



# **LOCAL GOVERNMENT ENERGY AUDIT PROGRAM: ENERGY AUDIT REPORT**

**PREPARED FOR: CAPE MAY COUNTY  
MUNICIPAL UTILITY AUTHORITY  
CAPE MAY REGIONAL  
WASTEWATER TREATMENT FACILITY**

**SLUDGE PROCESSING BUILDING  
545 SUNSET BOULEVARD  
CAPE MAY POINT, NJ 08212  
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**PREPARED BY: CONCORD ENGINEERING GROUP**



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## I. EXECUTIVE SUMMARY

This report presents the findings of the energy audit conducted for:

Cape May County Municipal Utility Authority  
 - Cape May Regional Waste Water Treatment Facility  
 - Sludge Processing Building  
 545 Sunset Blvd.  
 Cape May Point, NJ 08212

Municipal Contact Person: Mr. Charles M. Norkis  
 Facility Contact Person: Mr. Joshua Palombo

This audit is performed in connection with the New Jersey Clean Energy - Local Government Energy Audit Program. The energy audit is conducted to promote the mission of the office of Clean Energy, which is to use innovation and technology to solve energy and environmental problems in a way that improves the State's economy. This can be achieved through the wiser and more efficient use of energy.

The annual energy costs at this facility are as follows:

Electricity	\$ 135,980
Fuel Oil	\$11,199
Total	\$147,179

The potential annual energy cost savings for each energy conservation measure (ECM) and renewable energy measure (REM) are shown below in Table 1. Be aware that the ECM's and REM's are not additive because of the interrelation of some of the measures. This audit is consistent with an ASHRAE level 2 audit. The cost and savings for each measure is  $\pm 20\%$ . The evaluations are based on engineering estimations and industry standard calculation methods. More detailed analyses would require engineering simulation models, hard equipment specifications, and contractor bid pricing.

**Table 1  
Financial Summary Table**

<b>ENERGY CONSERVATION MEASURES (ECM's)</b>					
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>NET INSTALLATION COST<sup>A</sup></b>	<b>ANNUAL SAVINGS<sup>B</sup></b>	<b>SIMPLE PAYBACK (Yrs)</b>	<b>SIMPLE LIFETIME ROI</b>
ECM #1	General Lighting Upgrade	\$885	\$280	3.2	373.9%
ECM #2	NEMA Premium Efficient Pump Motor Replacement	\$3,150	\$314	10.0	79.4%
ECM #3	Heat & Ventillation Unit Upgrade	\$11,950	\$28	426.8	-96.5%
<b>RENEWABLE ENERGY MEASURES (REM's)</b>					
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>NET INSTALLATION COST</b>	<b>ANNUAL SAVINGS</b>	<b>SIMPLE PAYBACK (Yrs)</b>	<b>SIMPLE LIFETIME ROI</b>
REM #1	Solar PV 8.97 KW System	\$80,730	\$5,501	14.7	2.2%
REM #2	300 KW Wind Turbine	\$1,419,969	\$42,501	33.4	-40.1%

**Notes:** A. Cost takes into consideration applicable NJ Smart Start<sup>TM</sup> incentives.

B. Savings takes into consideration applicable maintenance savings.

The estimated demand and energy savings for each ECM and REM is shown below in Table 2. The descriptions in this table correspond to the ECM's and REM's listed in Table 1.

**Table 2  
Estimated Energy Savings Summary Table**

<b>ENERGY CONSERVATION MEASURES (ECM's)</b>				
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>ANNUAL UTILITY REDUCTION</b>		
		<b>ELECTRIC DEMAND (KW)</b>	<b>ELECTRIC CONSUMPTION (KWH)</b>	<b>NATURAL GAS (THERMS)</b>
ECM #1	General Lighting Upgrade	0.2	1,839.6	-
ECM #2	NEMA Premium Efficient Pump Motor Replacement	1.1	2,562.0	-
ECM #3	Heat & Ventillation Unit Upgrade	0.0	184.2	-
<b>RENEWABLE ENERGY MEASURES (REM's)</b>				
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>ANNUAL UTILITY REDUCTION</b>		
		<b>ELECTRIC DEMAND (KW)</b>	<b>ELECTRIC CONSUMPTION (KWH)</b>	<b>NATURAL GAS (THERMS)</b>
REM #1	Solar PV 8.97 KW System	9.0	10958.0	-
REM #2	300 KW Wind Turbine	300.0	343,663.0	-

Concord Engineering Group (CEG) recommends proceeding with the implementation of all ECM's that provide a calculated simple payback at or under ten (10) years. The following Energy Conservation Measures are recommended for the facility:

- **ECM #1:** Lighting Upgrade
- **ECM #2:** NEMA Premium Pump Motor Upgrade

Although ECM #3 does not provide a payback less than 10 years, it is recommended to proceed with the installation of an efficient heat and ventilation unit as suggested in ECM #3 (or equal) for the sludge building, since the existing unit is past its expected lifespan. However, before proceeding with ECM#3, a professional HVAC Professional Engineer, licensed in the State of New Jersey should be consulted to determine proper ventilation rates and unit sizing.

In addition to the ECMs, there are maintenance and operational measures that can provide significant energy savings and provide immediate benefit. The ECMs listed above represent investments that can be made to the facility which are justified by the savings seen overtime. However, the maintenance items and small operational improvements below are typically achievable with on site staff or maintenance contractors and in turn have the potential to provide substantial operational savings compared to the costs associated. The following are recommendations which should be considered a priority in achieving an energy efficient building:

1. Chemically clean the heating coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.
2. Maintain all weather stripping on entrance doors.
3. Clean all light fixtures to maximize light output.
4. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

## II. INTRODUCTION

The comprehensive energy audit covers the 6,714 square foot Sludge Processing Building, which includes the following spaces: Basement Pump room, First Floor Boiler room, Scum room, Electric Storage, Sludge Hauling and the former Polymer Equipment room, Second Floor Toilet room, Office and Storage room.

Electrical and Fuel Oil gas utility information is collected and analyzed for one full year's energy use of the building. The utility information allows for analysis of the building's operational characteristics; calculate energy benchmarks for comparison to industry averages, estimated savings potential, and baseline usage/cost to monitor the effectiveness of implemented measures. A computer spreadsheet is used to calculate benchmarks and to graph utility information (see the utility profiles below).

The Energy Use Index (EUI) is established for the building. Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year (BTU/ft<sup>2</sup>/yr), which is used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting the annual consumption of all energy sources to BTU's and dividing by the area (gross square footage) of the building. Blueprints (where available) are utilized to verify the gross area of the facility. The EUI is a good indicator of the relative potential for energy savings. A low EUI indicates less potential for energy savings, while a high EUI indicates poor building performance therefore a high potential for energy savings.

Existing building architectural and engineering drawings (where available) are utilized for additional background information. The building envelope, lighting systems, HVAC equipment, and controls information gathered from building drawings allow for a more accurate and detailed review of the building. The information is compared to the energy usage profiles developed from utility data. Through the review of the architectural and engineering drawings a building profile can be defined that documents building age, type, usage, major energy consuming equipment or systems, etc.

The preliminary audit information is gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is spent and opportunities exist within a facility. The entire site is surveyed to inventory the following to gain an understanding of how each facility operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Facility-specific equipment

The building site visit is performed to survey all major building components and systems. The site visit includes detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs

provided by the building manager are collected along with the system and components to determine a more accurate impact on energy consumption.

### III. METHOD OF ANALYSIS

Post site visit work includes evaluation of the information gathered, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on HVAC, lighting and building envelope improvements. Data collected is processed using energy engineering calculations to anticipate energy usage for each of the proposed energy conservation measures (ECMs). The actual building's energy usage is entered directly from the utility bills provided by the owner. The anticipated energy usage is compared to the historical data to determine energy savings for the proposed ECMs.

It is pertinent to note, that the savings noted in this report are not additive. The savings for each recommendation is calculated as standalone energy conservation measures. Implementation of more than one ECM may in some cases affect the savings of each ECM. The savings may in some cases be relatively higher if an individual ECM is implemented in lieu of multiple recommended ECMs. For example implementing reduced operating schedules for inefficient lighting will result in a greater relative savings. Implementing reduced operating schedules for newly installed efficient lighting will result in a lower relative savings, because there is less energy to be saved. If multiple ECM's are recommended to be implemented, the combined savings is calculated and identified appropriately.

ECMs are determined by identifying the building's unique properties and deciphering the most beneficial energy saving measures available that meet the specific needs of the facility. The building construction type, function, operational schedule, existing conditions, and foreseen future plans are critical in the evaluation and final recommendations. Energy savings are calculated base on industry standard methods and engineering estimations. Energy consumption is calculated based on manufacturer's cataloged information when new equipment is proposed.

Cost savings are calculated based on the actual historical energy costs for the facility. Installation costs include labor and equipment costs to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers. The NJ Smart Start Building® program incentives savings (where applicable) are included for the appropriate ECM's and subtracted from the installed cost. Maintenance savings are calculated where applicable and added to the energy savings for each ECM. The life-time for each ECM is estimated based on the typical life of the equipment being replaced or altered. The costs and savings are applied and a simple payback, simple lifetime savings, and simple return on investment are calculated. See below for calculation methods:

ECM Calculation Equations:

$$\text{Simple Payback} = \left( \frac{\text{Net Cost}}{\text{Yearly Savings}} \right)$$

$$\text{Simple Lifetime Savings} = (\text{Yearly Savings} \times \text{ECM Lifetime})$$

$$\text{Simple Lifetime ROI} = \frac{(\text{Simple Lifetime Savings} - \text{Net Cost})}{\text{Net Cost}}$$

$$\text{Lifetime Maintenance Savings} = (\text{Yearly Maintenance Savings} \times \text{ECM Lifetime})$$

$$\text{Internal Rate of Return} = \sum_{n=0}^N \left( \frac{\text{Cash Flow of Period}}{(1 + \text{IRR})^n} \right)$$

$$\text{Net Present Value} = \sum_{n=0}^N \left( \frac{\text{Cash Flow of Period}}{(1 + \text{DR})^n} \right)$$

Net Present Value calculations based on Interest Rate of 3%.

#### IV. HISTORIC ENERGY CONSUMPTION/COST

##### A. Energy Usage / Tariffs

The energy usage for the facility has been tabulated and plotted in graph form as depicted within this section. Each energy source has been identified and monthly consumption and cost noted per the information provided by the Owner.

The electric usage profile represents the actual electrical usage for the facility. Atlantic City Electric provides electricity to the facility under their Annual General Service rate structure. The electric utility measures consumption in kilowatt-hours (KWH) and maximum demand in kilowatts (KW). One KWH usage is equivalent to 1000 watts running for one hour. One KW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as generation service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the historical data received for the facility.

The oil usage profile shows the actual oil consumption for the facility. Oil is provided by PEDRONI to the facility. The oil provider measures consumption in gallons. One Gallon of #2 oil is equivalent to 140,000 BTUs of energy.

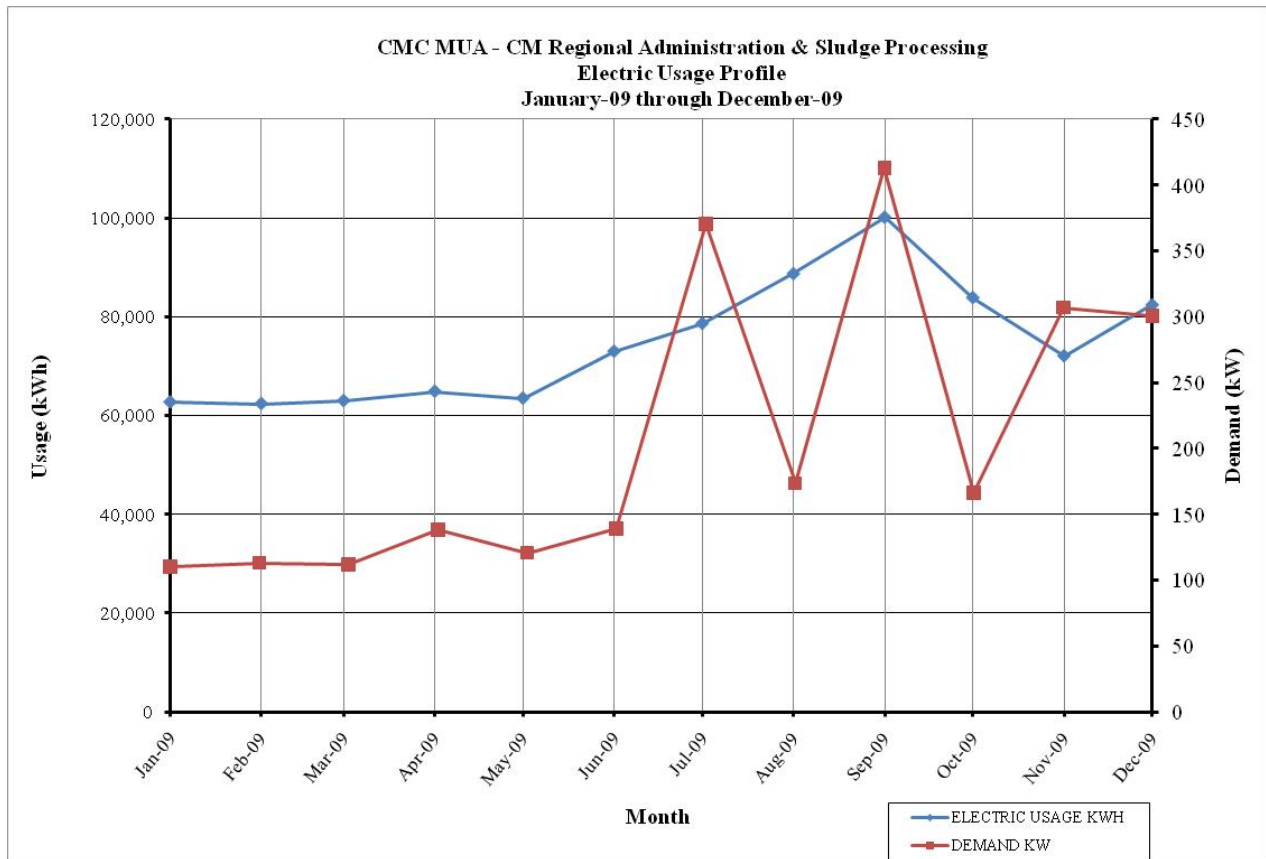
The overall cost for utilities is calculated by dividing the total cost by the total usage. Based on the utility history provided, the average cost for utilities at this facility is as follows:

<u>Description</u>	<u>Average</u>
Electricity	15.2¢ / kWh
Natural Gas	\$1.66 / Gallon

**Table 3  
Electricity Billing Data**

<b>ELECTRIC USAGE SUMMARY</b>			
Utility Provider: Atlantic City Electric			
Rate: Annual General Service			
Meter No: 82466301			
Customer ID No:			
Third Party Utility			
TPS Meter / Acct No:			
<b>MONTH OF USE</b>	<b>CONSUMPTION KWH</b>	<b>DEMAND</b>	<b>TOTAL BILL</b>
Jan-09	62,700	110.2	\$8,134
Feb-09	62,365	113.1	\$8,102
Mar-09	62,965	112.0	\$8,210
Apr-09	64,854	138.4	\$8,378
May-09	63,462	120.7	\$8,238
Jun-09	72,997	139.1	\$11,520
Jul-09	78,663	370.5	\$14,110
Aug-09	88,739	173.6	\$14,976
Sep-09	100,231	413.0	\$17,799
Oct-09	83,900	166.5	\$12,728
Nov-09	72,059	306.9	\$11,067
Dec-09	82,402	300.4	\$12,720
<b>Totals</b>	<b>895,337</b>	<b>413.0 Max</b>	<b>\$135,980</b>
<b>AVERAGE DEMAND      205.4 KW average</b> <b>AVERAGE RATE      \$0.152 \$/kWh</b>			

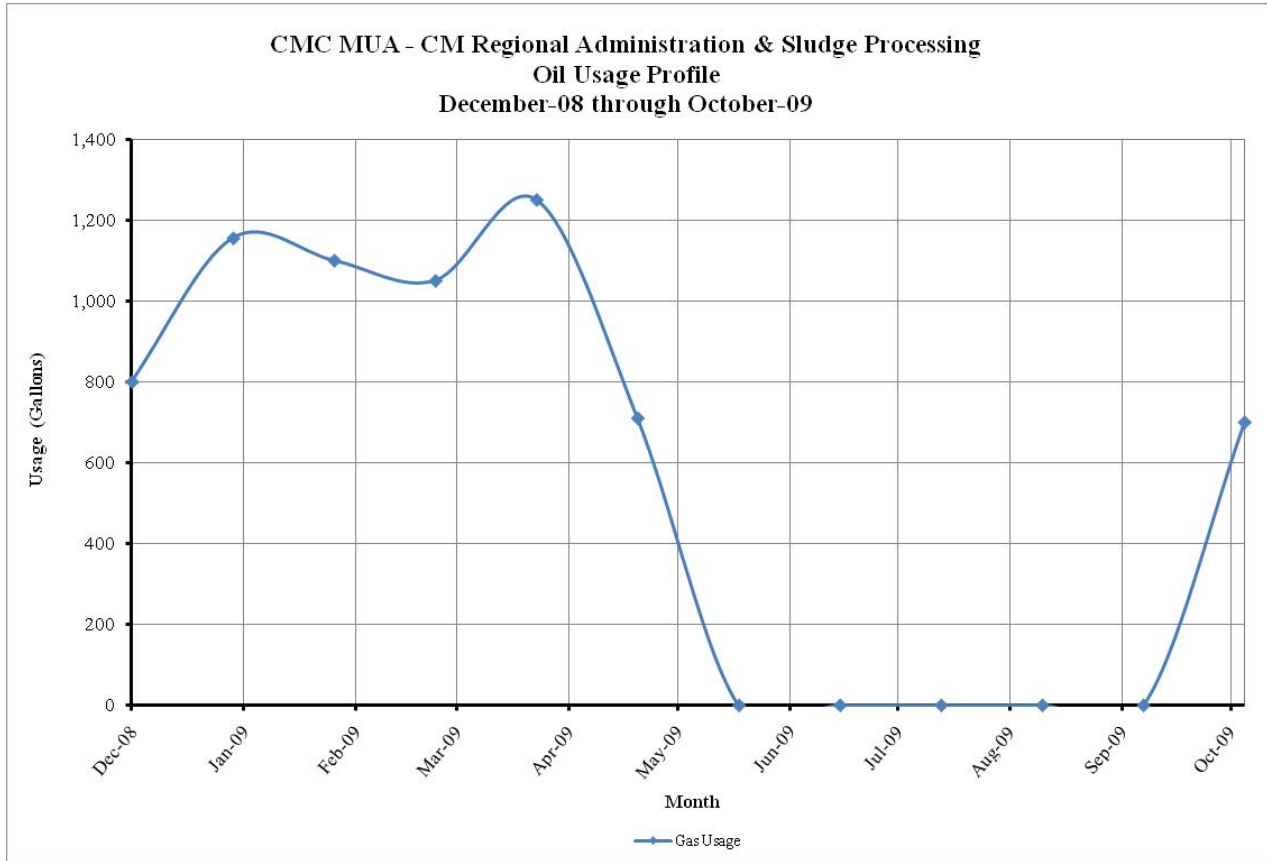
**Figure 1**  
**Electricity Usage Profile**



**Table 4  
Fuel Oil Billing Data**

<b>FUEL OIL USAGE SUMMARY</b>		
Utility Provider: Pedroni		
Rate: Varies		
Meter No:		
Point of Delivery ID:		
Third Party Utility Provider:		
TPS Meter No:		
<b>MONTH OF USE</b>	<b>CONSUMPTION (GALLONS)</b>	<b>TOTAL BILL</b>
Dec-08	800.10	\$1,448.18
Jan-09	1,155.00	\$1,767.15
Jan-09	1,100.00	\$1,894.75
Feb-09	1,050.00	\$1,522.50
Mar-09	1,250.00	\$1,873.75
Apr-09	710.10	\$1,105.27
May-09	0.00	\$0.00
Jun-09	0.00	\$0.00
Jul-09	0.00	\$0.00
Aug-09	0.00	\$0.00
Sep-09	0.00	\$0.00
Oct-09	700.00	\$1,586.90
<b>TOTALS</b>	<b>6,765.20</b>	<b>\$11,198.50</b>
<b>AVERAGE RATE:</b>	<b>\$1.66</b>	<b>\$/Gallon</b>

**Figure 2**  
**Fuel Oil Usage Profile**



## B. Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (BTU) and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.

The site and source EUI for this facility is calculated as follows:

$$\text{Building Site EUI} = \frac{(\text{Electric Usage in kBtu} + \text{Gas Usage in kBtu})}{\text{Building Square Footage}}$$

$$\text{Building Source EUI} = \frac{(\text{Electric Usage in kBtu} \times \text{SS Ratio} + \text{Gas Usage in kBtu} \times \text{SS Ratio})}{\text{Building Square Footage}}$$

**Table 5  
Facility Energy Use Index (EUI) Calculation**

<b>ENERGY USE INTENSITY CALCULATION</b>						
<b>ENERGY TYPE</b>	<b>BUILDING USE</b>			<b>SITE ENERGY</b>	<b>SITE-SOURCE</b>	<b>SOURCE ENERGY</b>
	<b>kWh</b>	<b>Therms</b>	<b>Gallons</b>	<b>kBtu</b>	<b>RATIO</b>	<b>kBtu</b>
ELECTRIC	895,337.00	-	-	3,056,681	3.340	10,209,313
FUEL OIL	-	-	6,765.20	940,363	1.010	949,766
TOTAL	-	-	-	3,997,043		11,159,079
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
<b>BUILDING AREA</b>	23,146 SQUARE FEET					
<b>BUILDING SITE EUI</b>	172.69 kBtu/SF/YR					
<b>BUILDING SOURCE EUI</b>	482.12 kBtu/SF/YR					

As a comparison, data has been gathered by the US Department of Energy (DOE) for various facilities cataloguing the standard site and source energy utilization. This data has been published in the 2003 Commercial Building Energy Consumption Survey and is noted as follows for facilities of this type:

- Other (Administration and Sludge Processing):  
104 kBtu/SF Site Energy, 213 kBtu/SF Source Energy, 56% electric usage

Based on the information compiled for the studied facility, as compared to the national average the energy usage is approximately 166% higher than the baseline building site data. Normalizing the building site data for 76.5% electric, site energy is 136 kBtu/SF and as compared to the national average the energy usage is approximately 127% higher than the baseline building site data.

There are possible reasons why these numbers are higher than average. The electric meter is a campus meter and not all of the buildings are part of this audit. The building areas of buildings not in the audit were estimated from satellite photographs so that a facility area could be used with facility total energy usage in the EUI calculation.

There are three (3) 450 HP and two (2) 75 HP effluent pumps that are in the campus but were not part of the audit. Typically, one (1) or two (2) 75 HP pumps will run in “off peak” conditions whereas one (1) 450 HP pump will run in “peak” flow conditions and two (2) 450 HP pumps will run in “flood” conditions. There are four (4) 200 HP blowers in the effluent building that run one at a time. The very large horsepower motors will increase the demand when multiple motors are required to operate simultaneously. These very large horsepower motors use a large amount of electricity and are most likely the reason for the above average EUI number.

C. EPA Energy Benchmarking System

The United States Environmental Protection Agency (EPA) in an effort to promote energy management has created a system for benchmarking energy use amongst various end users. The benchmarking tool utilized for this analysis is entitled Portfolio Manager. The Portfolio Manager tool allows tracking and assessment of energy consumption via the template forms located on the ENERGY STAR website ([www.energystar.gov](http://www.energystar.gov)). The importance of benchmarking for local government municipalities is becoming more important as utility costs continue to increase and emphasis is being placed on carbon reduction, greenhouse gas emissions and other environmental impacts.

Based on information gathered from the ENERGY STAR website, Government agencies spend more than \$10 billion a year on energy to provide public services and meet constituent needs. Furthermore, energy use in commercial buildings and industrial facilities is responsible for more than 50 percent of U.S. carbon dioxide emissions. It is vital that local government municipalities assess facility energy usage, benchmark energy usage utilizing Portfolio Manager, set priorities and goals to lessen energy usage and move forward with priorities and goals.

In accordance with the Local Government Energy Audit Program, CEG has created an ENERGY STAR account for the municipality to access and monitoring the facility’s yearly energy usage as it compares to facilities of similar type. The login page for the account can be accessed at the following web address; the username and password are also listed below:

<https://www.energystar.gov/istar/pmpam/index.cfm?fuseaction=login.login>

User Name: capemaymua  
 Password: lgeaceg2009  
  
 Security Question: What city were you born in?  
 Security Answer: “cape may”

The utility bills and other information gathered during the energy audit process are entered into the Portfolio Manager. The following is a summary of the results for the facility:

**Table 6  
 ENERGY STAR Performance Rating**

<b>ENERGY STAR PERFORMANCE RATING</b>		
<b>FACILITY DESCRIPTION</b>	<b>ENERGY PERFORMANCE RATING</b>	<b>NATIONAL AVERAGE</b>
Cape May Sludge Process Bldg.	N/A	N/A

An Energy Performance Rating cannot be established for the Cape May Regional Area or individual buildings. The Energy Star program does not have enough bin data available to

calculate a campus wide Energy Performance Rating at this time. Also, individual building ratings cannot be established due to the design of the Campus wide electric and gas distribution system. One year of utility data must be entered for each facility, since reliable building energy meters do not exist this approach cannot be taken.

## V. FACILITY DESCRIPTION

The 6,714 SF Sludge Processing Building is a two story facility with a basement. It is comprised of a Basement Pump room, First Floor Boiler room, Scum room, Electric Storage, Sludge Hauling and the former Polymer Equipment room, Second Floor Toilet room, Office and Storage room. The typical hours of operation for this facility are 50 hours a week. Exterior walls are block with split face block construction with minimum insulation typical of the time period. The amount of insulation within the wall is unknown. The windows throughout the facility are in good to fair condition and appear to be maintained. Typical windows throughout the facility are double pane, ¼” clear glass with vinyl clad wood frames. There are metal roll up doors. The roof is a built-up roof with gravel ballast on rigid insulation board on an 8” concrete roof deck. The amount of insulation below the built up roofing is unknown. The building was built in 1984 with no additions since the original construction.

### HVAC Systems

The Sludge Processing Building is heated by a Weil McLain model P-878-W water boiler. The has an input capacity of 7.58 GPH No.2 oil or 1084 MBH, Gross IBR 886 MBH output and 770 MBH net IBR output. The boiler is twenty six (26) years old and in fair condition and has nine (9) years of ASHRAE expected useful service life remaining. The boiler burner is a Carlin model number CR1-GO-12 rated at 7.5 GPH (1084 MBH). The boiler burner is twenty six (26) years old and in fair condition and is eleven (11) years past its ASHRAE expected useful service life and should be replaced.

There are two (2) heating water loop pumps piped in parallel and in a lead lag configuration. One (1) pump is a Leeson, 2 hp, 79% efficient motor on an Armstrong pump model 2D 4380 BF. The pump is twenty six (26) years old, leaking, in poor condition and should be replaced. The other loop pump is an Armstrong pump model 2x2x8 4380 BF-STD with a 3 hp motor, rated at 65 GPM at 55 FT. HD. This pump was recently replaced and is in very good condition.

There are propeller unit heaters with fractional horsepower motors, they are twenty six (26) years old, in fair condition and are six (6) years past their ASHRAE expected useful service life. These units should be maintained or replaced as needed as a maintenance project.

Outside air is introduced into the building through an air handling unit located just outside the boiler room. The unit is a Buffalo Air Handling unit model 85BR. The unit is twenty six (26) years old, in poor condition and six (6) years past its ASHRAE expected useful service life.

### Exhaust System

Air is exhausted from the facility through a ducted propeller exhaust fan. The exhaust system runs 24/7.

### HVAC System Controls

The HVAC systems within the facility are controlled via local thermostats.

### Domestic Hot Water

A domestic water heater was not located. The facility has a lavatory and slop sink on the second floor. It is believed that there is an electric 6 gallon, above ceiling water heater exists, but was not confirmed. The water heater is assumed to be twenty six (26) years old, in poor condition and fourteen (14) years past its expected useful service life. This heater should be replaced “in-kind” as a maintenance project as needed at the owner’s convenience.

### Lighting

The lighting in the Cape May Sludge Processing Building is primarily made up of fluorescent fixtures with T-12 lamps and magnetic ballasts, T-8 lamps with electronic ballasts. There are metal halide fixtures in the basement, second floor, mechanical room, electrical storage, sludge haler and some exterior poll lights. The exterior of the building has high pressure sodium lamps.

## VI. MAJOR EQUIPMENT LIST

The equipment list is considered major energy consuming equipment and through energy conservation measures could yield substantial energy savings. The list shows the major equipment in the facility and all pertinent information utilized in energy savings calculations. An approximate age was assigned to the equipment in some cases if a manufactures date was not shown on the equipment's nameplate. The ASHRAE service life for the equipment along with the remaining useful life is also shown in the Appendix.

Refer to the **Major Equipment List Appendix** for this facility.

## VII. ENERGY CONSERVATION MEASURES

### ECM #1: Lighting Upgrade - General

#### Description: General

The lighting in the Cape May Sludge Processing Building is primarily made up of fluorescent fixtures with T-12 lamps and magnetic ballasts, T-8 lamps with electronic ballasts. There are metal halide fixtures in the basement, second floor, mechanical room, electrical storage, sludge haler and some exterior poll lights. The exterior of the building has high pressure sodium lamps.

This ECM includes replacement of the existing basement fixtures containing metal halide lamps. The new energy efficient, T8 fixtures will provide adequate lighting and will save the owner on electrical costs due to the better performance of the lamp and ballasts. This ECM will also provide maintenance savings through the reduced number of lamps replaced per year. The expected lamp life of a T8 lamp is approximately 30,000 burn-hours, in comparison to the existing metal halide lamps which is approximately 15,000 burn-hours. The facility will need 50% less lamps replaced per year.

#### Energy Savings Calculations:

The **Investment Grade Lighting Audit Appendix – ECM#1** outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start<sup>®</sup> Program Incentives are calculated as follows:

From the **Smart Start Incentive Appendix**, the following incentives are warranted:

Replace HID metal halide 175w-249w fixture with new T-5 or T-8 lamps fixture w/electronic ballast = \$43 per fixture.

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (T5 \text{ or } T8 \text{ lamp fixtures} \times \$43)$$

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (5 \times \$43) = \underline{\$215}$$

Replacement and Maintenance Savings are calculated as follows:

$$\text{Savings} = (\text{reduction in lamps replaced per year}) \times (\text{repackment } \$ \text{ per lamp} + \text{Labor } \$ \text{ per lamp})$$

$$\text{Savings} = (1 \text{ lamps per year}) \times (\$2.00 + \$5.00) = \$7$$

**Energy Savings Summary:**

<b>ECM #1 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$1,100
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$215
<b>Net Installation Cost (\$):</b>	\$885
<b>Maintenance Savings (\$/Yr):</b>	\$0
<b>Energy Savings (\$/Yr):</b>	\$280
<b>Total Yearly Savings (\$/Yr):</b>	\$280
<b>Estimated ECM Lifetime (Yr):</b>	15
<b>Simple Payback</b>	3.2
<b>Simple Lifetime ROI</b>	373.9%
<b>Simple Lifetime Maintenance Savings</b>	\$0
<b>Simple Lifetime Savings</b>	\$4,194
<b>Internal Rate of Return (IRR)</b>	31%
<b>Net Present Value (NPV)</b>	\$2,453.09

## ECM #2: Install NEMA Premium Efficient Pump Motor

### Description:

Replacing an old pump motors with new efficient motor is a simple change that can provide substantial savings.

Existing electric motors equal to or greater than one horsepower ranged from 78 to 93% efficient. The improved efficiency of the NEMA premium efficient motors is primarily due to better designs with use of better materials to reduce losses. Surprisingly, the electricity used to power a motor represents 95 % of its total lifetime operating cost. Because many motors operate 40-80 hours per week, even small increases in efficiency can yield substantial energy and dollar savings.

This energy conservation measure would replace all motors equal to or greater than 1 HP with NEMA Premium® Efficient Motors. NEMA Premium® is the most efficient motor designation in the marketplace today. Using MotorMaster+, Version 4, the energy & cost savings were calculated for the fan/pump motors in this facility that are greater than or equal to 1 HP.

### Energy Savings Calculations:

Existing: A 5 HP system circulation pump Motor with the following characteristics:

Existing Motor Efficiency = 82.5%  
 Annual Hours of Operations = 2,416  
 1 HP = 0.746 Watt  
 Load Factor = 75%  
 Cost of electricity = \$0.152 / kWh

Existing 5HP Motor Operating Cost =

{0.746 Watt/HP x Motor HP x Load Factor x Hours of Operation x Cost of Electricity} ÷ Motor Efficiency  
 = [0.746 x 5 x 0.75 x 2,416 x 0.152] ÷ 0.825 = \$1245 / Year

New NEMA Premium Motor Efficiency = 90.2%

New NEMA Premium Efficiency Motor Operating Cost =

{0.746 x 5 x 0.75 x 2,416 x 0.152} ÷ 0.902 = \$1139 / Year

Savings = \$1245 - \$1139 = \$106 / Year

Installed Cost of a 5 HP NEMA Premium® Efficiency Motor = \$929 minus the SmartStart Building® incentive of 5hp x \$60/TEFC motor is \$869.

Simple Payback = \$869 / \$106.30 = 8.2 Years

kWh saved = \$106 / \$0.152/kWh = 699 kWh

kW saved = 699 kWh / 2,416 hrs./yr. = 0.29 kW

The following table outlines the potential motor replacements for this facility:

<b>POTENTIAL MOTOR REPLACEMENT</b>							
<b>Motor HP</b>	<b>QTY</b>	<b>ENCL. TYPE</b>	<b>No. of POLEs</b>	<b>INSTALLED Cost **</b>	<b>TOTAL COST</b>	<b>TOTAL SAVINGS</b>	<b>Simple Payback</b>
2	2	TEFC	4-Pole	\$708	\$1,416	\$58.29	24.3
3	2	TEFC	4-Pole	\$994	\$1,987	\$116.87	17.0
5	1	TEFC	4-Pole	\$869	\$869	\$106.30	8.2
5	1	TEFC	4-Pole	\$869	\$869	\$55.62	15.6
10	1	TEFC	4-Pole	\$1,412	\$1,412	\$151.67	9.3
25	1	TEFC	4-Pole	\$3,566	\$3,566	(\$11.70)	-304.8
<b>Totals:</b>					<i>\$10,119</i>	<i>\$477</i>	<i>21.2</i>

The motors that are past their useful life and should be replaced are listed in the table above. However, not all of the replacements would provide an economical benefit. The 2hp, 3hp and 25hp motors should be maintained and replaced as necessary. One of the boiler loop pumps will need immediate repair or replacement as it is leaking. The following table outlines the recommended motor replacement plan for this facility:

<b>RECOMMENDED MOTOR REPLACEMENT PLAN</b>							
<b>Motor HP</b>	<b>QTY</b>	<b>ENCL. TYPE</b>	<b>No. of POLEs</b>	<b>INSTALLED Cost **</b>	<b>TOTAL COST</b>	<b>TOTAL SAVINGS</b>	<b>Simple Payback</b>
5	1	TEFC	4-Pole	\$869	\$869	\$106.30	8.2
5	1	TEFC	4-Pole	\$869	\$869	\$55.62	15.6
10	1	TEFC	4-Pole	\$1,412	\$1,412	\$151.67	9.3
<b>Totals:</b>					<i>\$3,150</i>	<i>\$314</i>	<i>10.0</i>

**\*\* Net Cost after the SmartStart Buildings® incentive is applied.**

**Energy Savings Summary:**

<b>ECM #2 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$3,370
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$220
<b>Net Installation Cost (\$):</b>	\$3,150
<b>Maintenance Savings (\$/Yr):</b>	\$0
<b>Energy Savings (\$/Yr):</b>	\$314
<b>Total Yearly Savings (\$/Yr):</b>	\$314
<b>Estimated ECM Lifetime (Yr):</b>	18
<b>Simple Payback</b>	10.0
<b>Simple Lifetime ROI</b>	79.4%
<b>Simple Lifetime Maintenance Savings</b>	\$0
<b>Simple Lifetime Savings</b>	\$5,652
<b>Internal Rate of Return (IRR)</b>	7%
<b>Net Present Value (NPV)</b>	\$1,168.60

### ECM #3: Indoor Air handling Unit Replacement

#### Description:

The outdoor air handling units with hot water heating coils have surpassed their expected service life of fifteen (15) years as outlined in Chapter 36 of the 2007 ASHRAE Applications Handbook. This unit appears to be 1984 vintage, and is an excellent candidate for replacement. Due to escalating owning and maintenance costs, this unit should be replaced. This unit contains a hot water heating section and savings can be yielded from year round operation. The unit provides 4000 CFM (cubic feet per minute) of ventilation make up air.

This energy conservation measure would replace air handling units with fan motors equal to or greater than 1 HP with new air handling units having NEMA Premium® Efficient Motors. NEMA Premium® is the most efficient motor designation in the marketplace today. The Trane M-series or equivalents were utilized as a basis of design. Because many units operate 4832 hours (or more) per year, even small increases in efficiency can yield substantial energy and dollar savings.

#### Energy Savings Calculations:

Existing: Buffalo Air Handling Unit, has a fan motor with the following characteristics:

Existing Motor Efficiency = 84%

Existing motor HP = 2 HP

Annual Hours of Operations = 4832 (Heating hours)

1 HP = 0.746 Watt

Load Factor = 75%

Cost of electricity = \$0.152 / kWh

Existing AHU Motor Operating Cost =

$\{0.746 \text{ Watt/HP} \times \text{Motor HP} \times \text{Load Factor} \times \text{Hours of Operation} \times \text{Cost of Electricity}\} \div \text{Motor Efficiency}$

$= [0.746 \times 2 \times 0.75 \times 4,832 \times 0.152 \div 0.84 = \$978 / \text{Year}$

New AHU with NEMA Premium Motor Efficiency = 86.5%

New AHU with NEMA Premium Efficiency Motor Operating Cost =

$\{0.746 \times 2 \times 0.75 \times 4,832 \times 0.152\} \div 0.865 = \$950 / \text{Year}$

Savings = \$978 - \$950 = \$28 / Year

Installed Cost of a 4,000 CFM AHU with a 2 HP NEMA Premium® Efficiency Motor = \$12,000

The SmartStart Building® incentive of 2hp x \$50/motor is \$50

Net installed Cost = \$12,000 - \$50 = \$11,950.

Simple Payback = \$11,950 / \$28 = 426 Years

kWh saved = \$28 / \$0.152/kWh = 184.2 kWh

kW saved = 184.2 kWh / 4,832 hrs./yr. = 0.4 kW

### Energy Savings Summary:

<b>ECM #3 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$12,000
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$50
<b>Net Installation Cost (\$):</b>	\$11,950
<b>Maintenance Savings (\$/Yr):</b>	\$0
<b>Energy Savings (\$/Yr):</b>	\$28
<b>Total Yearly Savings (\$/Yr):</b>	\$28
<b>Estimated ECM Lifetime (Yr):</b>	15
<b>Simple Payback</b>	426.8
<b>Simple Lifetime ROI</b>	-96.5%
<b>Simple Lifetime Maintenance Savings</b>	\$0
<b>Simple Lifetime Savings</b>	\$420
<b>Internal Rate of Return (IRR)</b>	-27%
<b>Net Present Value (NPV)</b>	<b>(\$11,615.74)</b>

## VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policy. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable technologies. A renewable energy source can greatly reduce a building's operating expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy measures (REM) for the municipality utilizing renewable technologies and concluded that there is potential for solar energy generation. The solar photovoltaic system calculation summary will be concluded as **REM#1** within this report.

Solar energy produces clean energy and reduces a building's carbon footprint. This is accomplished via photovoltaic panels which will be mounted on all south and southwestern facades of the building. Flat roof, as well as sloped areas can be utilized; flat areas will have the panels turned to an optimum solar absorbing angle. (A structural survey of the roof would be necessary before the installation of PV panels is considered). The state of NJ has instituted a program in which one Solar Renewable Energy Certificate (SREC) is given to the Owner for every 1000 kWh of generation. SREC's can be sold anytime on the market at their current market value. The value of the credit varies upon the current need of the power companies. The average value per credit is around \$350, this value was used in our financial calculations. This equates to \$0.35 per kWh generated.

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. A roof area of 625 S.F. can be utilized for a PV system. A depiction of the area utilized is shown in **Renewable / Distributed Energy Measures Calculation Appendix**. Using this square footage it was determined that a system size of 8.97 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 10,958 KWh annually, reducing the overall utility bill by approximately 1.22% percent. A detailed financial analysis can be found in the **Renewable / Distributed Energy Measures Calculation Appendix**. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panels and the price of accumulated SREC's are factored into the payback.

The proposed photovoltaic array layout is designed based on the specifications for the Sun Power SPR-230 panel. This panel has a "DC" rated full load output of 230 watts, and has a total panel conversion efficiency of 18%. Although panels rated at higher wattages are available through Sun Power and other various manufacturers, in general most manufacturers who produce commercially available solar panels produce a similar panel in the 200 to 250 watt range. This provides more manufacturer options to the public entity if they wish to pursue the proposed solar recommendation without losing significant system capacity.

The array system capacity was sized on available roof space on the existing facility. Estimated solar array generation was then calculated based on the National Renewable Energy Laboratory

PVWatts Version 1.0 Calculator. In order to calculate the array generation an appropriate location with solar data on file must be selected. In addition the system DC rated kilowatt (kW) capacity must be inputted, a DC to AC de-rate factor, panel tilt angle, and array azimuth angle. The DC to AC de-rate factor is based on the panel nameplate DC rating, inverter and transformer efficiencies (95%), mismatch factor (98%), diodes and connections (100%), dc and ac wiring(98%, 99%), soiling, (95%), system availability (95%), shading (if applicable), and age(new/100%). The overall DC to AC de-rate factor has been calculated at an overall rating of 81%. The PVWatts Calculator program then calculates estimated system generation based on average monthly solar irradiance and user provided inputs. The monthly energy generation and offset electric costs from the PVWatts calculator is shown in the **Renewable/Distributed Energy Measures Calculation Appendix**.

The proposed solar array is qualified by the New Jersey Board of Public Utilities Net Metering Guidelines as a Class I Renewable Energy Source. These guidelines allow onsite customer generation using renewable energy sources such as solar and wind with a capacity of 2 megawatts (MW) or less. This limits a customer system design capacity to being a net user and not a net generator of electricity on an annual basis. Although these guidelines state that if a customer does net generate (produce more electricity than they use), the customer will be credited those kilowatt-hours generated to be carried over for future usage on a month to month basis. Then, on an annual basis if the customer is a net generator the customer will then be compensated by the utility the average annual PJM Grid LMP price per kilowatt-hour for the over generation. Due to the aforementioned legislation, the customer is at limited risk if they generate more than they use at times throughout the year. With the inefficiency of today’s energy storage systems, such as batteries, the added cost of storage systems is not warranted and was not considered in the proposed design.

Direct purchase involves the CMC MUA – Cape May Sludge Process Building paying for 100% of the total project cost upfront via one of the methods noted in the Installation Funding Options section below. Calculations include a utility inflation rate as well as the degradation of the solar panels over time. Based on our calculations the following is the payback period:

**Table 7  
Financial Summary – Photovoltaic System**

<b>FINANCIAL SUMMARY - PHOTOVOLTAIC SYSTEM</b>			
<b>PAYMENT TYPE</b>	<b>SIMPLE PAYBACK</b>	<b>SIMPLE ROI</b>	<b>INTERNAL RATE OF RETURN</b>
Direct Purchase	14.68 Years	6.8%	5.2%

\*The solar energy measure is shown for reference in the executive summary Renewable Energy Measure (REM) table

Given the large amount of capital required by the CMC MUA – Cape May Sludge Process Building to invest in a solar system through a Direct Purchase CEG does not recommend the CMC MUA – Cape May Sludge Process Building pursue this route. It would be more advantageous for the CMC MUA – Cape May Sludge Process Building to solicit Power Purchase

Agreement (PPA) Providers who will own, operate, and maintain the system for a period of 15 years. During this time the PPA Provider would sell all of the electric generated by Solar Arrays to the CMC MUA – Cape May Sludge Process Building at a reduced rate compared to their existing electric rate.

Wind Generation

In addition to the Solar Analysis, CEG also conducted a review of the applicability of wind energy for the facility. Wind energy production is another option available through the Renewable Energy Incentive Program. Wind turbines of various types can be utilized to produce clean energy on a per building basis. Cash incentives are available per kWh of electric usage. Based on CEG’s review of the applicability of wind energy for the facility; with an average annual wind speed of 5.30 meters per second at 30 meter height, it is sufficient enough to reach the cut in speed for most commercial sized wind turbines of 3.5 meters per second. The installation of three 100 kilowatt Northwind Wind Turbines with a 37 meter hub height at the facility would be able to produce approximately 343,663 kWh for all of the turbines. The selection of three Northwind turbines was made due to the amount of available space onsite, proximity to residential areas, and current electric usage at the site. Although the power generation from the turbines is substantial, the turbine installation itself has an expected payback of over 30 years, being priced at approximately \$1,400,000 installed for all three turbines. In addition upfront costs for permitting, further wind studies, environmental impact studies, and bird and bat studies could cost the MUA in upwards of half million dollars, without a guarantee that wind turbines will get approval for construction given the wetlands location of the plant. Based on our calculations the following is the payback period:

**Table 8  
Financial Summary – Wind Turbine System**

<b>REM #2 - WINDTURBINES</b>	
<b>Installation Cost (\$):</b>	\$1,635,000
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$215,031
<b>Net Installation Cost (\$):</b>	\$1,419,969
<b>Maintenance Savings (\$):</b>	(\$12,600)
<b>REC Revenue (\$/Yr):</b>	\$2,864
<b>Energy Savings (\$/Yr):</b>	\$52,237
<b>Total Yearly Savings (\$/Yr):</b>	\$42,501
<b>Estimated ECM Lifetime (Yr):</b>	20
<b>Simple Payback</b>	33.41
<b>Lifetime Energy Savings</b>	\$1,044,735

For further wind analysis refer to the **Wind Analysis Calculation Appendix**.

## IX. ENERGY PURCHASING AND PROCUREMENT STRATEGY

### Load Profile:

Load Profile analysis was performed to determine the seasonal energy usage of the facility. Irregularities in the load profile will indicate potential problems within the facility. Consequently based on the profile a recommendation will be made to remedy the irregularity in energy usage. For this report, the facility's energy consumption data was gathered in table format and plotted in graph form to create the load profile. Refer to The Electric, and Natural Gas Usage Profiles included within this report to reference the respective electricity and natural gas usage load profiles.

### Electricity:

The Electric Usage Profile shows increased usage in the cooling season between months July through October and relatively flat baseline usage in the heating season. The increase in the cooling season is relatively small compared to the base-line electric usage representing a high baseline usage. This is somewhat typical for an administration building with non electric heat, however this service is provided for multiple buildings which make comparisons to typical load profiles more difficult. The cooling season represents a typical load profile with increase usage from the building air conditioning systems. The electric demand is at its peak in the month of September representing the largest electric draw in the cooling season. The buildings connected to this service include the administration building as well as process buildings and pump stations. The load factor rating for this service is approximately 25%. Load factor is the total usage divided by the demand times the total hours (KWH/KW\*8760). This means that the full load electric draw for the facility is only used for 25% of the time. A higher load factor (rating of 50% or higher) along with a flat load profile will allow for more competitive energy prices when shopping for alternative suppliers.

### #2 Heating Oil:

The Heating Oil Usage Profile demonstrates a very typical (heat load) profile. The summer months zero consumption (complimenting the cooling electric load), July through November. There is an increase in consumption December through May. The primary use of the heating oil is the oil fired boiler. Heating oil is purchased based on market driven pricing and delivered on an as needed bases. This utility is unlike natural gas and electric utilities where time of use and load profiling has a more significant role.

### Tariff Analysis:

### Electricity:

This facility receives electrical service through Atlantic City Electric on their Annual General Service (AGS-Secondary) rate. This service classification is available for general service purposes on secondary voltages. This facility's rate is a three phase service at secondary voltages. For electric supply (generation), the customer has the option to purchase energy

through the utility's Generation Charge or a Third Party Supplier (TPS). This facility utilizes the generation service provide through Atlantic City Electric (BGS), Therefore, they will pay according to the default service. The Delivery Service includes the following charges: Customer Charge, Distribution Charge (kW Demand), Reactive Demand Charge (kvar Demand, over 1/3 kW), Distribution Charge kWh, Non-utility Generation Charge, Societal benefits Charge kWh, Regulatory Assets Recovery Charge kWh, Transition Bond Charge kWh, Market Transition Charge Tax kWh, System Control Charge kWh, CIEP Standby Fee kWh, Transmission Demand Charge kW, Reliability Must Run Transmission Surcharge kWh, Transmission Enhancement Charge kWh, Basic Generation Service Charge kWh, Regional Greenhouse Gas Initiative Recovery Charge kWh, Infrastructure Investment Surcharge.

The Demand charges are based on a ratchet demand rate of 80% of the highest demand set in the months of June through September. The usage charges are based on a stepped rate structure. The demand charges for this rate structure are far less than the usage charges on a typical basis making this rate structure less dependent on demand versus usage. The steps for the usage charges are very small increments of change which result in fairly steady costs per kWh per month despite the changes in electrical usage and demand.

#### #2 Heating Oil:

This facility receives deliveries for #2 heating oil on an as needed basis. The cost per gallon is determined based on the market driven costs. These utilities do not include tariffs and rate structures.

Natural gas is a utility similar to electric which includes delivery and supply charges based on a rate structure and utility tariff. If the county were to consider the addition of natural gas to this facility, the County should review the following: Customers of natural gas service may either purchase gas supply from a Third Party (TPS) or from Public Services Basic Gas Supply Service default service as detailed in the utility rate schedule. Different service rates are available and should be considered for the facility prior to beginning a contract.

When considering a third party supplier for natural gas it is important to understand the costs associated with imbalances. Most natural gas rate schedules have a balancing charge included in their rate structure. Should the TPS not deliver, the customer may receive service from the default delivery utility under their Emergency Sales Service. Emergency Sales Service carries an extremely high penalty cost of service. Should the TPS un-deliver to the utility on behalf of the client, the utility will automatically supply this default service to the client. Imbalances occur when Third Party Suppliers are used to supply natural gas, full-delivery is not made, and when a new supplier is contracted or the customer returns to the utility. It is important when utilizing a Third Party Supplier, that an experienced regional supplier is used. Otherwise, imbalances can occur, jeopardizing economics and scheduling.

**Recommendations:**

CEG recommends a global approach that will be consistent with all facilities within the County. Based on the latest electric utility bill, the average price per kWh (kilowatt hour) for the building based on 1-year historical average price is \$0.1226/kWh based on the utility information provided (this is the average “price to compare” if the client intends to shop for energy). The average price per gallon of #2 oil is \$ 1.66 / gallon. Energy commodities are among the most volatile of all commodities, however at this point and time, energy is relatively competitive. The County should consider procuring energy through alternative supply sources to shop for the most competitive prices.

CEG also recommends that the County schedule a meeting with the current utility providers to review their utility charges and current tariff structures for electricity. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), the County can learn more about the competitive supply process. Cape May County can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at [www.nj.gov/bpu](http://www.nj.gov/bpu). The County should consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the information for ongoing demand-side management projects. The County should ask the utility representative about alternative billing options, such as consolidated billing when utilizing the service of a Third Party Supplier. This could be performed with the aid of an “energy advisor”.

## X. INSTALLATION FUNDING OPTIONS

CEG has reviewed various funding options for the facility owner to utilize in subsidizing the costs for installing the energy conservation measures noted within this report. Below are a few alternative funding methods:

- i. *Energy Savings Improvement Program (ESIP)* – Public Law 2009, Chapter 4 authorizes government entities to make energy related improvements to their facilities and pay for the costs using the value of energy savings that result from the improvements. The “Energy Savings Improvement Program (ESIP)” law provides a flexible approach that can allow all government agencies in New Jersey to improve and reduce energy usage with minimal expenditure of new financial resources.
- ii. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.
- iii. *Power Purchase Agreement* – Public Law 2008, Chapter 3 authorizes contractor of up to fifteen (15) years for contracts commonly known as “power purchase agreements.” These are programs where the contracting unit (Owner) procures a contract for, in most cases, a third party to install, maintain, and own a renewable energy system. These renewable energy systems are typically solar panels, windmills or other systems that create renewable energy. In exchange for the third party’s work of installing, maintaining and owning the renewable energy system, the contracting unit (Owner) agrees to purchase the power generated by the renewable energy system from the third party at agreed upon energy rates.
- iv. *Pay For Performance* – *The New Jersey Smart Start Pay for Performance program includes incentives based on savings resulted from implemented ECMs. The program is available for all buildings with average demand loads above 200 KW. The facility’s participation in the program is assisted by an approved program partner. An “Energy Reduction Plan” is created with the facility and approved partner to show at least 15% reduction in the building’s current energy use. Multiple energy conservation measures implemented together are applicable toward the total savings of at least 15%. No more than 50% of the total energy savings can result from lighting upgrades / changes.*

*Total incentive is capped at 50% of the project cost. The program savings is broken down into three benchmarks; Energy Reduction Plan, Project*

*Implementation, and Measurement and Verification. Each step provides additional incentives as the energy reduction project continues. The benchmark incentives are as follows:*

- 1. Energy Reduction Plan – Upon completion of an energy reduction plan by an approved program partner, the incentive will grant \$0.10 per square foot between \$5,000 and \$50,000, and not to exceed 50% of the facility’s annual energy expense. (Benchmark #1 is not provided in addition to the local government energy audit program incentive.)*
- 2. Project Implementation – Upon installation of the recommended measures along with the “Substantial Completion Construction Report,” the incentive will grant savings per KWH or Therm based on the program’s rates. Minimum saving must be 15%. (Example \$0.11 / kWh for 15% savings, \$0.12/ kWh for 17% savings, ... and \$1.10 / Therm for 15% savings, \$1.20 / Therm for 17% saving, ... ) Increased incentives result from projected savings above 15%.*
- 3. Measurement and Verification – Upon verification 12 months after implementation of all recommended measures, that actual savings have been achieved, based on a completed verification report, the incentive will grant additional savings per kWh or Therm based on the program’s rates. Minimum savings must be 15%. (Example \$0.07 / kWh for 15% savings, \$0.08/ kWh for 17% savings, ... and \$0.70 / Therm for 15% savings, \$0.80 / Therm for 17% saving, ... ) Increased incentives result from verified savings above 15%.*

CEG recommends the Owner review the use of the above-listed funding options in addition to utilizing their standard method of financing for facilities upgrades in order to fund the proposed energy conservation measures.

## **XI. ADDITIONAL RECOMMENDATIONS**

The following recommendations include no cost/low cost measures, Operation & Maintenance (O&M) items, and water conservation measures with attractive paybacks. These measures are not eligible for the Smart Start Buildings incentives from the office of Clean Energy but save energy none the less.

- A. Chemically clean the heating coils periodically to optimize efficiency. Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.
- B. Maintain all weather stripping on windows and doors.
- C. Clean all light fixtures to maximize light output.
- D. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

**ECM COST & SAVINGS BREAKDOWN**

CONCORD ENGINEERING GROUP

Cape May Sludge Processing Building

ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME (Yr)	LIFETIME ENERGY SAVINGS	LIFETIME MAINTENANCE SAVINGS	LIFETIME ROI	SIMPLE PAYBACK	INTERNAL RATE OF RETURN	NET PRESENT VALUE
		MATERIAL	LABOR	REBATES, INCENTIVES	NET INSTALLATION COST	ENERGY	MAINT./ SREC	TOTAL		(Yearly Saving * ECM Lifetime)	(Yearly Maint Saving * ECM Lifetime)	(Lifetime Savings - Net Cost) / (Net Cost)	(Net cost / Yearly Savings)	$\sum_{n=0}^N \frac{C_n}{(1+IRR)^n}$	$\sum_{n=0}^N \frac{C_n}{(1+DR)^n}$
		(\$)	(\$)	(\$)	(\$)	(\$/Yr)	(\$/Yr)	(\$/Yr)		(\$)	(\$)	(%)	(Yr)	(\$)	(\$)
ECM #1	General Lighting Upgrade	\$1,100	\$0	\$215	\$885	\$280	\$0	\$280	15	\$4,194	\$0	373.9%	3.2	31.05%	\$2,453.09
ECM #2	NEMA Premium Efficient Pump Motor Replacement	\$3,370	\$0	\$220	\$3,150	\$314	\$0	\$314	18	\$5,652	\$0	79.4%	10.0	7.04%	\$1,168.60
ECM #3	Heat & Ventillation Unit Upgrade	\$12,000	\$0	\$50	\$11,950	\$28	\$0	\$28	15	\$420	\$0	-96.5%	426.8	-27.21%	(\$11,615.74)
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	Solar PV 8.97 KW System	\$80,730	\$0	\$0	\$80,730	\$1,666	\$3,835	\$5,501	15	\$82,515	\$57,525	2.2%	14.7	0.27%	(\$15,059.42)
REM #2	300 KW Wind Turbine	\$1,635,000	\$0	\$215,031	\$1,419,969	\$52,237	(\$9,736)	\$42,501	20	\$850,020	-\$194,720	-40.1%	33.4	-4.46%	(\$787,661.44)

- Notes:**
- 1) The variable Cn in the formulas for Internal Rate of Return and Net Present Value stands for the cash flow during each period.
  - 2) The variable DR in the NPV equation stands for Discount Rate
  - 3) For NPV and IRR calculations: From n=0 to N periods where N is the lifetime of ECM and Cn is the cash flow during each period.



# Concord Engineering Group, Inc.

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## SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives as of February, 2010:

### **Electric Chillers**

Water-Cooled Chillers	\$12 - \$170 per ton
Air-Cooled Chillers	\$8 - \$52 per ton

Energy Efficiency must comply with ASHRAE 90.1-2004

### **Gas Cooling**

Gas Absorption Chillers	\$185 - \$400 per ton
Gas Engine-Driven Chillers	Calculated through custom measure path)

### **Desiccant Systems**

\$1.00 per cfm – gas or electric	
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### **Electric Unitary HVAC**

Unitary AC and Split Systems	\$73 - \$93 per ton
Air-to-Air Heat Pumps	\$73 - \$92 per ton
Water-Source Heat Pumps	\$81 per ton
Packaged Terminal AC & HP	\$65 per ton
Central DX AC Systems	\$40- \$72 per ton
Dual Enthalpy Economizer Controls	\$250
Occupancy Controlled Thermostat (Hospitality & Institutional Facility)	\$75 per thermostat

Energy Efficiency must comply with ASHRAE 90.1-2004

### **Ground Source Heat Pumps**

Closed Loop & Open Loop	\$450 per ton, EER ≥ 16
	\$600 per ton, EER ≥ 18
	\$750 per ton, EER ≥ 20

Energy Efficiency must comply with ASHRAE 90.1-2004

### Gas Heating

Gas Fired Boilers < 300 MBH	\$300 per unit
Gas Fired Boilers ≥ 300 - 1500 MBH	\$1.75 per MBH
Gas Fired Boilers ≥1500 - ≤ 4000 MBH	\$1.00 per MBH
Gas Fired Boilers > 4000 MBH	(Calculated through Custom Measure Path)
Gas Furnaces	\$300 - \$400 per unit, AFUE ≥ 92%

### Variable Frequency Drives

Variable Air Volume	\$65 - \$155 per hp
Chilled-Water Pumps	\$60 per hp
Compressors	\$5,250 to \$12,500 per drive

### Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons	\$50 per unit
Gas-Fired Water Heaters > 50 gallons	\$1.00 - \$2.00 per MBH
Gas-Fired Booster Water Heaters	\$17 - \$35 per MBH
Gas Fired Tankless Water Heaters	\$300 per unit

### Prescriptive Lighting

Retro fit of T12 to T-5 or T-8 Lamps w/Electronic Ballast in Existing Facilities	\$15 per fixture (1-4 lamps)
Replacement of T12 with new T-5 or T-8 Lamps w/Electronic Ballast in Existing Facilities	\$25 per fixture (1-2 lamps) \$30 per fixture (3-4 lamps)
T-8 reduced Wattage (28w/25w 4', 1-4 lamps) Lamp & ballast replacement	\$10 per fixture
Hard-Wired Compact Fluorescent	\$25 - \$30 per fixture
Metal Halide w/Pulse Start	\$25 per fixture
LED Exit Signs	\$10 - \$20 per fixture
T-5 and T-8 High Bay Fixtures	\$16 - \$284 per fixture
HID ≥ 100w Retrofit with induction lamp, power coupler and generator (must be 30% less watts/fixture than HID system)	\$50 per fixture
HID ≥ 100w Replacement with new HID ≥ 100w	\$70 per fixture
LED Refrigerator/Freezer case lighting replacement of fluorescent in medium and low temperature display case	\$42 per 5 foot \$65 per 6 foot

### Lighting Controls – Occupancy Sensors

Wall Mounted	\$20 per control
Remote Mounted	\$35 per control
Daylight Dimmers	\$25 per fixture
Occupancy Controlled hi-low Fluorescent Controls	\$25 per fixture controlled

### Lighting Controls – HID or Fluorescent Hi-Bay Controls

Occupancy hi-low	\$75 per fixture controlled
Daylight Dimming	\$75 per fixture controlled
Daylight Dimming - office	\$50 per fixture controlled

### Premium Motors

Three-Phase Motors	\$45 - \$700 per motor
Fractional HP Motors Electronic Communicated Motors (replacing shaded pole motors in refrigerator/freezer cases)	\$40 per electronic communicated motor

### Other Equipment Incentives

Performance Lighting	\$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1- 2004 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive
Custom Measures	\$0.16 KWh and \$1.60/Therm of 1st year savings, or a buy down to a 1 year payback on estimated savings. Minimum required savings of 75,000 KWh or 1,500 Therms and a IRR of at least 10%.
Multi Measures Bonus	15%

**MAJOR EQUIPMENT LIST**

Concord Engineering Group

"Cape May Sludge Process Building"

Boiler														
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Output (MBh)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
-	Boiler Room	Sludge Building	Weil Mclain	1	P-878-W	CP 2791289	1084	886	81.7	NG /Oil?	20	35	15	

Boiler - Burner													
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Input (MBh)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
-	Boiler Room	Sludge Building	Power Flame	1	CR1-60-12	O19569861	1084	80	NG /Oil?	20	21	1	

Pumps																
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	HP	RPM	GPM	Ft. Hd	Frame Size	Volts / Phase	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
-	Boiler Room	Sludge Building	Armstrong	1	2x2x3 4380	556059	3	1800	65	55	BF-STD	208/230/3	2006	10	6	
-	Boiler Room	Sludge Building	Leeson	1	C145T17FK12B	120931	2	1750	65.5	53	T145UM	208/230/3	1998	10	(-2)	82% NEMA Eff.
-	Scum Room	Sludge Building	(pump motor) Reliance	1	10500997-PJ	79163-20-H	3	-	-	-	-	-	1984	10	(-16)	1 hr/day in summer, 82% NEMA Eff.
-	Basement	Sludge Building	US Electrical Motors	1	XA741845	P08P1310361F	7.5	865	-	-	256T	430/3	2008	10	8	82.5% NEMA Eff.
-	Basement	Sludge Building	Marathon Electric	1	NA215TTFL7726AP-R16	-	10	1740	-	-	215T	208-230/240	1984	10	(-16)	86.8 NEMA Eff.
-	Basement	Sludge Building	Baldor	1	ECP2333T-4	8900/602	15	1765	-	-	D254T	460/3	2 YEARS	10	8	15 HP REPLACED A 10 HP (DID NOT IMPROVE PERFORMANCE), 92% NEMA Eff
-	Basement	Sludge Building	Reliance	2	B77C3647M	7340	2	1725	-	-	145	230/460	1996	10	(-4)	81.5% NEMA Eff.
-	Basement	Sludge Building	Muffin Monster - Baldor	2	VM3611	7340	3	1725	-	-	184C	460/3	1996	10	(-4)	82.5% NEMA Eff.
-	Basement	Recycle pump	Marathon Electric	1	NE184TTFL7333ANL	-	5	1730	-	-	184T	230/460	1984	10	(-16)	82.5% NEMA Eff.
-	Basement	Recycle pump	LEESON	1	Cat. 150027, M/N G184T17FB1E	-	5	1740	-	-	184T	208-230/460	1996	10	(-4)	86 % NEMA Eff.
-	Sludge Container Room	Transfer Pump	Hayward Gordon	1	XC85A	2623171	25	1750	600	68	184T	460/3	1984	10	(-16)	93.8 NEMA Efficient

Domestic Hot Water Heater															
Tag	Location	Area Served	Manufacturer	Qty	Model #	Serial #	Input (MBh)	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	Service Life	Remaining Life	Notes
-	Not Accessible	Sludge Building	Bradford White	1	M1-12UT6SS13	-	1500 Watts	7	12	-	Electric	1999	12	1	Assumed Make/model - same as 7 mile middle Project Crew wa

Unit Heaters and Cabinet Unit Heaters															
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Heating Type	Heating Capacity (MBH)	CFM	RPM / HP	GPM	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
-	Ground / Second	Ground / Second	Trane	13	136-104-01	D82L4725	NG	42	-	-	-	1982	20	(-8)	

Heating and Ventilation Units																
Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	Heating Coil	Capacity (Btu/h)	Fan HP	Fan RPM	Volts / Phase	Amps	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
-	Outside Boiler RM	Sludge Bldg	Buffalo Air Handling	1	85BR	V00538000001	HW	-	2	-	460/3	-	1984	15	(-11)	GE M/N SKS49ZN8083 84.0% NEMA Eff.

NOTE: IF AN ITEM IS LEFT BLANK, THE INFORMATION IS EITHER NOT AVAILABLE OR NOT APPLICABLE FOR THIS PIECE OF EQUIPMENT.

## Investment Grade Lighting Audit

CEG Job #: 9C09168

Project: CMC MUA - CM Sludge Processing Building

Address: 545 Sunset Blvd.

Cape May Point, NJ 08212

Building SF: 6,714

"CM Sludge Processing "

KWH COST: \$0.152

### ECM #1: Lighting Upgrade - General

EXISTING LIGHTING					PROPOSED LIGHTING										SAVINGS							
CEG Type	Fixture Location	Yearly Usage	No. Fixts	No. Lamps	Fixture Type	Fixt Watts	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	No. Fixts	No. Lamps	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly \$ Savings	Yearly Simple Payback
736	Mechanical Room	100	3	1	175w MH, Pendant Mnt., Prismatic Lens	210	0.63	63.0	\$9.58	3	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00
221.31	Boiler Room	100	3	2	1x4, 2 Lamp, 32w T8, Elect. Ballast, Pendant Mnt., Prismatic Lens	58	0.17	17.4	\$2.64	3	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00
733	Electrical Storage	100	2	1	150w MH Lo Bay - No Lens	188	0.38	37.6	\$5.72	2	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00
736	Sludge Hauler	100	6	1	175w MH, Pendant Mnt., Prismatic Lens	210	1.26	126.0	\$19.15	6	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00
128.11	Scum Room	100	3	2	8' Channel, 2 Lamp, 96w T12, Mag. Ballast, Surface Mnt., No Lens	209	0.63	62.7	\$9.53	3	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00
736	Basement	8760	5	1	175w MH, Pendant Mnt., Prismatic Lens	210	1.05	9,198.0	\$1,398.10	5	6	2x4, 64 Lamp, 32w T8, Elect. Ballast, w/Wire Guard - Lo Bay	168	0.84	7358.4	\$1,118.48	\$220.00	\$1,100.00	0.21	1839.6	\$279.62	3.93
736	2nd Floor Storage	100	5	1	175w MH, Pendant Mnt., Prismatic Lens	210	1.05	105.0	\$15.96	5	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00
242.21	Office	100	1	4	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	104	0.10	10.4	\$1.58	1	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00
731	Exterior	3600	10	1	150w MH Pole Mnt., "Shoobox"	188	1.88	6,768.0	\$1,028.74	10	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00
725		3600	3	1	150w HPS Wallpack	188	0.56	2,030.4	\$308.62	3	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00
<b>Totals</b>			41	15			7.72	18,418.5	\$2,799.61	41	6			0.84	7358.4	\$1,118.48		\$1,100.00	0.21	1839.6	\$279.62	3.93

NOTES: 1. Simple Payback noted in this spreadsheet does not include Maintenance Savings and NJ Smart Start Incentives.  
2. Lamp totals only include T-12 tube replacement calculations

Project Name: LGEA Solar PV Project - Cape May Sludge Processing Building							
Location: Cape May, NJ							
Description: Photovoltaic System - Direct Purchase							
<b>Simple Payback Analysis</b>							
	Photovoltaic System - Direct Purchase						
Total Construction Cost	\$80,730						
Annual kWh Production	10,958						
Annual Energy Cost Reduction	\$1,666						
Annual SREC Revenue	\$3,835						
First Cost Premium	<b>\$80,730</b>						
Simple Payback:	<b>14.68</b>						Years
<b>Life Cycle Cost Analysis</b>							
Analysis Period (years):	25			Financing %:	0%		
Financing Term (mths):	0			Maintenance Escalation Rate:	3.0%		
Average Energy Cost (\$/kWh)	<b>\$0.152</b>			Energy Cost Escalation Rate:	3.0%		
Financing Rate:	0.00%			SREC Value (\$/kWh)	\$0.350		
Period	Additional Cash Outlay	Energy kWh Production	Energy Cost Savings	Additional Maint Costs	SREC Revenue	Net Cash Flow	Cumulative Cash Flow
0	\$80,730	0	0	0	\$0	(80,730)	0
1	\$0	10,958	\$1,666	\$0	\$3,835	\$5,501	(\$75,229)
2	\$0	10,903	\$1,716	\$0	\$3,816	\$5,532	(\$69,697)
3	\$0	10,849	\$1,767	\$0	\$3,797	\$5,564	(\$64,133)
4	\$0	10,794	\$1,820	\$0	\$3,778	\$5,598	(\$58,535)
5	\$0	10,740	\$1,875	\$111	\$3,759	\$5,523	(\$53,012)
6	\$0	10,687	\$1,931	\$110	\$3,740	\$5,561	(\$47,451)
7	\$0	10,633	\$1,989	\$110	\$3,722	\$5,601	(\$41,850)
8	\$0	10,580	\$2,048	\$109	\$3,703	\$5,643	(\$36,207)
9	\$0	10,527	\$2,110	\$108	\$3,685	\$5,686	(\$30,521)
10	\$0	10,475	\$2,173	\$108	\$3,666	\$5,731	(\$24,790)
11	\$0	10,422	\$2,238	\$107	\$3,648	\$5,779	(\$19,011)
12	\$0	10,370	\$2,306	\$107	\$3,630	\$5,828	(\$13,182)
13	\$0	10,318	\$2,375	\$106	\$3,611	\$5,880	(\$7,303)
14	\$0	10,267	\$2,446	\$106	\$3,593	\$5,934	(\$1,369)
15	\$0	10,215	\$2,519	\$105	\$3,575	\$5,990	\$4,621
16	\$0	10,164	\$2,595	\$105	\$3,558	\$6,048	\$10,668
17	\$0	10,113	\$2,673	\$104	\$3,540	\$6,108	\$16,777
18	\$0	10,063	\$2,753	\$104	\$3,522	\$6,171	\$22,948
19	\$0	10,013	\$2,836	\$103	\$3,504	\$6,237	\$29,185
20	\$0	9,963	\$2,921	\$103	\$3,487	\$6,305	\$35,490
21	\$1	9,913	\$3,008	\$102	\$3,469	\$6,376	\$41,866
22	\$2	9,863	\$3,099	\$102	\$3,452	\$6,449	\$48,315
23	\$3	9,814	\$3,191	\$101	\$3,435	\$6,525	\$54,840
24	\$4	9,765	\$3,287	\$101	\$3,418	\$6,604	\$61,444
25	\$5	9,716	\$3,386	\$100	\$3,401	\$6,686	\$68,131
<b>Totals:</b>		258,126	\$60,727	\$2,211	\$90,344	\$148,861	(\$148,005)
<b>Net Present Value (NPV)</b>						<b>\$68,156</b>	
<b>Internal Rate of Return (IRR)</b>						<b>5.2%</b>	

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW <sub>DC</sub>	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
Sludge Processing Building	625	Sunpower SPR230	39	14.7	573	8.97	10,958	1,287	15.64



AC Energy & Cost Savings



Station Identification	
City:	Atlantic_City
State:	New_Jersey
Latitude:	39.45° N
Longitude:	74.57° W
Elevation:	20 m
PV System Specifications	
DC Rating:	9.0 kW
DC to AC Derate Factor:	0.810
AC Rating:	7.3 kW
Array Type:	Fixed Tilt
Array Tilt:	10.0°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	11.2 ¢/kWh

Results			
Month	Solar Radiation (kWh m <sup>2</sup> day)	AC Energy (kWh)	Energy Value (\$)
1	2.58	583	65.30
2	3.33	688	77.06
3	4.31	961	107.63
4	5.20	1095	122.64
5	5.85	1250	140.00
6	6.14	1217	136.30
7	6.06	1229	137.65
8	5.54	1130	126.56
9	4.85	971	108.75
10	3.76	793	88.82
11	2.65	556	62.27
12	2.23	487	54.54
Year	4.38	10958	1227.30

= Proposed PV Layout

Notes:

1. Estimated kWh based on the National Renewable Energy Laboratory PVWatts Version 1 Calculator Program.

<b>REM #2 - WINDTURBINES</b>	
<b>Installation Cost (\$):</b>	\$1,635,000
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$215,031
<b>Net Installation Cost (\$):</b>	\$1,419,969
<b>Maintenance Savings (\$):</b>	(\$12,600)
<b>REC Revenue (\$/Yr):</b>	\$2,864
<b>Energy Savings (\$/Yr):</b>	\$52,237
<b>Total Yearly Savings (\$/Yr):</b>	\$42,501
<b>Estimated ECM Lifetime (Yr):</b>	20
<b>Simple Payback</b>	33.41
<b>Lifetime Energy Savings</b>	\$1,044,735

x3 Northwind 100 kW Turbines

Location/Building	Average Wind Speed, m/s	Turbine #1 Generation, kWh	Turbine #2 Generation, kWh	Turbine #3 Generation, kWh	Total Generation, kWh	Electric Cost Offset	Annual Maint Cost	Wind REC Revenue	Total Annual Savings	Project Cost	Incentive	Net Project Cost	Simple Payback
Cape May Regional- Sludge Processing Bt	5.469	114,554	114,554	114,554	343,663	\$52,237	\$12,600	\$2,864	\$42,501	\$1,635,000	\$215,031	\$1,419,969	33.41

Wind REC	\$0.0250												
Electric Cost	\$0.1520												
Wind Shear Exponent													
alpha	0.150												
Wind Data Height (m)	30												
Hub height (m)	37												
Avg. Wind Speed	5.300	m/s											
Avg. Speed Adjust.	5.469	m/s											
Hours per Year	8,760												
Turbine Availability	95%												
Adj. Hours per Year	8,322												
Electrical Losses	5%												

0.3048 m per ft

Wind Systems

Production Rebate Amount

Feasibility Study 50% of project costs up to \$50,000

Production Rebate Amount	per kWh	Incentive
1-16,000	\$3.20	16,000 \$51,200.00
16,000-1,000,000	\$0.50	327,663 <u>\$163,831.33</u> \$215,031.33

POWER CURVE OF TURBINE BEING PROPOSED TO COMPUTER kW<sub>e</sub> RATING BASED ON WIND SPEED

Northwind NW100 - 100 kW Turbine - 37 m Hub Height

Power Curve Data		Avg Speed
Vm (m/s)	Power (kW <sub>e</sub> )	Power Rating
1.00	(0.50)	
1.50	(0.55)	
2.00	(0.60)	
2.50	(0.65)	
3.00	(0.70)	
3.50	1.50	
4.00	3.70	
4.50	7.10	
5.00	10.50	
5.50	14.75	
6.00	19.00	
6.50	24.20	
7.00	29.40	
7.50	35.20	
8.00	41.00	
8.50	47.65	
9.00	54.30	
9.50	60.55	
10.00	66.80	

14.48971306

**Northwind NW100 - 100 kW Turbine  
- 37 m Hub Height**

Power Curve Data	
Vm (m/s)	Power (kWe)
1.00	(0.50)
1.50	(0.55)
2.00	(0.60)
2.50	(0.65)
3.00	(0.70)
3.50	1.50
4.00	3.70
4.50	7.10
5.00	10.50
5.50	14.75
6.00	19.00
6.50	24.20
7.00	29.40
7.50	35.20
8.00	41.00
8.50	47.65
9.00	54.30
9.50	60.55
10.00	66.80
10.50	72.25
11.00	77.70
11.50	82.05
12.00	86.40
12.50	89.60
13.00	92.80
13.50	95.05
14.00	97.30
14.50	98.65
15.00	100.00
15.50	100.40
16.00	100.80
16.50	100.70
17.00	100.60
17.50	100.20
18.00	99.80
18.50	99.60
19.00	99.40
19.50	99.00
20.00	98.60
20.50	98.20
21.00	97.80
21.50	97.55
22.00	97.30
22.50	97.30
23.00	97.30
23.50	97.65

**SkyStream - 2.4 kW -  
30 ft Hub Height**

Power Curve Data	
Vm (m/s)	Power (kWe)
0.00	0.00
3.50	0.08
5.00	0.20
6.00	0.40
7.50	0.80
10.00	2.00
12.50	2.40
15.00	2.40
18.50	2.00
23.00	2.00
25.00	1.80

**Gale Vertical Axis  
Turbine**

Power Curve Data	
Vm (m/s)	Power (kWe)
0.00	0.00
3.00	0.15
4.00	0.25
5.00	0.35
6.00	0.50
7.00	0.75
8.00	1.10
9.00	1.55
10.00	2.30
11.00	3.10
12.00	4.00
13.00	4.30
14.00	4.25
15.00	4.20
16.00	4.20
17.00	4.20
18.00	4.20
19.00	4.20
20.00	4.20

24.00	98.00
24.50	98.85
25.00	99.70

**SKYSTREAM**

<u>Description</u>	<u>Qty</u>	<u>\$/Unit</u>	<u>Material Cost</u>	<u>Labor Cost</u>	<u>Total</u>
Skystream 3.7	1	\$20,000	\$20,000	\$10,000	\$30,000
Misc Costs	1	\$10,000	\$10,000	\$0	\$10,000
Crane	1	\$0	<u>\$0</u>	<u>\$0</u>	<u>\$0</u>
Total			\$30,000	\$10,000	\$40,000

**NORTHWIND**

<u>Description</u>	<u>Qty</u>	<u>\$/Unit</u>	<u>Material Cost</u>	<u>Labor Cost</u>	<u>Total</u>
Northwind 100 Turbine w/ T	3	\$330,000	\$990,000	\$495,000	\$1,485,000
Misc Costs	2	\$50,000	\$100,000	\$0	\$100,000
Crane	1	\$50,000	<u>\$50,000</u>	<u>\$0</u>	<u>\$50,000</u>
Sub-Total			\$1,140,000	\$495,000	\$1,635,000

**GALE**

<u>Description</u>	<u>Qty</u>	<u>\$/Unit</u>	<u>Material Cost</u>	<u>Labor Cost</u>	<u>Total</u>
Gale Vertical Axis	1	\$28,496	\$28,496	\$14,248	\$42,744
Misc Costs	1	\$20,000	\$20,000	\$0	\$20,000
Crane	1	\$8,000	<u>\$8,000</u>	<u>\$0</u>	<u>\$8,000</u>
Sub-Total			\$56,496	\$14,248	\$70,744

	Qty	\$/Unit	Total Cost
Annual Maintenance	1	\$60	\$60

	Qty	\$/Unit	Total Cost
Annual Maintenance	3	\$4,200	\$12,600

	Qty	\$/Unit	Total Cost
Annual Maintenance	1	\$60	\$60