	2	260	7	125	65	29	0	29
24	Public Works - Salt Silo	Ext	Exterior	Wall Mounted	S	Inc	4	1	60	PC	12	180	0	240	518	CFL	Wall Mounted	CFL	S	PC	4	1	20	12	180	0	80	173	346	0	346
25	Public Works - Salt Silo	Ext	Exterior	Wall Mounted	S	MH	1	1	75	PC	12	180	21	96	207	N/A	Wall Mounted	MH	S	PC	1	1	75	12	180	21	96	207	0	0	0
14	Public Works - Steel Garage	1	Silo	Ceiling Mounted	S	MH	3	1	100	Sw	16	180	28	384	1,106	N/A	Ceiling Mounted	MH	S	Sw	3	1	100	16	180	28	384	1106	0	0	0
15	Public Works - Steel Garage	Ext	Exterior	Wall Mounted	S	Inc	1	1	60	PC	12	365	0	60	263	CFL	Wall Mounted	CFL	S	PC	1	1	20	12	365	0	20	88	175	0	175
16	Public Works - Well 1	Ext	Exterior	Wall Mounted	S	Inc	1	1	60	PC	12	365	0	60	263	CFL	Wall Mounted	CFL	S	PC	1	1	20	12	365	0	20	88	175	0	175
17	Public Works - Well 1	1	Garage	Parabolic Ceiling Suspended	M	8T12	5	2	80	Sw	9	260	20	900	2,106	T8	Parabolic Ceiling Suspended	8T8	E	Sw	5	2	59	9	260	7	625	1463	644	0	644
18	Public Works - Well 2	1	Well House	Ceiling Mounted	S	Inc	2	1	60	Sw	2	180	0	120	43	CFL	Ceiling Mounted	CFL	S	Sw	2	1	20	2	180	0	40	14	29	0	29
19	Public Works - Well 2	Ext	Exterior	Wall Mounted	S	Inc	1	1	60	PC	12	365	0	60	263	CFL	Wall Mounted	CFL	S	PC	1	1	20	12	365	0	20	88	175	0	175
20	Public Works - Well 3	1	Well House	Ceiling Mounted	S	Inc	2	1	60	Sw	2	180	0	120	43	CFL	Ceiling Mounted	CFL	S	Sw	2	1	20	2	180	0	40	14	29	0	29
21	Public Works - Well 3	Ext	Exterior	Wall Mounted	S	Inc	1	1	60	PC	12	365	0	60	263	CFL	Wall Mounted	CFL	S	PC	1	1	20	12	365	0	20	88	175	0	175
22	Public Works - Main Office/Garage	1	Well House	Ceiling Mounted	S	Inc	1	1	60	Sw	2	180	0	60	22	CFL	Ceiling Mounted	CFL	S	Sw	1	1	20	2	180	0	20	7	14	0	14
23	Public Works - Main Office/Garage	Ext	Exterior	Wall Mounted	S	Inc	1	1	60	PC	12	365	0	60	263	CFL	Wall Mounted	CFL	S	PC	1	1	20	12	365	0	20	88	175	0	175
26	Public Works - Main Office/Garage	1	Utility Rm	Parabolic Ceiling Suspended	M	8T12	2	2	80	Sw	2	260	20	360	187	T8	Parabolic Ceiling Suspended	8T8	E	Sw	2	2	59	2	260	7	250	130	57	0	57
27	Public Works - Main Office/Garage	1	Office	Recessed Parabolic	M	8T12	4	2	80	Sw	9	260	20	720	1,685	T8	Recessed Parabolic	8T8	E	Sw	4	2	59	9	260	7	500	1170	515	0	515
28	Public Works - Main Office/Garage	1	Office	Recessed Parabolic	M	4T12	4	2	40	Sw	9	260	12	368	861	T8	Recessed Parabolic	4T8	E	Sw	4	2	32	9	260	5	276	646	215	0	215
29	Public Works - Main Office/Garage	1	Storage Closet	Ceiling Mounted	S	Inc	2	1	60	Sw	2	260	0	120	62	CFL	Ceiling Mounted	CFL	S	Sw	2	1	20	2	260	0	40	21	42	0	42
30	Public Works - Main Office/Garage	1	Wood Shop	Parabolic Ceiling Suspended	M	8T12	5	2	80	Sw	9	260	20	900	2,106	T8	Parabolic Ceiling Suspended	8T8	E	Sw	5	2	59	9	260	7	625	1463	644	0	644
31	Public Works - Main Office/Garage	1	Office	Parabolic Ceiling Suspended	M	4T12	3	2	40	Sw	9	260	12	276	646	T8	Parabolic Ceiling Suspended	4T8	E	Sw	3	2	32	9	260	5	207	484	161	0	161
32	Public Works - Main Office/Garage	1	Office	Ceiling Mounted	S	Inc	2	1	60	Sw	9	260	0	120	281	CFL	Ceiling Mounted	CFL	S	Sw	2	1	20	9	260	0	40	94	187	0	187
33	Public Works - Main Office/Garage	1	Mechanical Rm	Ceiling Mounted	S	Inc	5	1	60	Sw	2	260	0	300	156	CFL	Ceiling Mounted	CFL	S	Sw	5	1	20	2	260	0	100	52	104	0	104
34	Public Works - Main Office/Garage	1	Storage Rm	Ceiling Mounted	M	4T12	1	4	40	Sw	2	260	12	172	89	T8	Ceiling Mounted	4T8	E	Sw	1	4	32	2	260	5	133	69	20	0	20
35	Public Works - Main Office/Garage	1	Storage Rm	Ceiling Mounted	S	Inc	1	1	60	Sw	2	260	0	60	31	CFL	Ceiling Mounted	CFL	S	Sw	1	1	20	2	260	0	20	10	21	0	21
36	Public Works - Main Office/Garage	1	Truck Bay	Parabolic Ceiling Suspended	M	8T12	2	2	80	Sw	12	260	20	360	1,123	T8	Parabolic Ceiling Suspended	8T8	E	Sw	2	2	59	12	260	7	250	780	343	0	343
37	Public Works - Main Office/Garage	1	Truck Bay	Parabolic Ceiling Suspended	S	Inc	1	1	60	Sw	12	260	0	60	187	CFL	Parabolic Ceiling Suspended	CFL	S	Sw	1	1	20	12	260	0	20	62	125	0	125
38	Public Works - Main Office/Garage	1	Lunch Rm	Parabolic Ceiling Suspended	M	4T12	7	4	40	Sw	8	260	12	1,204	2,504	T8	Parabolic Ceiling Suspended	4T8	E	Sw	7	4	32	8	260	5	931	1936	568	0	568
40	Public Works - Main Office/Garage	1	Locker Room	Ceiling Mounted	M	2T12	2	2	20	Sw	9	260	6	92	215	T8	Ceiling Mounted	2T8	E	Sw	2	2	17	9	260	2	72	168	47	0	47
41	Public Works - Main Office/Garage	1	Locker Room	Ceiling Mounted	S	Inc	4	1	60	Sw	9	260	0	240	562	CFL	Ceiling Mounted	CFL	S	Sw	4	1	20	9	260	0	80	187	374	0	374
42	Public Works - Main Office/Garage	1	Bathroom	Ceiling Mounted	M	2T12	1	4	20	Sw	9	260	6	86	201	T8	Ceiling Mounted	2T8	E	Sw	1	4	17	9	260	2	70	164	37	0	37
43	Public Works - Main Office/Garage	1	Lunch Rm	Exit Sign	S	LED	2	1	5	N	24	365	1	11	96	N/A	Exit Sign	LED	S	N	2	1	5	24	365	1	11	96	0	0	0
<b>Totals:</b>							<b>117</b>	<b>67</b>	<b>2,585</b>				<b>417</b>	<b>13,853</b>	<b>33,735</b>						<b>117</b>	<b>69</b>				<b>190</b>	<b>9,111</b>	<b>22,103</b>	<b>11,631</b>	<b>0</b>	<b>11,631</b>

Rows Highlighted Yellow Indicate an Energy Conservation Measure is recommended for that space

<b>Proposed Lighting Summary Table</b>		
Total Gross Floor Area (SF)	20,100	
Average Power Cost (\$/kWh)	0.1710	
<b>Exterior Lighting</b>	<b>Existing</b>	<b>Proposed</b>
Exterior Annual Consumption (kWh)	4,983	2,360
Exterior Power (watts)	1,308	628
<b>Total Interior Lighting</b>	<b>Existing</b>	<b>Proposed</b>
Annual Consumption (kWh)	28,752	19,743
Lighting Power (watts)	12,545	8,483
Lighting Power Density (watts/SF)	0.62	0.42
Estimated Cost of Fixture Replacement (\$)	10,140	
Estimated Cost of Controls Improvements (\$)	0	
<b>Total Consumption Cost Savings (\$)</b>	<b>4,368</b>	

<b>Legend</b>							
<b>Fixture Type</b>		<b>Lamp Type</b>			<b>Control Type</b>	<b>Ballast Type</b>	<b>Retrofit Category</b>
Ceiling Suspended	Recessed	CFL	3'T12	8'T5	Autom. Timer (T)	S (Self)	N/A (None)
Exit Sign	Sconce	Inc	3'T12 U-Shaped	8'T5 U-Shaped	Bi-Level (BL)	E (Electronic)	T8 (Install new T8)
High Bay	Spotlight	LED	3'T5	8'T8	Contact (Ct)	M (Magnetic)	T5 (Install new T5)
Parabolic Ceiling Mounted	Track	HPS	3'T5 U-Shaped	8'T8 U-Shaped	Daylight & Motion (M)		CFL (Install new CFL)
Parabolic Ceiling Suspended	Vanity	MH	3'T8	Circline - T5	Daylight & Switch (DLSw)		LEDex (Install new LED Exit)
Pendant	Wall Mounted	MV	3'T8 U-Shaped	Circline - T8	Daylight Sensor (DL)		LED (Install new LED)
Recessed Parabolic	Wall Suspended	1'T12	4'T5	Circline - T12	Delay Switch (DSw)		D (Delamping)
Ceiling Mounted	Wallpack	1'T12 U-Shaped	4'T5 U-Shaped	Fl.	Dimmer (D)		C (Controls Only)
Chandelier		1'T5	6'T12	Hal	Motion Sensor (MS)		PSMH (Install new Pulse-Start Metal Halide)
Equipment / Fume Hood		1'T5 U-Shaped	6'T12 U-Shaped	Induction	Motion& Switch (MSw)		
Flood		1'T8	6'T5	Infrared	None (N)		
Landscape		1'T8 U-Shaped	6'T5 U-Shaped	LPS	Occupancy Sensor (OS)		
Low Bay		2'T12 U-Shaped	6'T8	Mixed Vapor	Occupancy Sensor - CM (OSCM)		
Parabolic Wall Mounted		2'T5	6'T8 U-Shaped	Neon	Photocell (PC)		
Pole Mounted		2'T5 U-Shaped	8'T12	Quartz Halogen	Switch (Sw)		
Pole Mounted Off Building		2'T8 U-Shaped	8'T12 U-Shaped				

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

Third Party Gas Suppliers for PSEG Service Territory	Telephone & Web Site
<b>Cooperative Industries</b> 412-420 Washington Avenue Belleville, NJ 07109	(800) 628-9427 <a href="http://www.cooperativenet.com">www.cooperativenet.com</a>
<b>Direct Energy Services, LLC</b> 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 <a href="http://www.directenergy.com">www.directenergy.com</a>
<b>Dominion Retail, Inc.</b> 395 Highway 170, Suite 125 Lakewood, NJ 08701	(866) 275-4240 <a href="http://www.retail.dom.com">www.retail.dom.com</a>
<b>Gateway Energy Services Corp.</b> 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 <a href="http://www.gesc.com">www.gesc.com</a>
<b>UGI Energy Services, Inc.</b> 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 <a href="http://www.ugienergyservices.com">www.ugienergyservices.com</a>
<b>Great Eastern Energy</b> 116 Village Riva, Suite 200 Princeton, NJ 08540	(888) 651-4121 <a href="http://www.greateastern.com">www.greateastern.com</a>
<b>Hess Corporation</b> 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 <a href="http://www.hess.com">www.hess.com</a>
<b>Hudson Energy Services, LLC</b> 545 Route 17 South Ridgewood, NJ 07450	(877) 483-7669 <a href="http://www.hudsonenergyservices.com">www.hudsonenergyservices.com</a>
<b>Intelligent Energy</b> 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024	(800) 724-1880 <a href="http://www.intelligentenergy.org">www.intelligentenergy.org</a>
<b>Keil &amp; Sons</b> 1 Bergen Blvd. Fairview, NJ 07002	(877) 797-8786 <a href="http://www.systemenergy.com">www.systemenergy.com</a>
<b>Metro Energy Group, LLC</b> 14 Washington Place Hackensack, NJ 07601	(888) 536-3876 <a href="http://www.metroenergy.com">www.metroenergy.com</a>
<b>MxEnergy, Inc.</b> 510 Thornall Street, Suite 270 Edison, NJ 08837	(800) 375-1277 <a href="http://www.mxenergy.com">www.mxenergy.com</a>
<b>NATGASCO (Mitchell Supreme)</b> 532 Freeman Street Orange, NJ 07050	(800) 840-4427 <a href="http://www.natgasco.com">www.natgasco.com</a>

Third Party Gas Suppliers for PSEG Service Territory	Telephone & Web Site
<b>Pepco Energy Services, Inc.</b> 112 Main Street Lebanon, NJ 08833	(800) 363-7499 <a href="http://www.pepco-services.com">www.pepco-services.com</a>
<b>PPL EnergyPlus, LLC</b> 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 <a href="http://www.pplenergyplus.com">www.pplenergyplus.com</a>
<b>Sempra Energy Solutions</b> 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 <a href="http://www.semprasolutions.com">www.semprasolutions.com</a>
<b>South Jersey Energy Company</b> One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 <a href="http://www.southjerseyenergy.com">www.southjerseyenergy.com</a>
<b>Sprague Energy Corp.</b> 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 <a href="http://www.spragueenergy.com">www.spragueenergy.com</a>
<b>Stuyvesant Energy LLC</b> 10 West Ivy Lane, Suite 4 Englewood, NJ 07631	(800) 646-6457 <a href="http://www.stuyfuel.com">www.stuyfuel.com</a>
<b>Woodruff Energy</b> 73 Water Street Bridgeton, NJ 08302	(800) 557-1121 <a href="http://www.woodruffenergy.com">www.woodruffenergy.com</a>

## APPENDIX D: GLOSSARY AND METHOD OF CALCULATIONS

**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 expressed as 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:

Year	Cash Flow
0	\$(5,000.00)
1	\$ 850.00
2	\$ 850.00
3	\$ 850.00
4	\$ 850.00
5	\$ 850.00
6	\$ 850.00
7	\$ 850.00
8	\$ 850.00
9	\$ 850.00
10	\$ 850.00

IRR: 11.03%

NPV: \$2,250.67

Formula:  
 =IRR(F4:F14)  
 =NPV(0.03,F5:F14)+F4

## 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: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

## STATEMENT OF ENERGY PERFORMANCE Borough of Chatham - Public Works

Building ID: 2282974  
For 12-month Period Ending: February 28, 2010<sup>1</sup>  
Date SEP becomes ineligible: N/A

Date SEP Generated: May 14, 2010

<b>Facility</b> Borough of Chatham - Public Works 446 Main Street Chatham, NJ 07928	<b>Facility Owner</b> N/A	<b>Primary Contact for this Facility</b> N/A
<b>Year Built:</b> 1898		
<b>Gross Floor Area (ft<sup>2</sup>):</b> 20,010		

**Energy Performance Rating<sup>2</sup> (1-100)** N/A

**Site Energy Use Summary<sup>3</sup>**

Electricity - Grid Purchase(kBtu)	2,347,456
Natural Gas (kBtu) <sup>4</sup>	441,980
Total Energy (kBtu)	2,789,436

**Energy Intensity<sup>5</sup>**

Site (kBtu/ft <sup>2</sup> /yr)	139
Source (kBtu/ft <sup>2</sup> /yr)	415

**Emissions (based on site energy use)**

Greenhouse Gas Emissions (MtCO <sub>2</sub> e/year)	381
---	-----

**Electric Distribution Utility**

FirstEnergy - Jersey Central Power & Lt Co

**National Average Comparison**

National Average Site EUI	104
National Average Source EUI	213
% Difference from National Average Source EUI	95%
Building Type	Other

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<sup>6</sup> 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 F: 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' 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 G: ENERGY CONSERVATION MEASURES**

Recommended 0-5 Year Payback ECMs																			
ECM #	ECM description	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr	
1	Upgrade 4 of thermostats to programmable type in the offices and garages	668	none at this time	668	573	0.2	22	0.2	1,167	1,290	12	15,484	0.5	2,218	185	193	11,652	1,264	
2	Replace 1 incandescent Exit sign with LED type	150	20	130	477	0.2	0	0.1	18	99	15	1,486	1.3	1,043	70	76	1,004	854	
3	Upgrade 37 incandescent fixtures to CFLs	1,295	none at this time	1,295	3,548	1.1	0	0.6	175	782	5	3,909	1.7	202	40	53	2,194	6,353	
4	Install 1 beverage and 1 Snacks vending machine energy misers in break room	404	none at this time	404	1,400	0.4	0	0.2	0	239	12	2,873	1.7	611	51	59	1,890	2,507	
5	Upgrade 8 Metal Halide (MH) fixtures to T5	1,000	160	840	711	0.2	0	0.1	113	234	15	3,511	3.6	318	21	27	1,855	1,273	
6	Upgrade 63 T12 fixtures to T8 fixtures	9,450	1,575	7,875	6,895	2.2	0	1.2	315	1,494	15	22,411	5.3	185	12	17	9,405	12,345	
<b>Totals</b>		<b>12,967</b>	<b>1,755</b>	<b>11,212</b>	<b>13,604</b>	<b>4.3</b>	<b>22</b>	<b>2.4</b>	<b>1,787</b>	<b>4,139</b>	<b>-</b>	<b>49,674</b>	<b>2.7</b>	<b>343</b>	<b>-</b>	<b>35</b>	<b>27,999</b>	<b>24,596</b>	

**Assumptions:** Discount Rate: 3.2% per DOE FEMP; Energy Price Escalation Rate: 0% per DOE FEMP Guidelines  
**Note:** A 0.0 electrical demand reduction/month indicates that it is very low/negligible

Recommended 5-10 Year Payback ECMs																		
ECM #	ECM description	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
7	Replace 1 old Break room refrigerator with 18 cu ft Energy Star model	750	0	750	350	0.1	0	0.1	50	110	12	1,318	6.8	76	6	10	320	627
<b>Totals</b>		<b>750</b>	<b>0</b>	<b>750</b>	<b>350</b>	<b>0.1</b>	<b>0</b>	<b>0.1</b>	<b>50</b>	<b>110</b>	<b>-</b>	<b>1,318</b>	<b>6.8</b>	<b>76</b>	<b>-</b>	<b>10</b>	<b>320</b>	<b>627</b>

Recommended End of Life Cycle and >10 Year Payback ECMs																		
ECM #	ECM description	est. installed cost, \$	est. incentives, \$	net est. ECM cost with incentives, \$	kWh, 1st yr savings	kW, demand reduction/mo	therms, 1st yr savings	kBtu/sq ft, 1st yr savings	est. operating cost, 1st yr savings, \$	total 1st yr savings, \$	life of measure, yrs	est. lifetime cost savings, \$	simple payback, yrs	lifetime return on investment, %	annual return on investment, %	internal rate of return, %	net present value, \$	CO <sub>2</sub> reduced, lbs/yr
8	Install 49.7 kW PV rooftop system with incentives	372,600	39,744	332,856	34,163	49.7	0	5.8	0	26,340	25	453,514	12.6	36	1	3	7,595	61,169
9	Replace gas-fired heating/electric cooling split HVAC system with a high efficiency 14 SEER system	5,500	484	5,016	822	0.2	42	0.4	0	318	15	4,764	15.8	-5	0	-1	-1,225	1,618
<b>Totals</b>		<b>378,100</b>	<b>40,228</b>	<b>337,872</b>	<b>34,985</b>	<b>49.9</b>	<b>42</b>	<b>6.2</b>	<b>0</b>	<b>26,657</b>	<b>-</b>	<b>458,278</b>	<b>12.7</b>	<b>36</b>	<b>-</b>	<b>-</b>	<b>7,595</b>	<b>62,786</b>

## APPENDIX H: METHOD OF ANALYSIS

### Assumptions and tools

Energy modeling tools: Established/standard industry assumptions, E-Quest  
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 Public Works and Water Plant 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 Public Works and Water Plant(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.***