



LOCAL GOVERNMENT ENERGY AUDIT PROGRAM: ENERGY AUDIT REPORT

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

**FACILITY TUNNELS
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I. EXECUTIVE SUMMARY

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

Cape May County Municipal Utility Authority

- Ocean City Regional Waste Water Treatment Facility

- Facility Tunnels

4500 Haven Avenue

Ocean City, NJ 08226

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	\$ 242,218
Natural Gas	\$ 41,705
Total	\$ 283,923

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

ENERGY CONSERVATION MEASURES (ECM's)					
ECM NO.	DESCRIPTION	NET INSTALLATION COST^A	ANNUAL SAVINGS^B	SIMPLE PAYBACK (Yrs)	SIMPLE LIFETIME ROI
ECM #1	General Lighting Upgrade	\$8,540	\$4,511	1.9	692.3%
ECM #2	Exhaust Fan Motor Replacement	\$766	\$67	11.4	57.4%
ECM #3	NEMA Premium Efficient Motor Replacement	\$18,132	\$570	31.8	-43.4%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	DESCRIPTION	NET INSTALLATION COST	ANNUAL SAVINGS	SIMPLE PAYBACK (Yrs)	SIMPLE LIFETIME ROI
REM #1	295.78 KW PV Campus System	\$2,662,020	\$177,731	15.0	66.9%
REM #2	300 KW Wind Turbine	\$1,431,925	\$38,667	37.0	-46.0%
Notes: A. Cost takes into consideration applicable NJ Smart Start™ 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

ENERGY CONSERVATION MEASURES (ECM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
ECM #1	General Lighting Upgrade	7.59	31,891	0.0
ECM #2	Exhaust Fan Motor Replacement	0.18	475	0.0
ECM #3	NEMA Premium Efficient Motor Replacement	1.60	4,045	0.0
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
REM #1	295.78 KW PV Campus System	295.8	361,341.0	0.0
REM #2	300 KW Wind Turbine	300.0	319751.0	0.0

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**

Although ECMs #2 and #3 do not provide a payback less than 7 years, it is recommended to proceed with the installation of efficient motors as suggested in ECM #2 and #3 (or equal) for the tunnel facility, since this equipment is past its expected lifespan.

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. Maintain all weather stripping on entrance doors.
2. Clean all light fixtures to maximize light output.
3. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

Renewable Energy Measures (REMs) were also reviewed for implementation at the CMC MUA – Ocean City Facility Administration Building and Tunnels. CEG utilized a grade mounted solar array to house a substantial PV system. The recommended 295.78 kW PV system will produce approximately 361,341 kWh of electricity annually and will reduce the campus electrical consumption from the grid by 21.08%. The system's calculated simple payback of 15.0 years is past the standard 10 year simple payback threshold; however, with alternative funding this payback could be lessened. CEG recommends the Owner review all funding options before deciding to not implement this renewable energy measure.

Overall, the CMC MUA – Ocean City Facility Tunnels appears to be operating at a lower than average efficiency level compared to other Energy Star buildings in the "Other" category in the region. The above average EUI number can be reconciled by understanding there are other buildings and equipment on the campus meter where there is equipment with large horsepower requirements that were not within scope of this report. With the implementation of the above recommended measures the CMC MUA will realize further energy savings at the Ocean City Facility Tunnels.

II. INTRODUCTION

The comprehensive energy audit covers the 4,480 square foot Ocean City Facility Tunnels, which includes the following spaces: Tunnel entry, pipe tunnels and pump areas.

Electrical and natural 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/ft²/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 gas usage profile shows the actual natural gas energy usage for the facility. South Jersey Gas provides natural gas to the facility under the Firm Transportation rate structure. The gas utility measures consumption in cubic feet x 100 (CCF), and converts the quantity into Therms of energy. One Therm is equivalent to 100,000 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	14.1¢ / kWh
Natural Gas	\$1.63 / Therm

Table 3
Electricity Billing Data

ELECTRIC USAGE SUMMARY			
Utility Provider: Atlantic City Electric Rate: Annual General Service Meter No: 82890317 Customer ID No: 0941 1479 9995 Third Party Utility TPS Meter / Acct No:			
MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
Jan-09	135,216	270.9	\$17,049
Feb-09	134,573	269.1	\$16,994
Mar-09	131,909	264.4	\$16,764
Apr-09	131,387	275.8	\$16,654
May-09	145,559	268.2	\$18,223
Jun-09	159,109	310.1	\$24,831
Jul-09	161,166	305.1	\$25,523
Aug-09	162,152	338.9	\$25,823
Sep-09	176,408	382.7	\$28,461
Oct-09	140,359	306.1	\$19,513
Nov-09	104,000	289.6	\$14,142
Dec-09	132,160	274.4	\$18,241
Totals	1,713,998	382.7 Max	\$242,217
AVERAGE DEMAND 296.3 KW average AVERAGE RATE \$0.141 \$/kWh			

Figure 1
Electricity Usage Profile

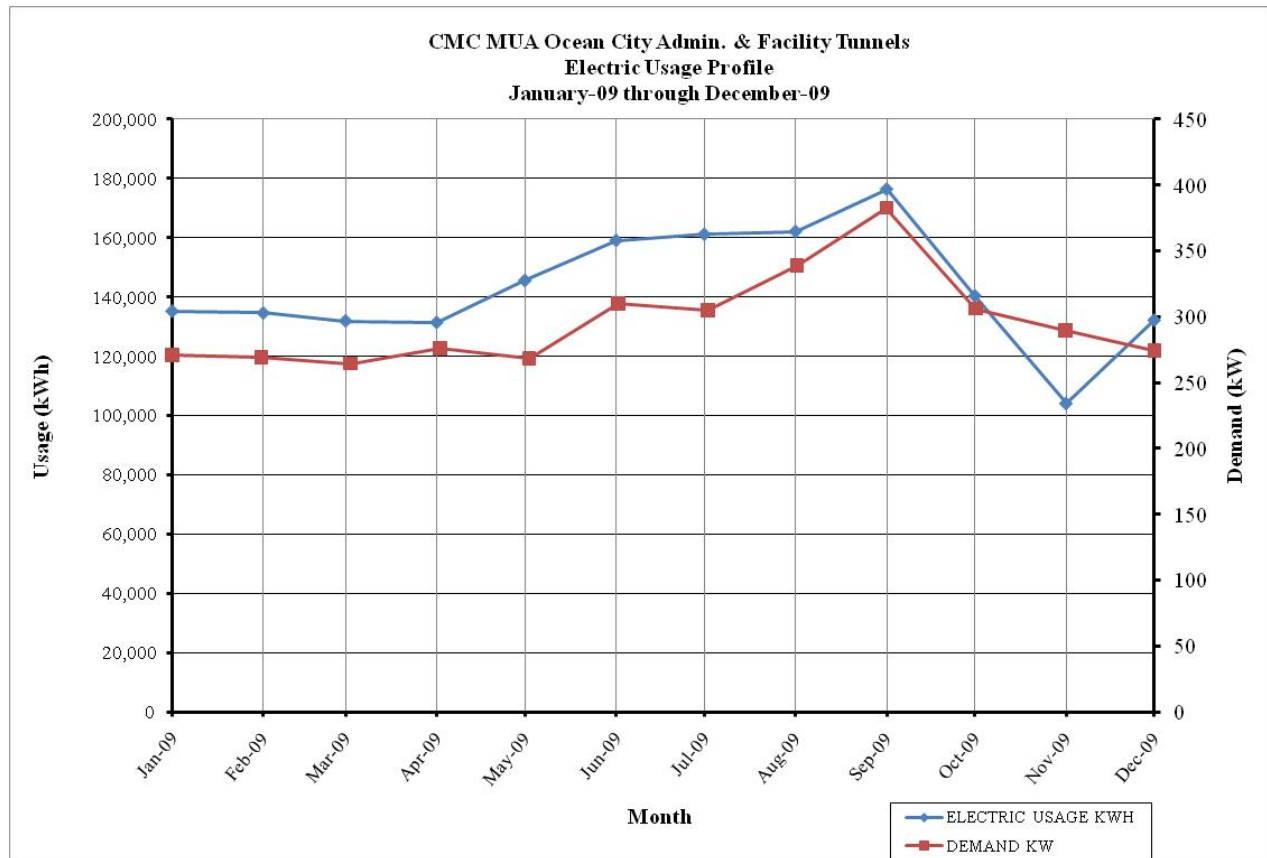
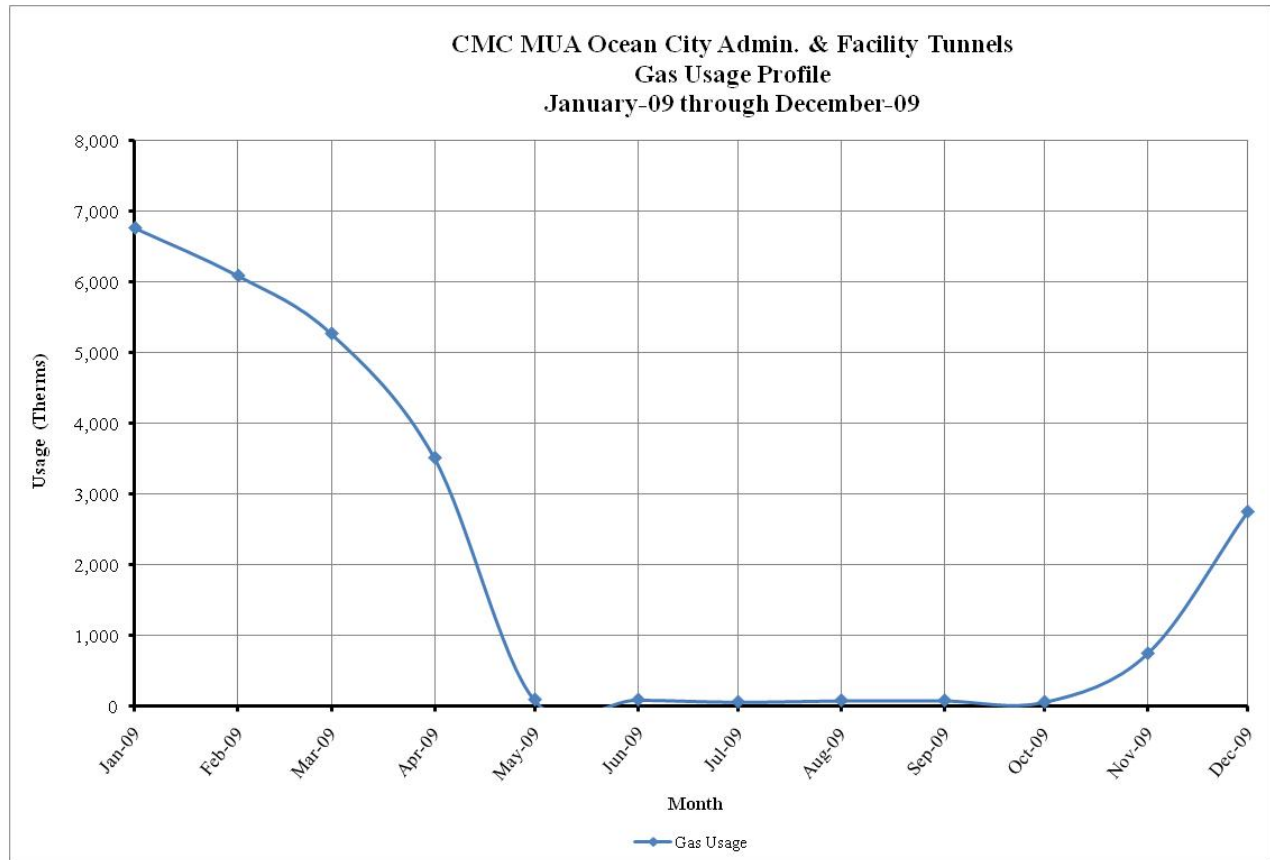


Table 4
Natural Gas Billing Data

NATURAL GAS USAGE SUMMARY		
Utility Provider: South Jersey Gas Rate: Firm Transportation Meter No: 515182 Point of Delivery ID: Third Party Utility Provider: Woodruff Energy TPS Meter No:		
MONTH OF USE	CONSUMPTION (THERMS)	TOTAL BILL
Jan-09	6,767.76	\$10,924.59
Feb-09	6,091.68	\$9,877.26
Mar-09	5,273.52	\$8,553.33
Apr-09	3,515.71	\$5,710.13
May-09	92.97	\$169.23
Jun-09	93.15	\$169.73
Jul-09	62.10	\$119.83
Aug-09	82.56	\$154.48
Sep-09	82.00	\$152.48
Oct-09	61.44	\$118.25
Nov-09	748.25	\$1,241.94
Dec-09	2,752.36	\$4,514.23
TOTALS	25,623.50	\$41,705.48
AVERAGE RATE: \$1.63 \$/THERM		

Figure 2
Natural Gas 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

ENERGY USE INTENSITY CALCULATION						
ENERGY TYPE	BUILDING USE			SITE ENERGY	SITE-SOURCE RATIO	SOURCE ENERGY
	kWh	Therms	Gallons	kBtu		kBtu
ELECTRIC	1,713,998.00			5,851,589	3.340	19,544,308
NATURAL GAS		25,623.50		2,562,350	1.047	2,682,780
FUEL OIL			-	0	1.010	0
PROPANE			-	0	1.010	0
TOTAL				8,413,939		22,227,088
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
**Building area is based on known building area of buildings being audited and areas of buildings from satellite photographs that are not being audited.						
BUILDING AREA **	24,030 SQUARE FEET					
BUILDING SITE EUI	350.14 kBtu/SF/YR					
BUILDING SOURCE EUI	924.97 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 (Waste Water Treatment):
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 337% higher than the baseline building site data. Normalizing the baseline building site data for 100% electric, baseline site energy is 185.7 kBtu/SF and as compared to the national average the energy usage is approximately 188% higher than the baseline building site data.

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). 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

ENERGY STAR PERFORMANCE RATING		
FACILITY DESCRIPTION	ENERGY PERFORMANCE RATING	NATIONAL AVERAGE
Ocean City Facility Tunnels	N/A	N/A

An Energy Performance Rating cannot be established for the Ocean City 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 4,480 SF Ocean City Facility Tunnels is an above ground entryway and a below ground tunnel and pump area. The facility operates typically 30 hours a week. Exterior walls are block and brick construction with minimum insulation typical of the time period. The amount of insulation within the wall is unknown. The tunnel walls and roof below grade are poured concrete. The entryway roof is a built-up roof with light color stone covering. The amount of insulation below the roofing is unknown. The building was built in 1982 with no additions since the original construction.

HVAC Systems

There is no cooling for the tunnel. Heating for the tunnel is provided by fractional horsepower hot water unit heaters. The unit heaters are fed from the Administration building's boiler. The above ground entry is heated by a fractional horse power electric unit heater. The unit heaters appear to be original to the building, are in fair condition and are fifteen (15) years past their ASHRAE expected useful service life. These units should be maintained or replaced as a maintenance project.

Exhaust System

Tunnel ventilation is provided by three (3) exhaust fans. Two (2) fans Penn Barry model D15, have a 2 hp fan motor. The fans are two (2) years old, in very good condition and have thirteen (13) years of ASHRAE expected useful service life remaining. One (1) fan has a Baldor model 161-018-722N 1 hp TE fan motor. The fan is fifteen (15) years old, in fair condition and is at the end of its ASHRAE expected useful service life. The three (3) exhaust systems run 24/7 continuously.

HVAC System Controls

The unit heaters within the tunnels and entryway are controlled via local thermostats.

Domestic Hot Water

Domestic hot water for use in the tunnel is provided by a 40 gallon A.O Smith model EES 40 917 electric water heater with a capacity of 4500 Watts. The domestic hot water piping insulation appeared to be in good condition.

Process Pumps

There are process pumps with motor horse power ranging from 3hp to 10 hp. There are two (2) Baldor 3 hp, model VM3611T, TE motors serving the Muffin monster pumps that are twenty (20) years old, in fair to poor condition and are ten (10) years past their ASHRAE expected useful service life. There are three (3) Baldor 3 hp, model VM3611T, TE motors serving the Muffin monster pumps that are fifteen (15) years old, in fair condition and are five (5) years past their ASHRAE expected useful service life. There is one (1) Baldor 3 hp, model VM3611T, TE

motor serving a Muffin monster pump that is eleven (11) years old, in fair condition and is one (1) year past its ASHRAE expected useful service life.

There are two (2) Secondary Sludge 91.7% NEMA efficient and one (1) Primary Sludge 90.2% NEMA efficient pumps, model ECP2332T-4 Super E, 10 hp TE. They are fourteen (14) years old, in fair condition and are four years past the ASHRAE expected useful service life.

There is one (1) North #2 Primary Sludge pump, model M2332T, 10 hp, 85% NEMA Efficient. It is fourteen (14) years old, in fair condition and is four years past its ASHRAE expected useful service life.

There is two (2) Sew-Eurodrive model DFT100LHTH, TEFC 5 hp, 1680 rpm motors. They are two (2) years old, in good condition and have eight (8) years of ASHRAE expected useful service life remaining.

There are three (3) Nord type SK112MH/4, 5hp TEFC, 1770 rpm motors. They are eleven (11) years old, in fair condition and is one (1) year past their ASHRAE expected useful service life.

There are one (1) Baldor model 259CF450094 and one (1) Baldor model 93A168-0128 DC 10 hp, TEFC, 1770 rpm motors. They are twenty-one (21) years old, in fair condition and are eleven (11) years of ASHRAE expected useful service life remaining.

There is one Century pump motor model 6-350906-01, 10 hp, 1160 rpm, 86.7% NEMA Efficient. It is twenty-one (21) years old, in fair condition and is eleven (11) years past its ASHRAE expected useful service life.

Lighting

Typical lighting throughout the tunnels is fluorescent tube fixtures with T-12 lamps and magnetic ballasts. There are some T-8 lamped fluorescent fixtures with electronic ballasts. There are some metal halide low bay and wall pack fixtures.

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 Ocean County Facility Tunnels is primarily made up of fluorescent fixtures with T-12 lamps and magnetic ballasts, T-8 lamps with electronic ballasts, and low-bay metal halides.

This ECM includes replacement of the existing fixtures containing T12 and metal halides lamps with magnetic ballasts to fixtures containing T8 lamps and electronic ballasts. 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 T12 lamps which is approximately 20,000 burn-hours. The facility will need 33% 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[®] Program Incentives are calculated as follows:

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

Retrofit fluorescent T12 lamps and magnetic ballast with T-5 or T-8 lamps w/electronic ballast (1-4 lamp retrofitted) = \$15 per fixture.

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (\# \text{ of } 1-4 \text{ lamp fixtures retrofitted} \times \$15)$$

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (69 \times \$15) = \underline{\$1,035}$$

Replace HID metal halide 400w-499w fixture with new T-5 or T-8 lamps fixture w/electronic ballast = \$100 per fixture.

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (T5 \text{ or } T8 \text{ lamp fixtures} \times \$100)$$

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (20 \times \$100) = \underline{\$2,000}$$

Total Incentive:

$$\text{Total Smart Start}^{\circledR} \text{ Incentive} = \$1,035 + \$2,000 + \$150 = \underline{\$3,035}$$

Replacement and Maintenance Savings are calculated as follows:

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

$$\text{Savings} = (2 \text{ lamps per year}) \times (\$2.00 + \$5.00) = \$14$$

From the Smart Start Incentive appendix, there is no incentive for replacing incandescent lamps with compact fluorescent lamps. The incentive is only available if the entire light fixture is replaced. In most cases, the existing fixtures can be re-lamped by the facility's staff to obtain the energy savings without the expense of a new fixture and the involvement of an electrician to install a new fixture.

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$11,575
NJ Smart Start Equipment Incentive (\$):	\$3,035
Net Installation Cost (\$):	\$8,540
Maintenance Savings (\$/Yr):	\$14
Energy Savings (\$/Yr):	\$4,497
Total Yearly Savings (\$/Yr):	\$4,511
Estimated ECM Lifetime (Yr):	15
Simple Payback	1.9
Simple Lifetime ROI	692.3%
Simple Lifetime Maintenance Savings	\$210
Simple Lifetime Savings	\$67,665
Internal Rate of Return (IRR)	53%
Net Present Value (NPV)	\$45,312.03

ECM #2: Exhaust Fan Replacement

Description:

One (1) exhaust fan has arrived at its expected service life of fifteen (15) years as outlined in Chapter 36 of the 2007 ASHRAE Applications Handbook. This fan is fifteen years old and is an excellent candidate for replacement. Due to escalating owning and maintenance costs as well as improved motor efficiency, this unit should be replaced. The existing tunnel exhaust fan is 3 hp, 460 volt- 3 phase, and 1750 rpm.

This energy conservation measure would replace the one (1) exhaust fan motor with a motor equal to or greater than 1 HP with a new having NEMA Premium® Efficient Motor. NEMA Premium® is the most efficient motor designation in the marketplace today. Because this unit operates 30-40 hours per week, even small increases in efficiency can yield substantial energy and dollar savings.

Energy Savings Calculations:

Existing: Exhaust Fan 1 serving the tunnels, has a fan motor with the following characteristics:

Existing Motor Efficiency = 81.5%

Existing motor HP = 3 HP

Annual Hours of Operations = 2600 (Average)

1 HP = 0.746 Watt

Load Factor = 75%

Cost of electricity = \$0.141 / kWh

Existing Exhaust Motor Operating Cost =

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

$= [0.746 \times 3 \times 0.75 \times 2,600 \times 0.141] \div 0.815 = \$755 / \text{Year}$

New AHU with NEMA Premium Motor Efficiency = 89.5%

New AHU with NEMA Premium Efficiency Motor Operating Cost =

$\{0.746 \times 3 \times 0.75 \times 2,600 \times 0.141\} \div 0.895 = \$688 / \text{Year}$

Savings = \$755 - \$688 = \$67 / Year

Installed Cost of a 3 HP NEMA Premium® Efficiency Motor = \$820

The SmartStart Building® incentive for 1 motor x \$54/motor is \$54

Net installed Cost = \$820 - \$54 = \$766.

Simple Payback = \$766 / \$67 = 11.4 Years

kWh saved = \$67 / \$0.141/kWh = 475 kWh

kW saved = 475 kWh / 2,600 hrs./yr. = 0.18 kW

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$820
NJ Smart Start Equipment Incentive (\$):	\$54
Net Installation Cost (\$):	\$766
Maintenance Savings (\$/Yr):	\$0
Energy Savings (\$/Yr):	\$67
Total Yearly Savings (\$/Yr):	\$67
Estimated ECM Lifetime (Yr):	18
Simple Payback	11.4
Simple Lifetime ROI	57.4%
Simple Lifetime Maintenance Savings	\$0
Simple Lifetime Savings	\$1,206
Internal Rate of Return (IRR)	5%
Net Present Value (NPV)	\$155.49

ECM #3: Install NEMA Premium Efficient Pump Motor

Description:

Replacing the old system pump motors with new efficient motors 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 30-60 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.

Energy Savings Calculations:

Motor Operating Cost =

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

SmartStart Building® incentive for 2, 3 and 5 hp NEMA motor = \$54/motor.

SmartStart Building® incentive for 10 hp NEMA motor = \$90/motor.

NEMA Premium Efficient Motor Replacement					
Motor HP	Existing Efficiency	NEMA Premium Efficiency	kW Savings	kWh Savings	Cost Savings
3	86.5%	89.5%	0.52	1,353	\$191
5	86.5%	89.5%	0.33	846	\$119
10	90.2%	91.7%	0.71	1,847	\$260
Total Savings			1.6	4,045	\$570

The following table outlines the motor replacement plan for this facility:

MOTOR REPLACEMENT PLAN

MOTOR REPLACEMENT PLAN							
Motor HP	QTY	ENCL. TYPE	No. of POLEs	INSTALLED Cost **	TOTAL COST	TOTAL SAVINGS	Simple Payback
3	8	XPFC	4-Pole	\$766	\$6,128	\$190.76	32.1
5	3	XPFC	4-Pole	\$886	\$2,658	\$119.22	22.3
10	7	XPFC	4-Pole	\$1,510	\$10,570	\$260.38	40.6
Totals:					\$19,356	\$570	33.9

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

Energy Savings Summary:

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost (\$):	\$19,356
NJ Smart Start Equipment Incentive (\$):	\$1,224
Net Installation Cost (\$):	\$18,132
Maintenance Savings (\$/Yr):	\$0
Energy Savings (\$/Yr):	\$570
Total Yearly Savings (\$/Yr):	\$570
Estimated ECM Lifetime (Yr):	18
Simple Payback	31.8
Simple Lifetime ROI	-43.4%
Simple Lifetime Maintenance Savings	\$0
Simple Lifetime Savings	\$10,260
Internal Rate of Return (IRR)	-5%
Net Present Value (NPV)	(\$10,292.50)

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 or at grade. Flat roof, as well as sloped areas and areas on grade can be utilized; flat areas will have the panels turned to an optimum solar absorbing angle. Areas on grade must be far enough away from trees and structures so that a shadow is not cast onto the photovoltaic panels. (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 site of the Administration Building and Tunnels being audited for the purposes of determining a potential for a grade mounted photovoltaic system. An area of 21,000 S.F. at grade can be utilized for a campus 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 295.78 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 361,341 KWh annually, reducing the overall utility bill by approximately 21.08% 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 Ocean City Facility Administration Building and Tunnels 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

FINANCIAL SUMMARY - PHOTOVOLTAIC SYSTEM			
PAYMENT TYPE	SIMPLE PAYBACK	SIMPLE ROI	INTERNAL RATE OF RETURN
Direct Purchase	15.0 Years	6.67%	4.9%

*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 MUA Ocean City Facility Administration Building and Tunnels to invest in a solar system through a Direct Purchase CEG does not recommend the MUA Ocean City Administration Building and Facility Tunnels pursue this route. It would be more advantageous for the MUA Ocean City Facility Administration Building and Tunnels 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 MUA Ocean City Facility Administration Building and Tunnels 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 319,751 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

REM #2 - WINDTURBINES	
Installation Cost (\$):	\$1,635,000
NJ Smart Start Equipment Incentive (\$):	\$203,075
Net Installation Cost (\$):	\$1,431,925
Maintenance Savings (\$):	(\$12,600)
REC Revenue (\$/Yr):	\$2,665
Energy Savings (\$/Yr):	\$48,602
Total Yearly Savings (\$/Yr):	\$38,667
Estimated ECM Lifetime (Yr):	20
Simple Payback	37.03
Lifetime Energy Savings	\$972,043

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 June 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 51%. Load factor is the total usage divided by the demand times the total hours ($KWH/KW \times 8760$). This means that the full load electric draw for the facility is used for 51% of the time. This load factor shows that the connected buildings to a single service provides diversity for that service and ultimately flattens the load profile. 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.

Natural Gas:

The Natural Gas Usage Profile demonstrates a very typical natural gas (heat load) profile. The summer months demonstrate very low consumption (complimenting the cooling electric load), May through September. There is an increase in consumption November through April. The main gas fired boiler which provides heating hot water to the facility, is responsible for the majority of the natural gas load. A base-load shaping (flat) will secure more competitive energy prices when procuring through an alternative energy source.

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.

Natural Gas:

This facility receives natural gas service through South Jersey Gas Company on its General Service Gas rate, "Firm Transportation". This is a firm delivery service (higher level of delivery) for general purposes where 1) customer does not qualify for any other rate schedule. Customers may either purchase gas supply from a Third Party (TPS) or from Public Services Basic Gas Supply Service default service as detailed in the rate schedule. This service has a much higher priority of delivery, based on the pipeline capacity. The "firm" service is the highest priority, and does not get interrupted.

This rate schedule has a Delivery Charge Mechanism which includes: Basic Gas Supply Service Charge, Capital Investment Recovery Charge, Transportation Initiation Charge, Societal Benefits Charge, Temperature Adjustment Charge, Balancing Service Charge, Economic Development Rate Charge, Conservation Incentive Program Charge, and Energy Efficiency Tracker Charge. The customer can elect to have the Supply Charge (Commodity Charge) serviced through the utility or by a Third Party Supplier (TPS). Note: If the facility should choose to utilize a third party supplier (TPS) and the TPS not deliver, the customer may receive service from South Jersey Gas under 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 decatherm for natural gas is \$ 11.93 / dth based on the utility information provided (this is the average “price to compare” if the client intends to shop for energy). 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. 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. Maintain all weather stripping on windows and doors.
- B. Clean all light fixtures to maximize light output.
- C. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING GROUP

Ocean City Facility Tunnel

ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME	LIFETIME ENERGY SAVINGS	LIFETIME MAINTENANCE SAVINGS	LIFETIME ROI	SIMPLE PAYBACK	INTERNAL RATE OF RETURN	NET PRESENT VALUE (NPV)
		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)	$\sum_{n=0}^Y \frac{C_n}{(1 + IRR)^n}$	$\sum_{n=0}^Y \frac{C_n}{(1 + DR)^n}$
		(\$)	(\$)	(\$)	(\$)	(\$/Yr)	(\$/Yr)	(\$/Yr)		(\$)	(\$)	(%)	(Yr)	(\$)	(\$)
ECM #1	General Lighting Upgrade	\$11,575	\$0	\$3,035	\$8,540	\$4,497	\$14	\$4,511	15	\$67,665	\$210	692.3%	1.9	52.73%	\$45,312.03
ECM #2	Exhaust Fan Motor Replacement	\$820	\$0	\$54	\$766	\$67	\$0	\$67	18	\$1,206	\$0	57.4%	11.4	5.29%	\$155.49
ECM #3	NEMA Premium Efficient Motor Replacement	\$19,356	\$0	\$1,224	\$18,132	\$570	\$0	\$570	18	\$10,260	\$0	-43.4%	31.8	-5.41%	(\$10,292.50)
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	295.78 KW PV Campus System	\$2,662,020	\$0	\$0	\$2,662,020	\$51,039	\$126,692	\$177,731	25	\$4,443,275	\$3,167,300	66.9%	15.0	4.40%	\$432,836.15
REM #2	300 KW Wind Turbine	\$1,635,000	\$0	\$203,075	\$1,431,925	\$48,602	(\$9,935)	\$38,667	20	\$773,340	-\$198,700	-46.0%	37.0	-5.26%	(\$856,657.68)

- 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*.



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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

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 $\geq$ 16 \$600 per ton, EER $\geq$ 18 \$750 per ton, EER $\geq$ 20
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Energy Efficiency must comply with ASHRAE 90.1-2004

Gas Heating

Gas Fired Boilers < 300 MBH	\$300 per unit
Gas Fired Boilers $\geq$ 300 - 1500 MBH	\$1.75 per MBH
Gas Fired Boilers $\geq$ 1500 - $\leq$ 4000 MBH	\$1.00 per MBH
Gas Fired Boilers > 4000 MBH	(Calculated through Custom Measure Path)
Gas Furnaces	\$300 - \$400 per unit, AFUE $\geq$ 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 $\leq$ 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 $\geq$ 100w Retrofit with induction lamp, power coupler and generator (must be 30% less watts/fixture than HID system)	\$50 per fixture
HID $\geq$ 100w Replacement with new HID $\geq$ 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
"Ocean City Facility Tunnels"**

Motors																
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
-	Tunnel	Tunnel	Baldor Super-E	3	ECP2332T-4	01990-0775	10	1180	-	-	256T	460/3	14	10	(-4)	
-	Tunnel	Tunnel	Sew-Eurodrive ince	3	DFT100L4TH	850063780.08.08.002	5	1680	-	-	-	230/460/3	2	10	8	
-	Tunnel	Tunnel	Baldor	1	M2332T	09C1011655	10	1160	-	-	256T	230/460/3	14	10	(-4)	
-	Tunnel	Tunnel	Baldor	7	VM3611T	3511143734	3	1725	-	-	182TC	208/230/460/3	20, 15, 11	10	(-10, -5, -11)	
-	Tunnel	Tunnel	Nord	3	112MH/4	160320229917	5	1770	-	-	1121	230/460/3	11	10	(-1)	gear motor
-	Tunnel	Tunnel	Baldor	2	92A168-0128	N0602210005	10	1750	-	-	259ATC	150/3	20	10	(-10)	DC Motor
-	Tunnel	Tunnel	Century	1	6-350906-01	-	10	1160	-	-	256I	230/460/3	21	10	(-11)	
-	Tunnel	Tunnel	Baldor	1	161-018-722N	301835-00	3	1750	-	-	143	460/3	15	15	0	Exhaust Fan

Domestic Hot Water Heater

Tag	Location	Area Served	Manufacturer	Qty	Model #	Serial #	Input	Recovery (gal/h)	Capacity (gal)	Efficiency (%)	Fuel	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
-	Tunnel	Tunnel	AO Smith	1	EES 40 917	QL99-5226294-917	4500 Watts	-	40	-	Electric	1999	12	1	

Air Compressor

Tag	Location	Area Served	Manufacturer	Qty.	Model #	Serial #	HP	Pressure	Capacity SCFM	Volts / Phase	FLA	Approx. Age	ASHRAE Service Life	Remaining Life	Notes
-	Tunnel	Tunnel	Ingersoll Rand	1	Granger 234	402040194	5	175 max	14.7	-	-	6	18	12	80 gallon, 1575 rpm
-	Tunnel	Tunnel	Emglo	1	Marathon 7UC56B17D55574B P	-	1 1/2	-	-	115/230/1	14/7	1995	18	3	
-	Tunnel	Tunnel	Emglo	1	K2A-60V	B012496169	5	-	-	-	-	1995	18	3	NJ074414-090

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

Appendix D-1
Page 1 of 1

CEG Job #: 9C09168

Project: CMC MUA – Ocean City Facility Tunnels

Address: 4500 Haven Avenue

Ocean City, NJ 08226

Building SF: 4,480

"Ocean City Facility Tunnels"

KWH COST: \$0.141

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			
121.36	Tunnels	4200	30	2	1x4, 2 Lamp 34w T12, Mag. Ballast, Pendant Mnt., Gasketed Acrylic Lens	78	2.34	9,828.0	\$1,385.75	30	2	2 lamp, 32w T8, Elect. Ballast; retrofit	58	1.74	7308	\$1,030.43	\$75.00	\$2,250.00	0.60	2520	\$355.32	6.33			
221.36		4200	12	2	1x4, 2 Lamp 32w T8, Elect. Ballast, Pendant Mnt., Gasketed Acrylic Lens	62	0.74	3,124.8	\$440.60	12	0	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00			
400		4200	20	1	400w MH Lo-bay	452	9.04	37,968.0	\$5,353.49	20	4	(2) 1x4, 2 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Gasketed Acrylic Lens	116	2.32	9744	\$1,373.90	\$320.00	\$6,400.00	6.72	28224	\$3,979.58	1.61			
111.16		4200	39	1	1x4, 1 lamp, 34w T12, Mag. Ballast, Surface Mnt., Gasketed Acrylic Lens	40	1.56	6,552.0	\$923.83	39	1	1 Lamp, 32w T8, Elect. Ballast; retrofit	33	1.29	5405.4	\$762.16	\$75.00	\$2,925.00	0.27	1146.6	\$161.67	18.09			
401		4200	7	1	400w MH Wallpack	452	3.16	13,288.8	\$1,873.72	7	30	No Change	0	0.00	0	\$0.00	\$0.00	\$0.00	0.00	0	\$0.00	0.00			
		Totals		108	7			16.85	70,761.6	\$9,977.39	108	37			5.347	22457.4	\$3,166.49		\$11,575.00	7.59	31890.6	\$4,496.57	2.57		

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 replacment calculations

Project Name: LGEA Solar PV Project - Facility Administration Building and Tunnels							
Location: Ocean City, NJ							
Description: Photovoltaic System - Direct Purchase							
Simple Payback Analysis							
		Photovoltaic System - Direct Purchase					
Total Construction Cost		\$2,662,020					
Annual kWh Production		361,341					
Annual Energy Cost Reduction		\$50,949					
Annual SREC Revenue		\$126,469					
First Cost Premium		\$2,662,020					
Simple Payback:		15.00					Years
Life Cycle Cost Analysis							
Analysis Period (years):		25		Financing %:		0%	
Financing Term (mths):		0		Maintenance Escalation Rate:		3.0%	
Average Energy Cost (\$/kWh)		\$0.141		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	\$2,662,020	0	0	0	\$0	(2,662,020)	0
1	\$0	361,341	\$50,949	\$0	\$126,469	\$177,418	(\$2,484,602)
2	\$0	359,534	\$52,478	\$0	\$125,837	\$178,315	(\$2,306,287)
3	\$0	357,737	\$54,052	\$0	\$125,208	\$179,260	(\$2,127,027)
4	\$0	355,948	\$55,673	\$0	\$124,582	\$180,255	(\$1,946,772)
5	\$0	354,168	\$57,344	\$3,648	\$123,959	\$177,655	(\$1,769,118)
6	\$0	352,397	\$59,064	\$3,630	\$123,339	\$178,773	(\$1,590,344)
7	\$0	350,635	\$60,836	\$3,612	\$122,722	\$179,947	(\$1,410,397)
8	\$0	348,882	\$62,661	\$3,593	\$122,109	\$181,176	(\$1,229,221)
9	\$0	347,138	\$64,541	\$3,576	\$121,498	\$182,463	(\$1,046,758)
10	\$0	345,402	\$66,477	\$3,558	\$120,891	\$183,810	(\$862,948)
11	\$0	343,675	\$68,471	\$3,540	\$120,286	\$185,218	(\$677,730)
12	\$0	341,957	\$70,525	\$3,522	\$119,685	\$186,688	(\$491,042)
13	\$0	340,247	\$72,641	\$3,505	\$119,086	\$188,223	(\$302,819)
14	\$0	338,546	\$74,820	\$3,487	\$118,491	\$189,824	(\$112,994)
15	\$0	336,853	\$77,065	\$3,470	\$117,899	\$191,494	\$78,500
16	\$0	335,169	\$79,377	\$3,452	\$117,309	\$193,234	\$271,733
17	\$0	333,493	\$81,758	\$3,435	\$116,722	\$195,046	\$466,779
18	\$0	331,825	\$84,211	\$3,418	\$116,139	\$196,932	\$663,711
19	\$0	330,166	\$86,737	\$3,401	\$115,558	\$198,895	\$862,606
20	\$0	328,515	\$89,340	\$3,384	\$114,980	\$200,936	\$1,063,543
21	\$1	326,873	\$92,020	\$3,367	\$114,405	\$203,058	\$1,266,601
22	\$2	325,238	\$94,780	\$3,350	\$113,833	\$205,264	\$1,471,865
23	\$3	323,612	\$97,624	\$3,333	\$113,264	\$207,555	\$1,679,420
24	\$4	321,994	\$100,552	\$3,317	\$112,698	\$209,934	\$1,889,353
25	\$5	320,384	\$103,569	\$3,300	\$112,134	\$212,404	\$2,101,757
Totals:		8,511,731	\$1,857,566	\$72,895	\$2,979,106	\$4,763,777	(\$6,542,190)
Net Present Value (NPV)						\$2,101,782	
Internal Rate of Return (IRR)						4.9%	

Building	Roof Area (sq ft)	Panel	Qty	Panel Sq Ft	Panel Total Sq Ft	Total KW _{DC}	Total Annual kWh	Panel Weight (33 lbs)	W/SQFT
Ocean City Facility Tunnels	21000	Sunpower SPR230	1286	14.7	18,910	295.78	361,341	42,438	15.64



CMCMUA Max system 21000 sq. ft.

Station Identification		Results			
City:	Atlantic_City	Month	Solar Radiation (kWh/m ² /day)	AC Energy (kWh)	Energy Value (\$)
State:	New_Jersey	1	2.58	19213	27.09
Latitude:	39.45° N	2	3.33	22687	31.99
Longitude:	74.57° W	3	4.31	31685	44.68
Elevation:	20 m	4	5.20	36092	50.89
PV System Specifications		5	5.85	41220	58.12
DC Rating:	295.8 kW	6	6.14	40122	56.57
DC to AC Derate Factor:	0.810	7	6.06	40531	57.15
AC Rating:	239.6 kW	8	5.54	37247	52.52
Array Type:	Fixed Tilt	9	4.85	32026	45.16
Array Tilt:	10.0°	10	3.76	26151	36.87
Array Azimuth:	180.0°	11	2.65	18323	25.84
Energy Specifications		12	2.23	16046	22.62
Cost of Electricity:	0.1 ¢/kWh	Year	4.38	361341	509.49

[Red Diamond] = Proposed PV Layout

Notes:

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

REM #2 - WINDTURBINES	
Installation Cost (\$):	\$1,635,000
NJ Smart Start Equipment Incentive (\$):	\$203,075
Net Installation Cost (\$):	\$1,431,925
Maintenance Savings (\$):	(\$12,600)
REC Revenue (\$/Yr):	\$2,665
Energy Savings (\$/Yr):	\$48,602
Total Yearly Savings (\$/Yr):	\$38,667
Estimated ECM Lifetime (Yr):	20
Simple Payback	37.03
Lifetime Energy Savings	\$972,043

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 Bu	5.469	106,584	106,584	106,584	319,751	\$48,602	\$12,600	\$2,665	\$38,667	\$1,635,000	\$203,075	\$1,431,925	37.03

Wind REC	\$0.0250												
Electric Cost	\$0.1520												
Wind Shear Exponent													
alpha	0.150												
Wind Data Height (m)	30		ft										0.3048 m per ft
Hub height (m)	37		ft										
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%												

Wind Systems

Production Rebate Amount

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

			Incentive
1-16,000	\$3.20 per kWh	16,000	\$51,200.00
16,000-1,000,000	\$0.50 per kWh	303,751	<u>\$151,875.46</u>
			\$203,075.46

POWER CURVE OF TURBINE BEING PROPOSED TO COMPUTER kWe RATING BASED ON WIND SPEED

Northwind NW100 - 100 kW Turbine - 37 m Hub Height

Power Curve Data				Avg Speed Power Rating
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	7.00	29.40	
4.00	3.70	7.50	35.20	
4.50	7.10	8.00	41.00	
5.00	10.50	8.50	47.65	
5.50	14.75	9.00	54.30	
6.00	19.00	9.50	60.55	
6.50	24.20	10.00	66.80	13.48153128

**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