LOCAL GOVERNMENT ENERGY AUDIT PROGRAM: ENERGY AUDIT REPORT

PREPARED FOR: **BOROUGH OF AVALON**
PUBLIC WORKS FACILITY
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AVALON, NJ 08202
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I. EXECUTIVE SUMMARY

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

Borough of Avalon
Public Works Facility
1400 Dune Drive
Avalon, NJ 08202

Municipal Contact Person: Jeff Hesley, Municipal Green Team Liaison
Facility Contact Person: Bill Macomber

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	$ 51,127
Natural Gas	$ 35,828
Total	$ 86,955

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 ± 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	Super T8 Lighting Upgrade	$5,160	$646	8.0	87.8%
ECM #2	Low-Bay Lighting Upgrades	$14,620	$3,554	4.1	264.7%
ECM #3	LED Exit Signs	$585	$481	1.2	1134.4%
ECM #4	Occupancy Sensors	$2,640	$724	3.6	311.4%
ECM #5	New Split AHU System for Administration Offices	$47,940	$1,697	28.2	-46.9%
ECM #6	Upgrade to DDC System	$75,000	$8,009	9.4	60.2%
ECM #7	Install Programmable Thermostats in Shops	$2,880	$9,286	0.3	4736.5%
ECM #8	Water Conservation Opportunities	$1,600	$161	9.9	0.6%
RENEWABLE ENERGY MEASURES (REM's)					
ECM NO.	**DESCRIPTION**	**NET INSTALLATION COST**	**ANNUAL SAVINGS**	**SIMPLE PAYBACK (Yrs)**	**SIMPLE LIFETIME ROI**
REM #1	22.54 KW PV System	$202,860	$13,934	14.6	71.7%
REM #2	2.4 kW Ground Mounted Wind System	$18,155	$1,091	16.6	-9.9%

Notes: A. Cost takes into consideration applicable NJ Smart StartTM 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	Super T8 Lighting Upgrade	1.94	4,140	0
ECM #2	Low-Bay Lighting Upgrades	10.92	22,784	0
ECM #3	LED Exit Signs	0.14	1,253	0
ECM #4	Occupancy Sensors	0.00	4,645	0
ECM #5	New Split AHU System for Administration Offices	0.00	10,883	0
ECM #6	Upgrade to DDC System	0.00	38,246	1,246
ECM #7	Install Programmable Thermostats in Shops	0.00	0	5,660
ECM #8	Water Conservation Opportunities	0.00	326	0
RENEWABLE ENERGY MEASURES (REM's)				
ECM NO.	DESCRIPTION	ANNUAL UTILITY REDUCTION		
		ELECTRIC DEMAND (KW)	ELECTRIC CONSUMPTION (KWH)	NATURAL GAS (THERMS)
REM #1	22.54 KW PV System	0.00	27,536	0
REM #2	2.4 kW Ground Mounted Wind System	0.0	6184.0	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 this facility:

- **ECM #1:** Super T8 Lighting Upgrade
- **ECM #2:** Lo-Bay Lighting Upgrade
- **ECM #3:** LED Exit Signs
- **ECM #4:** Occupancy Sensors
- **ECM #6:** Upgrade to DDC System
- **ECM #7:** Install Programmable Thermostats in Shops
- **ECM #8:** Water Conservation Opportunities

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 condenser and evaporator 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.

Renewable Energy Measures (REMs) were also reviewed for implementation at the Public Works Facility. CEG utilized a roof mounted solar array to house a PV system. The recommended 22.5 kW PV system will produce approximately 27,536 kWh of electricity annually and will reduce the electrical consumption from the grid by 8.4%. The system's calculated simple payback of 14.6 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.

In addition to the above recommendations, based on the review of the facility's energy bills and discussions with the facility management team, the energy audit team recommends Retro-Commissioning of this facility to meet the following objectives:

- Bring existing HVAC equipment to its proper operational state including all air distribution systems
- Reduce energy use and energy costs
- Improve indoor air quality
- Verify the installation and performance of identified system upgrades
- Address overall building energy use and demand and identify areas of highest energy use and demand
- Identify the location of the most comfort problems or trouble spots in the building
- Review current O&M practices

The Public Works Building can benefit from retro-commissioning of all HVAC systems. For example, several of the VAV terminal units are not functioning properly. Also, the HVAC controls need to be calibrated and programmed to optimize energy savings and equipment operation.

Overall, after reviewing the utility information, existing building documentation and performing the detailed site inspections, there are several energy savings opportunities in lighting, lighting controls, HVAC controls, and water conservation measures at the Public Works Facility. In addition, a review of the renewable energy conservation recommendation should be completed as well as investigating the available funding through the New Jersey Clean Energy Programs.

II. INTRODUCTION

This comprehensive energy audit covers the 18,200 square foot Public Works Facility which includes administration offices, control center, locker rooms, kitchen, mechanic shop, equipment storage, weld shop, carpenter shop, lawn care shop, warehouse, sign shop and vehicle storage. Normal hours of operation are 8:00 AM to 4:30 PM during weekdays except during emergencies such as snow removal.

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/ft^2/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:

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

$$Simple\ Lifetime\ Savings = \left(Yearly\ Savings \times ECM\ Lifetime \right)$$

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

$$Lifetime\ Ma\,\mathrm{int}\,enance\ Savings = \left(Yearly\ Ma\,\mathrm{int}\,enance\ Savings \times ECM\ Lifetime \right)$$

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

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

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 (ACE) provides electricity to the facility under their Annual General Service – Secondary (AGS) 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 this facility. South Jersey Gas Company provides natural gas to the facility under the Basic General Supply Service (GSG) 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:

Description	Average
Electricity	15.6¢ / kWh
Natural Gas	$1.64 / Therm

Table 3
Electricity Billing Data

ELECTRIC USAGE SUMMARY

Utility Provider: Atlantic City Electric
Rate: AGS
Meter No:
Customer ID No:
Third Party Utility
TPS Meter / Acct No:

MONTH OF USE	CONSUMPTION KWH	DEMAND	TOTAL BILL
Jan-09	30,680	112.0	$4,237
Feb-09	31,240	89.6	$4,199
Mar-09	29,200	89.6	$3,997
Apr-09	26,040	116.0	$3,781
May-09	21,040	100.0	$3,237
Jun-09	22,920	104.0	$4,197
Jul-09	30,000	112.0	$5,190
Aug-09	33,000	108.0	$5,595
Sep-09	24,040	112.0	$4,323
Oct-09	23,560	100.0	$3,697
Nov-09	23,240	108.0	$3,660
Dec-09	32,440	124.0	$5,015
Totals	**327,400**	**124.0 Max**	**$51,127**

AVERAGE DEMAND 106.3 KW average

AVERAGE RATE $0.156 $/kWh

Figure 1
Electricity Usage Profile

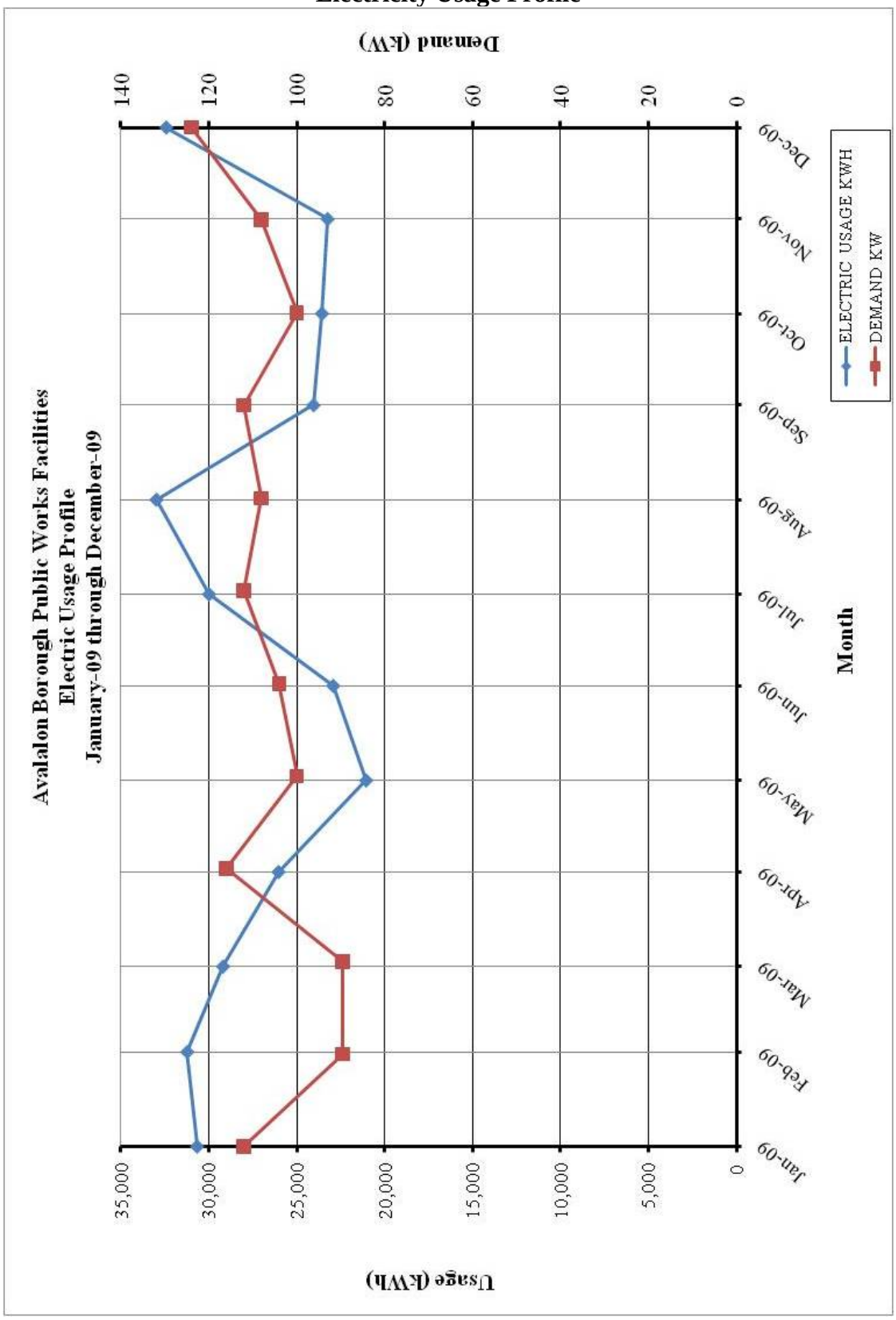
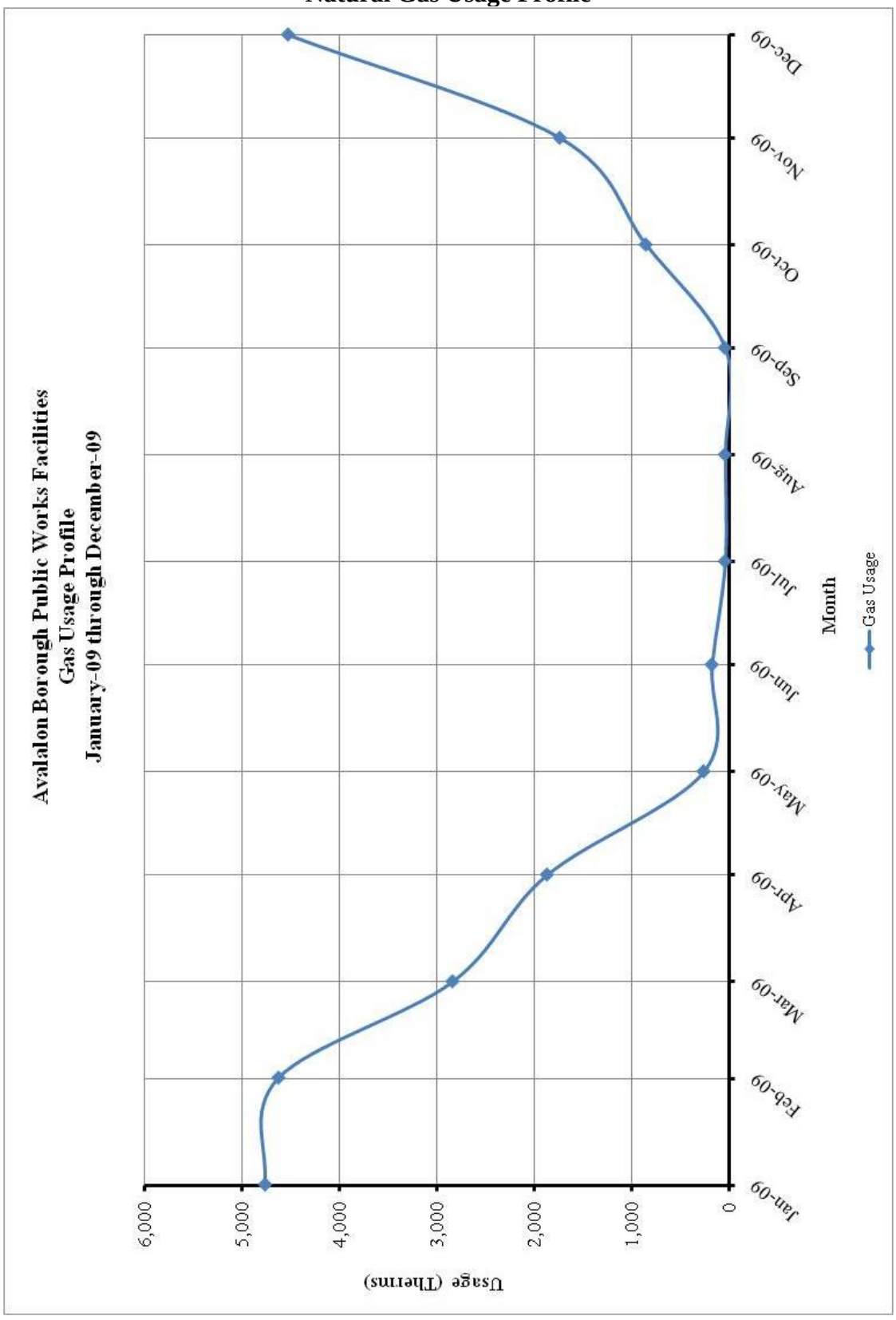


Table 4
Natural Gas Billing Data

NATURAL GAS USAGE SUMMARY		
Utility Provider:	South Jersey Gas	
Rate:	GSG	
Meter No:		
Point of Delivery ID:		
Third Party Utility Provider:		
TPS Meter No:		
MONTH OF USE	**CONSUMPTION (THERMS)**	**TOTAL BILL**
Jan-09	4,764.20	$7,810.83
Feb-09	4,626.85	$7,557.43
Mar-09	2,840.28	$4,641.81
Apr-09	1,870.63	$3,074.41
May-09	261.38	$447.71
Jun-09	177.33	$309.58
Jul-09	42.03	$87.61
Aug-09	42.03	$87.87
Sep-09	43.05	$89.07
Oct-09	854.85	$1,419.04
Nov-09	1,738.40	$2,862.61
Dec-09	4,529.48	$7,439.67
TOTALS	**21,790.48**	**$35,827.64**
AVERAGE RATE:	**$1.64**	**$/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:

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

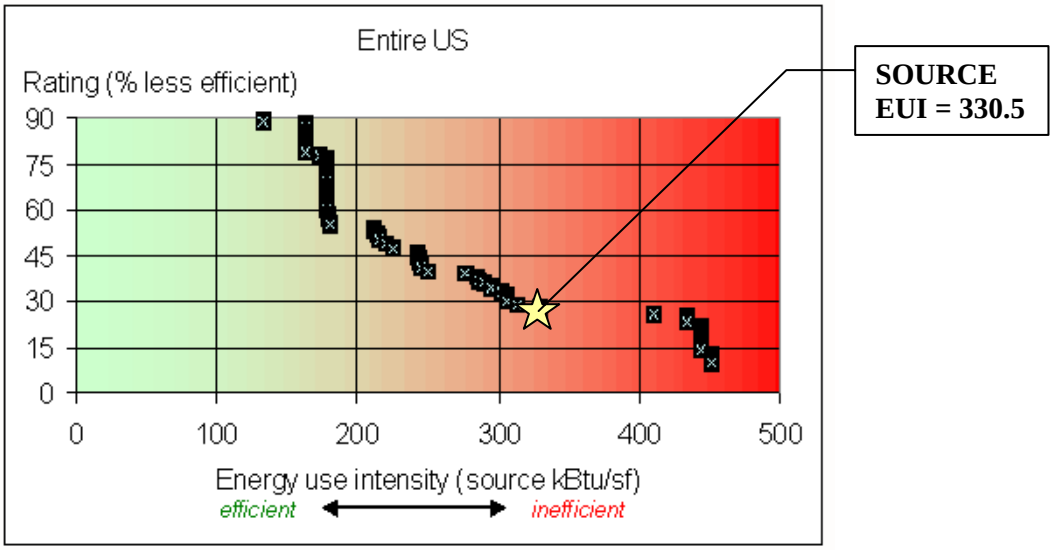
$$Building\ \ Source\ EUI = \frac{(Electric\ Usage\ in\ kBtu\ \ X\ \ SS\ \ Ratio + Gas\ Usage\ in\ kBtu\ \ X\ \ SS\ \ Ratio)}{Building\ \ Square\ \ Footage}$$

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	327400.0			1,117,744	3.340	3,733,264
NATURAL GAS		21790.5		2,179,048	1.047	2,281,463
FUEL OIL			0.0	0	1.010	0
PROPANE			0.0	0	1.010	0
TOTAL				3,296,791		6,014,726
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
BUILDING AREA		18,200	SQUARE FEET			
BUILDING SITE EUI		*181.14*	kBtu/SF/YR			
BUILDING SOURCE EUI		*330.48*	kBtu/SF/YR			

Figure 3 below depicts a national EUI grading for the source use of *Public Order and Safety Buildings*.

Figure 3
Source Energy Use Intensity Distributions: Public Order Buildings



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: avalonboro
Password: lgeaceg2009

Security Question: What city were you born in?
Security Answer: "avalon"

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**
Public Works Complex	N/A	N/A

The Avalon Public Works Complex falls under the "other" category which is not applicable for Energy Performance Rating. See the **Statement of Energy Performance Appendix** for the detailed energy summary. **Why does this need to be corrected?**

V. FACILITY DESCRIPTION

The 18,200 SF Public Works Facility is comprised of a single story, steel frame structure, sheet metal siding and a metal gable roof with a fascia panel. The facility includes administration offices, control center, locker rooms, kitchen, mechanic shops, equipment storage, weld shop, carpenter shop, lawn care shop, warehouse, sign shop and vehicle storage that are interconnected and have similar lighting/HVAC equipment. Due to this fact, the three sections of the Public Works Complex (Administration Offices, Repair Garages, and Workshops) are treated as one facility. Normal hours of operation are 8:00 AM to 4:30 PM during weekdays except during emergencies such as snow removal.

Exterior walls are sheet metal construction with minimum insulation typical of the time period. The amount of insulation within the wall is unknown. Interior walls are constructed of 8" masonry block. The windows throughout the facility are in good condition and appear to be maintained. Typical windows throughout the facility are double pane, ¼" clear glass with vinyl frames. Blinds are utilized through the facility for occupant comfort. The blinds are valuable because they help to reduce heat loss in the winter and reduce solar heat in the summer. The amount of insulation below the roofing is unknown. The building was built in 1994-1995 with no additions since the original construction.

HVAC Systems

The Public Works office administration area is served by a 1995 central VAV air handling unit made by Trane. A two-stage, gas-fired, duct heater provides heating. Cooling is achieved with a 15-Ton split air-cooled condensing unit behind the building on a pad. The system includes terminal variable air volume (VAV) boxes for office zoning. Local thermostats control each VAV box's airflow to regulate space temperature. Conditioned air is distributed to the administration office areas through ductwork to ceiling diffusers. Electric baseboard heaters are installed below each exterior window to assist the air handler in maintaining space heating setpoint. The entrance vestibule is heated via an electric ceiling cabinet heater.

The two-stage, gas-fired unit was replaced approximately two years ago and is in good condition, however the air handling portion of the system is not operating properly due to damper controls issues and communication between the unit and the VAV terminal controls. The 1995 Trane air handler has a bypass damper operation which maintains a minimum air velocity for the DX cooling and gas-fired heating by modulating two bypass air dampers. The air handling unit incorporates outside air intake, mixed air and relief air dampers. Currently the dampers have no motorized actuators and are manually adjusted to a set position. The system also incorporates two dampers which isolate the gas-fired heater during the summer months. These dampers are also operated manually. In addition, the VAV box controls are not communicating with the air handling unit preventing the correct operation of the entire system. Some of the existing VAV boxes do not respond to local thermostat control resulting in hot / cool areas throughout the offices.

The Mechanic Shops are heated and ventilated by three (3) 1995 Trane rooftop Make-up Air Units (MUA) which were not operating at the time of the site inspections. The Mechanic Office is heated/cooled by a 1995 heat pump with supplemental electric heat. The electrical room and restroom are heated by electrical baseboard units. The shop bays & vehicle storage are heated by gas-fired unit heaters interlocked with exhaust fans and gravity ventilators. The original units were only 80,000 BTUH output and larger units sized at 160,000 BTUH output have recently been installed in several of the shops. Single thermostats control the unit's operation and are located on interior walls. The weld shop is heated by gas-fired unit heaters rated at 80,000 BTUH output and also has an interlocked exhaust fan and gravity ventilator.

The Carpenter Shop, Lawnmower Shop and Warehouse are heated by 1995 Trane indoor, make-up air units with gas-fired heating. The units are interlocked to exhaust fans and gravity ventilators. In addition there are ten (10) infrared gas-fired heaters at overhead doors and the back wall of the shops. The warehouse office is heated and cooled by a 1995 heat pump with supplemental electric heat. The signage shop is heated by a Dayton 80,000 BTUH output gas-fired unit heater.

Most of the HVAC equipment is in fair to poor condition and is nearing the end of the equipment service life as outlined in Chapter 36 of the ASHRAE Handbook "HVAC Applications."

HVAC System Controls

The HVAC system in the Public Works administration area is currently being controlled by a 1995 Trane Varitrac™ Comfort Manager which is not working correctly. This control system was never completed or commissioned correctly and the software is obsolete. The system is fifteen years old and adjustments can only be made at the VAV room thermostats. There is no automatic changeover for the summer and winter modes to change the operation of the VAV terminal units from heating to cooling mode. The control of the VAV terminals is questionable and there is no night time setback programmed into the system. Consequently, the entire VAV system runs continuously at occupied temperature setpoints. The repair garages and workshops are controlled by manual wall thermostats or individual zone controls.

Domestic Hot Water

Domestic hot water for the Administration offices restrooms and showers is provided by an 80-gallon electric hot water heater. The domestic hot water piping insulation appears to be in good condition. Sinks and showers in the shops are feed by the domestic water heater in the Administration Section.

Lighting

Typical lighting throughout the facility is 1x4 and 2x4, 2-lamp, 32-Watt T-12 fixtures in the various shop offices; 250 Watt HPS Lo-Bay HID and T-12 fluorescent fixtures in the Carpentry Shop, Lawn Mower Shop, & Warehouse; T-12 fixtures in the Sign Shop; and 250-Watt MH and T-12 fluorescent fixtures in the Mechanic/Welding Shops. Exterior lighting is mostly 100- Watt, 250-Watt & 400-Watt HPS wall mounted fixtures. Only the exterior lighting on the Administration Offices section of the building are left on all night.

VI. MAJOR EQUIPMENT LIST

The equipment list contains major energy consuming equipment that through implementation of 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: Super T8 Lighting Upgrades

Description:

The large majority of office/task lighting at this facility is T-12 fluorescent lamps and magnetic ballasts. Improved fluorescent lamps and ballasts are available as direct replacements for the existing lamps and ballasts. A simple retrofit of the existing fixture can provide substantial savings. For example, a conventional drop-ceiling lay in fixture with four, 4-foot lamps (34-Watt lamps with magnetic ballast) has a total wattage of 144 Watts per fixture. A lighting fixture retrofit with high efficiency ballasts and T-8 lamps can improve lighting efficiency by approximately 25% over the existing T-12 fixtures. When looking for equivalent light output, T-8 lamps can be combined with low-power electronic ballasts to provide equal lumen levels at reduced input wattages. A T-8 lamp and low-power electronic ballast retrofit for a fixture with 3-lamps, has a total wattage of 86 Watts.

This ECM includes retrofitting each of the existing T-12 fluorescent lamp and magnetic ballast fixtures with F32T8 lamps and high-power electronic ballasts. High efficiency electronic ballasts reduce overall wattage while maintaining the existing lumen levels of the offices and shops. The average hours of operation for this facility are 2,600 hours per year. The replacement lamps are based on General Electric 32W lamps and the replacement ballast is GE-432-MAX-N/Ultra Instant Start Low Power Ballast or equivalent.

Energy Savings Calculations:

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed energy savings calculation for the replacement of the T-12 system to a high-efficiency T-8 system.

From the **NJ Smart Start Appendix**, the retrofit of an existing 34-Watt T-12 lamps/magnetic ballasts with F32T8 lamps/reduced-power electronic ballasts warrants a $15 incentive per fixture.

Energy Savings Summary:

ECM #1 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$6,000
NJ Smart Start Equipment Incentive ($):	$840
Net Installation Cost ($):	$5,160
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$646
Total Yearly Savings ($/Yr):	$646
Estimated ECM Lifetime (Yr):	15
Simple Payback	8.0
Simple Lifetime ROI	87.8%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$9,688
Internal Rate of Return (IRR)	9%
Net Present Value (NPV)	$2,550.35

ECM #2: Lo-Bay Lighting Upgrades

Description:

For indoor spaces with high ceilings, the Illuminating Engineering Society of North America (IESNA) categorizes spaces as either hi-bay (>25 ft.) or lo-bay (< 25 ft.). Most of the shops are lit by either lo-bay metal-halide or high pressure sodium systems. These conventional lo-bay fixtures have poor lumen maintenance, color shifts, noisy ballasts, and require up to 10 minutes to re-strike the lamps after shutdown. The new generation of lo-bay fixtures use Super T-8 lamps with electronic ballasts. Compared to metal-halide or high pressure sodium systems, T8s offer better lighting quality due to a higher color-rendering index, better light distribution, and lumen maintenance. The metal halide and high pressure sodium systems have a steep lumen depreciation rate – a 25% to 35% reduction in lighting output at 40% of the rated lamp life. The lumen depreciation becomes even greater as the lamp approaches the end of its life with losses of 60% being quite common. The Super T-8 lamp will only lose about 5% of its initial lumens.

The table below compares the performance of a Super T8 system with two of the existing types of lo-bay HID lighting fixtures in this facility.

Lamp Data	Super T8 (6-lamps)	250 Watt MH	250 Watt HPS
Lamp Lumens (initial)	21,950	23,000	28,000
Rated Life (hours)	20,000	10,000	20,000
Color Rendering Index (CRI)	82	70	21
Mean Lumens	20,850	17,000	20,500
Lumen Maintenance (40% life)	93%	74%	75%
Re-strike Time Requirement	None	10 min	10 min
System Data			
Number of Lamps	6	1	1
Ballast Factor (BF)	1.18	0.94	0.91
Initial System Lumens	21,950	21,620	26,100
Nominal System Watts	168	289	300
Mean System Lumens	20,850	15,980	20,500
Lumens per Watt	85	75	80
Mean Lumens per Watt	79	55	64

The table above shows that the T8 6-lamp system produces initial lumens (85 lumens per watt) and mean lumens (79 lumens per watt) which are 46% more efficient than the 250-Watt Metal Halide and 31% more efficient than the 250-Watt High Pressure Sodium.

This ECM would replace all Metal Halide (MH) and High Pressure Sodium (HPS) Lo-Bay fixtures with a system consisting of six 3,100-lumen Super T8 lamps operating on 1.18 BF ballasts producing 21,950 initial lumens.

The basis of calculation is the GE-132-MAX-L/Ultra Instant Start Low Power system with 168 input watts or equal.

Energy Savings Calculations:

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed energy savings calculation for the replacement of the MH and HPS systems with the T-8 systems.

From the **NJ Smart Start Appendix**, the replacement of a 250-Watt HID fixture with T-8 fixture warrants a $50 incentive per fixture.

Energy Savings Summary:

ECM #2 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$18,920
NJ Smart Start Equipment Incentive ($):	$4,300
Net Installation Cost ($):	$14,620
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$3,554
Total Yearly Savings ($/Yr):	$3,554
Estimated ECM Lifetime (Yr):	15
Simple Payback	4.1
Simple Lifetime ROI	264.7%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$53,314
Internal Rate of Return (IRR)	23%
Net Present Value (NPV)	$27,810.64

ECM #3: LED Exit Signs

Description:

Some of the existing exit signs are lit by two (2) 7-Watt CFL lamps with a total fixture input of 16 Watts. These exit signs should be replaced with more energy efficient LED units. LED is an acronym for light-emitting-diode. LED's are small light sources that are readily associated with electronic equipment. LED exit signs have been manufactured in a variety of shapes and sizes. The benefits of LED technology are substantial. LED exit signs will last for 20-30 years without maintenance. This results in tremendous maintenance savings considering that the compact fluorescent lamps in the existing fixtures need to be replaced at a rate of 1-2 times per year. Lamp costs ($5 each) and labor costs ($12 per lamp) add up rapidly. Additionally, a LED exit sign total fixture input is only 5 Watts.

This ECM will replace the thirteen (13) existing exit signs with new LED exit fixtures. The basis of calculation is the Progress Lighting PE001 LED Exit Sign or equal. The included battery provides 1-1/2 hours of emergency power. The maintenance savings for this ECM are as follows: 26 lamps x $5/lamp + 13 units x $12/ unit for labor = $286.

Energy Savings Calculations:

Refer to the **Investment Grade Lighting Audit Appendix** for a detailed energy savings calculation for the replacement of the existing CFL exit signs with LED units.

From the **NJ Smart Start Appendix**, the replacement of an existing exit sign fixture with a new LED fixture warrants a $20 incentive per fixture.

Energy Savings Summary:

ECM #3 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$845
NJ Smart Start Equipment Incentive ($):	$260
Net Installation Cost ($):	$585
Maintenance Savings ($/Yr):	$286
Energy Savings ($/Yr):	$195
Total Yearly Savings ($/Yr):	$481
Estimated ECM Lifetime (Yr):	15
Simple Payback	1.2
Simple Lifetime ROI	1134.4%
Simple Lifetime Maintenance Savings	$4,290
Simple Lifetime Savings	$7,221
Internal Rate of Return (IRR)	82%
Net Present Value (NPV)	$5,162.16

ECM #4: Occupancy Sensors

Description:

A common occurrence in many facilities is lighting fixtures being left on unnecessarily. There has been a belief that it is better to keep the lights on rather than to continuously switch them on and off. The on/off dilemma was studied and it was determined that the best option is to turn the lights off whenever possible. Although this practice reduces the lamp life, the energy savings far outweigh the lamp replacement costs. To better control lighting according to occupancy and reduce lighting energy consumption, CEG recommends installing occupancy sensors. Private offices, file rooms, conference rooms, etc. are good candidates for wall-mounted or ceiling mounted occupancy sensors. Dual technology sensors (ultrasonic and infrared) detect human motion and presence to ensure proper activation of lights. The basis of calculation is the SensorSwitch Model WSD wall switch or equivalent.

Energy Savings Calculations:

To determine an estimated savings for lighting controls, CEG used ASHRAE 90.1-2004 (NJ Energy Code). Appendix G states that occupancy sensors have a 10% power adjustment factor for daytime occupancies for buildings over 5,000 SF. CEG recommends the installation of dual technology occupancy sensors in all private offices, conference rooms, small-sized mechanical rooms, storage rooms, data rooms, file rooms, etc. This energy conservation measure can be applied to sixteen (16) rooms throughout the facility which amounts to approximately 7,000 square feet of space. From the lighting survey for this site, CEG calculated the lighting power density (Watts/ft^2) of the existing facility to be 2.37 Watts/SF. Ten percent of this value is the resultant energy savings due to installation of the occupancy sensors:

10% x 2.37 Watts/SF x 7,000 SF x 2,800 hrs/yr. = 4,645kWh/year

Annual Energy Savings = 4,645 kWh/yr. x $0.156/kWh = $724 / yr

The installed cost of each type of occupancy sensor including rewiring, relays, J-Boxes, sensors, power packs, on/off photocells, inhibit photocells, etc. is as follows:

Wall Switches	$160/Unit x 8 Units = $ 1,280
Ceiling Mounted Sensors	$240/Unit x 8 Units = $ 1,920
	TOTAL COST = $ 3,200

From the **NJ Smart Start Appendix**, the installation of Occupancy Sensor Remote Mounted (OSR) lighting controls warrants a $35 incentive per control. Sixteen (16) sensors x $35/sensor = $560.

Energy Savings Summary:

ECM #4 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$3,200
NJ Smart Start Equipment Incentive ($):	$560
Net Installation Cost ($):	$2,640
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$724
Total Yearly Savings ($/Yr):	$724
Estimated ECM Lifetime (Yr):	15
Simple Payback	3.6
Simple Lifetime ROI	311.4%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$10,860
Internal Rate of Return (IRR)	27%
Net Present Value (NPV)	$6,003.07

ECM #5: New Split AHU System for Administration Offices

Description:

The air handling system for the administration areas is not operating properly due to non-operating damper controls and other issues. The air handler has a bypass damper operation which maintains a minimum air velocity for the DX cooling and gas-fired heating by modulating two bypass air dampers. The air handling unit incorporates outside air intake, mixed air and relief air dampers. Currently the dampers have no motorized actuators and are wired to a set position. The system also incorporates two dampers which isolate the gas-fired heater during the summer months. These dampers are also operated manually. The unit runs continuously due to the VAV box controls not communicating with the air handling unit preventing the correct operation of the entire system. In addition, the outdoor, air-cooled, condensing unit is inefficient.

This ECM would install a new 15-Ton split air handling unit, new 15-Ton air-cooled condensing unit, variable speed drive on the supply air fan, and new AHU controller. This ECM would replace the existing 15-Ton split air handling unit with a high-efficiency Trane Model TTA180 or equal with an efficiency of EER=12.9. Included in this replacement is an air-cooled condensing unit, a variable speed drive on the supply air fan, and a new AHU controller.

Energy Savings Calculations:

Cooling Season Full Load Cooling Hrs.	= 1,800 hrs/yr.
Average Cost of Electricity	= $0.156/kWh
Total Rated Cooling Capacity	= 15 Tons
Existing System Efficiency	= 9.0 EER
Proposed Efficiency	= 12.9 EER

Cooling Savings Calculation:

$$EnergySavings = \frac{Cooling(Tons)\times 12{,}000\left(\frac{Btu}{Ton\ hr}\right)}{1000\left(\frac{Wh}{kWh}\right)}\times\left(\frac{1}{EER_{OLD}}-\frac{1}{EER_{NEW}}\right)\times Full\ Load\ Hrs.$$

$$EnergySavings = \frac{15\,(Tons)\times 12{,}000\left(\frac{Btu}{Ton\ hr}\right)}{1000\left(\frac{Wh}{kWh}\right)}\times\left(\frac{1}{9\left(\frac{Btu}{W}\right)}-\frac{1}{12.9\left(\frac{Btu}{W}\right)}\right)\times 1{,}800\ hours$$

$$= 10{,}883\,kWh$$

$$Cooling\ Cost\ Savings = 10{,}883\ (kWh) \times 0.156 \left(\frac{\$}{kWh} \right) = \$1{,}697$$

Installation cost for a complete 15-Ton split DX air handling system is estimated at $49,125.

From the **NJ Smart Start Appendix**, the installation of a high efficiency split system warrants an incentive of 15 Tons x $79/Ton = $1,185

Energy Savings Summary:

ECM #5 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$49,125
NJ Smart Start Equipment Incentive ($):	$1,185
Net Installation Cost ($):	$47,940
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$1,697
Total Yearly Savings ($/Yr):	$1,697
Estimated ECM Lifetime (Yr):	15
Simple Payback	28.2
Simple Lifetime ROI	-46.9%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$25,455
Internal Rate of Return (IRR)	-7%
Net Present Value (NPV)	($27,681.32)

ECM #6: HVAC Controls Upgrade for Administration Offices

Description:

The HVAC system in the Public Works administration area is currently being controlled by a Trane Varitrac™ Comfort Manager which is not working correctly. This control system was never completed or commissioned correctly and the software is obsolete. The system is fifteen years old and adjustments can only be made at the VAV room thermostats. There is no automatic changeover for the summer and winter modes to change the operation of the VAV terminal units from heating to cooling mode. The control of the VAV terminals is questionable and there is no night time setback programmed into the system. Consequently, the entire VAV system runs continuously at occupied temperature setpoints.

This ECM would install an open protocol system to take full control of the air handling unit and VAV terminal operation for automatic occupied, unoccupied and unoccupied override modes for each zone and for the air handler. Each VAV terminal would have a new controller and room sensor with local setpoint control and unoccupied mode capability. These new controls would include a graphics interface with programming for the various modes and automatic summer/winter changeover. Motorized damper actuators need to be installed at each damper, ductwork modifications are needed, and power wiring to each actuator installed. The total installed cost for this system including damper actuators, controls, ductwork modifications, electrical work, programming, etc. is estimated to be $75,000 (budget costs obtained from controls and mechanical contractors).

Energy Savings Calculations:

The energy savings resulting from this ECM are substantiated through a more efficient system operation and not running the VAV system continuously in occupied mode by incorporating night time setback. Heating and cooling systems that are not set back during hours of un-occupancy can be controlled to optimize their energy use. Keeping space temperature lower in the heating season and higher during the cooling season when the space is unoccupied along with shutting off the air conditioning when the building is not in use can save a significant amount of energy. The unoccupied temperature setbacks would be 60°F in the winter and 85°F in the summer.

A. <u>Energy savings due to more efficient control system</u>

Studies have shown that the installation of an updated, more efficient HVAC control system could save an estimated 5-15% of the energy costs for this portion of the facility. The annual energy costs for the Administration Offices is estimated to be 20% of the total facility annual electric costs and 20% of the annual gas costs = 0.2 x $51,127 + 0.2 x $35,828 = $17,391. Assuming a conservative 10% savings,

Annual Savings Due to New DDC System = 10% x $17,391 = $1,739

B. Energy savings from night time setback

Heating Savings Calculation:

Energy Used for Heating = 4,369 Therms = 436.9 MMBTU
Heating Degree Days = 4,806 HDD (Atlantic City Airport 5-Year Average)
Total Heating Setback Days = 45 days per year
Heating Setback Temp Diff = 74°F - 60°F = 14°F

Annual Energy Savings = [(Energy Used for Heating/Heating Degree Days) x (Total Heating Setback Days) x (Heating Setback Temperature Difference)] / Heating Efficiency

= [(436.9 MMBTU/4,806 °F-days/yr) x 45 days/year x 14°F] / 80%

= 71.6 MMBTU x $16.40/MMBTU = $1,174

Cooling Savings Calculation:

Energy Used for Cooling = 65,547 kWh = 223.6 MMBTU
Cooling Degree Days = 1,354 CDD (Atlantic City Airport 5-Year Average)
Total Cooling Setback Days = 45 days per year
Cooling Setback Temp Diff = 85°F - 70°F = 15°F

Annual Energy Savings = [(Energy Used for Cooling/Cooling Degree Days) x (Total Cooling Setback Days) x (Cooling Setback Temperature Difference)]

= [(223.6 MMBTU/1,354 °F-days/yr) x 45 days/year x 15°F]

= 111.5 MMBTU x 293.1 kWh/MMBTU = 32,672 kWh

= 32,672 kWh x $0.156/kWh = $5,096

Total Savings due to Temperature Setback = $1,174 + $5,096 = $6,270

Total Savings for this ECM = $6,270 + $1,739 = $8,009

Energy Savings Summary:

ECM #6 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$75,000
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$75,000
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$8,009
Total Yearly Savings ($/Yr):	$8,009
Estimated ECM Lifetime (Yr):	15
Simple Payback	9.4
Simple Lifetime ROI	60.2%
Simple Lifetime Maintenance Savings	0
Simple Lifetime Savings	$120,135
Internal Rate of Return (IRR)	7%
Net Present Value (NPV)	$20,610.92

ECM #7: Install Programmable Thermostats in the Shops

Description:

The various shops are heated by multiple gas fired unit heaters. The thermostats controlling the unit heaters are standard non programmable thermostats. The thermostats are set manually for the winter and are not re-adjusted throughout the day. The heat loss of the facility is compounded during the unoccupied periods due to increased wind speeds, lower ambient temperatures, etc.

Programmable thermostats provide automatic control of the space temperature during occupied and unoccupied periods of the day. When the space is not occupied the equipment can operate at the unoccupied set point. Once the space becomes occupied the thermostat raises the temperature of the space to the occupied set point. This control system approach is ideal for facilities with low occupancy levels and long unoccupied periods. New programmable have built in capability to adjust heating start times to ensure the space is up to temperature by the specified occupancy period. This is an added comfort feature so programming does not need to be re-adjusted as the season heating load changes.

This ECM includes replacement of the various unit heater thermostats with programmable 7-day thermostats with night time setback control. The recommended thermostat set points for heating in the DPW various shops is as follows:

Occupied Heating = 70° F (6:30AM – 3:30 PM)

Unoccupied Heating = 55° F (3:30 PM – 6:30 AM)

CEG recommends replacement of each gas-fired unit heater's dedicated thermostat in the service garages/shops. The total quantity of thermostats is as shown below. This ECM is based on the Honeywell RTH7500D 7-day programmable thermostats or equivalent.

Mechanic Shop Bays -	2 T-Stats
Carpenter Shop Bays -	2 T-Stats
Sign Shop -	1 T-Stat
Weld Shop-	3 T-Stats
Total	8 T-Stats

Energy Savings Calculations:

The energy savings of the 7-day programmable thermostats was calculated by using Energy Star Life Cycle Cost Estimate software for qualified programmable thermostats. Additional information on the referenced calculator can be found at www.energystar.gov or refer to the **Programmable Thermostats Calculator Appendix** for a detailed energy savings calculation for the replacement of the thermostats in the facility.

Energy Savings Summary:

ECM #7 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$2,880
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$2,880
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$9,286
Total Yearly Savings ($/Yr):	$9,286
Estimated ECM Lifetime (Yr):	15
Simple Payback	0.3
Simple Lifetime ROI	4736.5%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$139,290
Internal Rate of Return (IRR)	322%
Net Present Value (NPV)	$107,975.67

ECM #8: Water Conservation Opportunities

Description:

Water conservation is defined as any action that reduces the amount of water withdrawn from water supply sources, reduces consumptive use, reduces the loss or waste of water, improves the efficiency of water use, increases recycling and reuse of water, or prevents the pollution of water. Conversely, water waste is the excessive use of potable water that is unproductive or does not reasonably sustain economic benefits or life forms, particularly where there is a shortage of potable water.

A conventional showerhead is rated to use 3 to 5 gallons per minute at normal water pressure, about 60 psi. A 5-minute shower with a conventional showerhead typically consumes 15 to 25 gallons of water. High quality replacement showerheads that deliver 1 to 2.5 gallons per minute can save many gallons per shower. Products vary in price from $10 to $50.

Faucets for restrooms, kitchen, and workroom sinks vary in flow rates. Restroom sinks need no more than 1.5 gallons per minute and kitchen sinks need about 2.5 gallons per minute while workroom sinks may include automated controls and pre-mixed temperatures. Toilets and urinals account for almost half of a typical building's water consumption. According to the Plumbing Foundation, replacing all existing toilets with 1.6 gallons per flush, ultra-low flow models and urinals with 1.0 gallons per flush models would save almost 5,000 gallons of water per person each year.

Toilets and urinals can be retrofitted with electronic controls. Potential water savings are greater with retrofits because current fixtures generally do not meet the latest water conservation standards. Electronic controls for plumbing fixtures usually function by transmitting a continuous beam of infrared (IR) light. With toilets and urinals, the flush is actuated when the user moves away and the IR beam is no longer blocked. With toilets and urinals, some of the water savings may be attributable to reduced incidence of intentional multiple-flushing – a common practice with toilets and urinals.

This ECM would only install low flow high performance sink aerators. The other ECMs discussed above were investigated but the payback periods were longer than 10 years and therefore would not benefit the Owner.

Water Savings Calculations:

The water savings for the faucets, showerheads and urinals were calculated by using the U. S. Department of Energy Federal Energy Management Program (FEMP) energy cost calculators for faucets, showerheads and urinals. Additional information on the referenced calculators can be found at www1.eere.energy.gov/femp/technologies. The toilet water savings were calculated using the Sloan water savings calculator. Water and sewer rates obtained from the borough are as follows:

Water: $2.051/1,000 gallons + **Sewer**: $3.351/1,000 gallons = **Total**: $5.40/1,000 gallons

Summary of these water savings for the Public Works Facility are as follows:

Plumbing Fixture	# of Units	Water Cost Savings	Installed Cost	Payback(Yrs.)
Faucet	5	$109	$152	1.38
Urinal	2	$52	$420	8.0
Toilet	6	$69	$1,260	18
	Totals:	$230	$1,832	9.12 Avg.

The basis of calculation for the low flow high performance sink aerator is the UtilitySavers™ high performance Spray Stream.

Energy Savings Summary:

ECM #8 - ENERGY SAVINGS SUMMARY	
Installation Cost ($):	$1,600
NJ Smart Start Equipment Incentive ($):	$0
Net Installation Cost ($):	$1,600
Maintenance Savings ($/Yr):	$0
Energy Savings ($/Yr):	$161
Total Yearly Savings ($/Yr):	$161
Estimated ECM Lifetime (Yr):	10
Simple Payback	9.9
Simple Lifetime ROI	0.6%
Simple Lifetime Maintenance Savings	$0
Simple Lifetime Savings	$1,610
Internal Rate of Return (IRR)	0%
Net Present Value (NPV)	($226.64)

* ECM Calculations encompass savings for all plumbing fixtures but CEG recommends the implementation of high performance sink aerators and urinals **only**. This is because the faucet and urinal replacements have low payback periods of 1.38 and 8 years, respectively. The payback period for the other plumbing fixtures exceed 10 years when implemented on a singular basis making them unfavorable choices for replacement.

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 1,600 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 22.54 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 27,536 KWh annually, reducing the overall utility bill by approximately 8.4% 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 Borough paying for 100% of the total project cost upfront. The financial 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	14.56 Years	8.9%	5.3%

*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 Borough to invest in a solar system through a Direct Purchase, CEG does not recommend the Borough pursue this route. It would be more advantageous for the Borough 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 the Solar Arrays to the Borough 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 6.99 meters per second, it is sufficient enough to reach the cut in speed for most commercial sized wind turbines of 3.5 meters per second. Through the use of ground mounted Skystream 3.7, the Public Works Facility would be able to produce approximately 6,184 kWh for just one turbine. Although the power generation from one turbine is acceptable, the turbine itself is not cost effective, being priced at around $40,000 installed for just one turbine. Based on our calculations the following is the payback period:

Table 8
Financial Summary – Wind Turbine System

REM #2 - WINDTURBINES	
Installation Cost ($):	$40,000
NJ Smart Start Equipment Incentive ($):	$21,845
Net Installation Cost ($):	$18,155
REC Revenue ($/Yr):	$171
Energy Savings ($/Yr):	$920
Total Yearly Savings ($/Yr):	$1,090
Estimated ECM Lifetime (Yr):	15
Simple Payback	36.69
Lifetime Energy Savings	$16,353

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 is fairly consistent throughout the year for this facility. Due to the various activities that occur at the Public Works facility that require the use of electric the load stays steady. This makes the Public Works an advantageous user when it comes to procuring a Third Party Supplier (TPS) to provide the commodity end of the electric service.

Natural Gas:

The Natural Gas Usage Profile demonstrates a very typical heating load profile, with increasing consumption in the winter months (October – April) and a dramatic drop in consumption in the summer months (May – September). The main heating equipment throughout the various parts of the Public Works facility consists primarily of gas-fired equipment hence the noted profile.

Tariff Analysis:

Electricity:

This facility receives electrical Delivery Service from Atlantic City Electric on an AGS Secondary (Annual General Service) utility rate. The AGS rate is available at any point of Company's system where facilities of adequate character and capacity exist for the entire electric service requirements of any customer contracting for annual service delivered at one point and metered at or compensated to the voltage of delivery. This delivery service includes the following charges: Delivery Service Charges, Distribution Demand Charges, Reactive Demand Charges, Distribution Rates, Non-Utility Generation Charges, Societal Benefits Charges, Regulatory Assets Recovery Charges, Transition Bond Charges, Market Transition Charge Tax, Transmission Demand Charge, Regional Greenhouse Gas Initiative Recovery Charge, and Infrastructure Investment Surcharge.

Natural Gas:

This facility has natural gas serviced by South Jersey Gas Company (SJG) on its firm delivery rate, General Service Gas (GSG) from the utility and BGSS (Basic Generation Supply Service) commodity when not being served by a Third Party Supplier (TPS). This Delivery Rate has the following charges: Customer Charge, Delivery Charge, BSC Volume Charge and Commodity Charge under this rate structure. The BGSS Supply rates are designed to recover SJG's cost of gas applicable to customers who purchase gas from SJG. The company earns no profit from BGSS. BGSS consists of two (2) pricing mechanisms: Residential and Commercial customers that use less than 5,000 therms annually and Commercial and Industrial customers that consume at least 5,000 therms annually.

Imbalances occur when Third Party Suppliers (TPS) are used to supply natural gas and full-delivery is not made, and when a new supplier is contracted or the customer returns to the utility. Note: It is important when utilizing a Third Party Supplier, that an experienced regional supplier is used otherwise, imbalances can occur, jeopardizing economics and scheduling. If the supplier does not deliver they can be placed on a very costly rate. A customer can automatically be put on an alternative supply rate by the utility.

A "firm account" refers to the type of interstate pipeline service that the utility has subscribed for and delivered on behalf of the customer. Much like the telecom industry, the pipeline space (capacity) has been deregulated. The pipeline capacity is broken down into reliability of service. "Firm service" is the highest level of reliability and is the last, in pecking order, for interruption.

Recommendations:

CEG recommends a global approach that will be consistent with the facilities operated by the Borough of Avalon with their own electrical and natural gas service. This applies to the Community Center, Public Safety Building and the Public Works facilities as included within the scope of this project. The basic recommendation is to aggregate all energy loads of the facilities with single services (electric and natural gas) and procure energy for the commodity side of these utilities utilizing a "managed approach" through an energy procurement specialist. CEG's observations are seen in both the electric and natural gas costs for the noted facilities. The average "price to compare" per kWh (kilowatt hour) for all buildings is $.152 / kWh (kWh is the common unit of electric measure). The average "price to compare" per deca-therm for natural gas is $16.28 /dth (dth is the common unit of measure). These Weighted Average Prices are as supplied via current Borough of Avalon utility suppliers.

Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. The Borough of Avalon could see significant savings if it were to take advantage of these current market prices quickly, before energy increases. Based on the study period's historical consumption and current electric rates, the BOE could see an improvement of up to 15 % or up to $9,903 in its electric costs annually. (Note: Savings were calculated using an Average Annual Consumption of 622,360 kWh and an Average fixed one-year commodity contract). CEG recommends aggregating the entire electric load to gain the most

optimal energy costs. CEG recommends that the Borough of Avalon seek an energy advisor to maximize energy savings and to apply a "managed approach" to procuring energy.

CEG's secondary recommendation coincides with the Borough of Avalon's natural gas costs. Based on the current market, (which is very competitive), the Borough of Avalon could see a savings of over 20% or up to $7,142 annually in its natural gas expenditures. Again, CEG recommends the use of any energy advisor to review alternative energy sourcing strategies and to install a "managed approach" to energy procurement.

CEG also recommends that the Borough of Avalon review their current energy purchasing strategies in order to create a future plan for purchasing. This plan should utilize, as noted above, a "managed approach." The "managed approach" will take into account creating an "energy budget" that is in line with the Borough of Avalon's budget year and risk tolerance. Risk tolerance is the appetite that a customer has for risk. Based on the reduced state and local government budgets and the general aversion for risk, the local government is required to manage this risk. The Borough of Avalon should utilize a consultant familiar with energy purchasing and contracts to ensure "best practice" is utilized when joining into a fixed term pricing contract for commodity. Typical contracts last for one to two years and are a fixed-term commitment.

Finally, CEG recommends the Borough of Avalon schedule a meeting with their current utility providers to review their utility charges and current tariff structures for electricity and natural gas. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local Distribution Company (LDC), they will learn more about the competitive supply process. They can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at www.nj.gov/bpu, and should also consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the data to manage ongoing demand-side management projects. Furthermore, CEG recommends special attention is given to credit mechanisms, imbalances, balancing charges and commodity charges when meeting with their utility representative. In addition, the Borough of Avalon should also ask the utility representative about alternative billing options. Some utilities allow for consolidated billing options when utilizing the service of a Third Party Supplier. It is pertinent to note, that if the Borough of Avalon decides to enter into a commodity contract and frequently changes its suppliers, balancing of the current account should be closely monitored so that overages do not appear when the contract is close to termination.

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 par 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 that were audited as part of the NJ Clean Energy's Local Government Energy Audit Program. 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 shown 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%.

v. *Direct Install Program* – The New Jersey Clean Energy's Direct Install Program is a state funded program that targets small commercial and industrial facilities with peak demand of less than 200 kW. This turnkey program is aimed at providing owners a seamless, comprehensive process for analysis, equipment replacement and financial incentives to reduce consumption, lower utility costs and improve profitability. The program covers up to 80% of the cost for eligible upgrades including lighting, lighting controls, refrigeration, HVAC, motors, variable speed drives, natural gas and food service. Participating contractors (refer to www.njcleanenergy.com) conduct energy assessments in addition to your standard local government energy audit and install the cost-effective measures.

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 condenser and evaporator 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.

E. Confirm that outside air economizers on the rooftop units are functioning properly to take advantage of free cooling and avoid excess outside air during occupied periods.

F. Identify water conservation opportunities including drips, leaks, and unnecessary flows in restrooms, kitchen/lounge, showers, etc.

ECM COST & SAVINGS BREAKDOWN

CONCORD ENGINEERING GROUP

Borough of Avalon - Public Works Facility

ECM NO.	DESCRIPTION	INSTALLATION COST				YEARLY SAVINGS			ECM LIFETIME	LIFETIME ENERGY SAVINGS	LIFETIME MAINTENANCE SAVINGS	LIFETIME ROI	SIMPLE PAYBACK	INTERNAL RATE OF RETURN (IRR)	NET PRESENT VALUE (NPV)
		MATERIAL	LABOR	REBATES, INCENTIVES	NET INSTALLATION COST	ENERGY	MAINT. / SREC	TOTAL		(Yearly Saving * ECM Lifetime)	(Yearly Maint Svaing * 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)	($/Yr)	(Yr)	($)	($)	(%)	(Yr)	($)	($)
ECM #1	Super T8 Lighting Upgrade	$6,000	$0	$840	$5,160	$646	$0	$646	15	$9,688	$0	87.8%	8.0	9.15%	$2,550.35
ECM #2	Low-Bay Lighting Upgrades	$18,920	$0	$4,300	$14,620	$3,554	$0	$3,554	15	$53,314	$0	264.7%	4.1	23.25%	$27,810.64
ECM #3	LED Exit Signs	$845	$0	$260	$585	$195	$286	$481	15	$7,221	$4,290	1134.4%	1.2	82.28%	$5,162.16
ECM #4	Occupancy Sensors	$3,200	$0	$560	$2,640	$724	$0	$724	15	$10,860	$0	311.4%	3.6	26.63%	$6,003.07
ECM #5	New Split AHU System for Administration Offices	$49,125	$0	$1,185	$47,940	$1,697	$0	$1,697	15	$25,455	$0	-46.9%	28.2	-7.04%	($27,681.32)
ECM #6	Upgrade to DDC System	$75,000	$0	$0	$75,000	$8,009	$0	$8,009	15	$120,135	$0	60.2%	9.4	6.56%	$20,610.92
ECM #7	Install Programmable Thermostats in Shops	$2,880	$0	$0	$2,880	$9,286	$0	$9,286	15	$139,290	$0	4736.5%	0.3	322.43%	$107,975.67
ECM #8	Water Conservation Opportunities	$1,600	$0	$0	$1,600	$161	$0	$161	10	$1,610	$0	0.6%	9.9	0.11%	($226.64)
REM RENEWABLE ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY															
REM #1	22.54 KW PV System	$202,860	$0	$0	$202,860	$4,296	$9,638	$13,934	25	$348,350	$240,950	71.7%	14.6	4.68%	$39,774.80
REM #2	2.4 kW Ground Mounted Wind System	$40,000	$0	$21,845	$18,155	$920	$171	$1,091	15	$16,365	$2,565	-9.9%	16.6	-1.27%	($5,130.71)

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.

520 BURNT MILL ROAD
VOORHEES, NEW JERSEY 08043
PHONE: (856) 427-0200
FAX: (856) 427-6508

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 ≥ 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

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

Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	$15 per fixture (1-4 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

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%

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
Public Works Facility

Building ID: 2224029
For 12-month Period Ending: December 31, 2009[1]
Date SEP becomes ineligible: N/A
Date SEP Generated: April 07, 2010

Facility
Public Works Facility
1400 Dune Drive
15th street and Dune Drive
avalon, NJ 08202

Facility Owner
Borough of Avalon
3100 Dune Drive
Avalon, NJ 08202

Primary Contact for this Facility
Jeffrey Hesley
3100 Dune Drive
Avalon, NJ 08202

Year Built: 1994
Gross Floor Area (ft²): 18,200

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

Site Energy Use Summary[3]

Electricity - Grid Purchase(kBtu)	1,117,089
Natural Gas (kBtu)[4]	2,179,051
Total Energy (kBtu)	3,296,140

Energy Intensity[5]

Site (kBtu/ft²/yr)	181
Source (kBtu/ft²/yr)	330

Emissions (based on site energy use)

Greenhouse Gas Emissions ($MtCO_2e$/year)	286

Electric Distribution Utility
Pepco - Atlantic City Electric Co

National Average Comparison

National Average Site EUI	90
National Average Source EUI	189
% Difference from National Average Source EUI	75%
Building Type	Public Order and Safety

Stamp of Certifying Professional

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

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

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

Certifying Professional
Michael Fischette
520 South Burnt Mill Road
Voorhees, NJ 08043

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

ENERGY STAR® Data Checklist for Commercial Buildings

In order for a building to qualify for the ENERGY STAR, a Professional Engineer (PE) must validate the accuracy of the data underlying the building's energy performance rating. This checklist is designed to provide an at-a-glance summary of a property's physical and operating characteristics, as well as its total energy consumption, to assist the PE in double-checking the information that the building owner or operator has entered into Portfolio Manager.

Please complete and sign this checklist and include it with the stamped, signed Statement of Energy Performance.
NOTE: You must check each box to indicate that each value is correct, OR include a note.

CRITERION	VALUE AS ENTERED IN PORTFOLIO MANAGER	VERIFICATION QUESTIONS	NOTES	☑
Building Name	Public Works Facility	Is this the official building name to be displayed in the ENERGY STAR Registry of Labeled Buildings?		☐
Type	Public Order and Safety	Is this an accurate description of the space in question?		☐
Location	1400 Dune Drive,15th street and Dune Drive, avalon, NJ 08202	Is this address accurate and complete? Correct weather normalization requires an accurate zip code.		☐
Single Structure	Single Facility	Does this SEP represent a single structure? SEPs cannot be submitted for multiple-building campuses (with the exception of acute care or children's hospitals) nor can they be submitted as representing only a portion of a building		☐
Avalon Public Works (Other)				
CRITERION	**VALUE AS ENTERED IN PORTFOLIO MANAGER**	**VERIFICATION QUESTIONS**	**NOTES**	☑
Gross Floor Area	18,200 Sq. Ft.	Does this square footage include all supporting functions such as kitchens and break rooms used by staff, storage areas, administrative areas, elevators, stairwells, atria, vent shafts, etc. Also note that existing atriums should only include the base floor area that it occupies. Interstitial (plenum) space between floors should not be included in the total. Finally gross floor area is not the same as leasable space. Leasable space is a subset of gross floor area.		☐
Number of PCs	5(Optional)	Is this the number of personal computers in the space?		☐
Weekly operating hours	60Hours(Optional)	Is this the total number of hours per week that the space is 75% occupied? This number should exclude hours when the facility is occupied only by maintenance, security, or other support personnel. For facilities with a schedule that varies during the year, "operating hours/week" refers to the total weekly hours for the schedule most often followed.		☐
Workers on Main Shift	10(Optional)	Is this the number of employees present during the main shift? Note this is not the total number of employees or visitors who are in a building during an entire 24 hour period. For example, if there are two daily 8 hour shifts of 100 workers each, the Workers on Main Shift value is 100.		☐

ENERGY STAR® Data Checklist for Commercial Buildings

Energy Consumption

Power Generation Plant or Distribution Utility: Pepco - Atlantic City Electric Co

Fuel Type: Electricity

Meter: Electric (kWh (thousand Watt-hours))
Space(s): Entire Facility
Generation Method: Grid Purchase

Start Date	End Date	Energy Use (kWh (thousand Watt-hours))
12/01/2009	12/31/2009	32,440.00
11/01/2009	11/30/2009	23,240.00
10/01/2009	10/31/2009	23,560.00
09/01/2009	09/30/2009	24,040.00
08/01/2009	08/31/2009	33,000.00
07/01/2009	07/31/2009	30,000.00
06/01/2009	06/30/2009	22,920.00
05/01/2009	05/31/2009	21,040.00
04/01/2009	04/30/2009	26,040.00
03/01/2009	03/31/2009	29,200.00
02/01/2009	02/28/2009	31,240.00
01/01/2009	01/31/2009	30,680.00
Electric Consumption (kWh (thousand Watt-hours))		**327,400.00**
Electric Consumption (kBtu (thousand Btu))		**1,117,088.80**
Total Electricity (Grid Purchase) Consumption (kBtu (thousand Btu))		**1,117,088.80**
Is this the total Electricity (Grid Purchase) consumption at this building including all Electricity meters?		☐

Fuel Type: Natural Gas

Meter: Gas (therms)
Space(s): Entire Facility

Start Date	End Date	Energy Use (therms)
12/01/2009	12/31/2009	4,529.48
11/01/2009	11/30/2009	1,738.40
10/01/2009	10/31/2009	854.85
09/01/2009	09/30/2009	43.05
08/01/2009	08/31/2009	42.03
07/01/2009	07/31/2009	42.03
06/01/2009	06/30/2009	177.33
05/01/2009	05/31/2009	261.38
04/01/2009	04/30/2009	1,870.63
03/01/2009	03/31/2009	2,840.28

02/01/2009	02/28/2009	4,626.85
01/01/2009	01/31/2009	4,764.20
Gas Consumption (therms)		**21,790.51**
Gas Consumption (kBtu (thousand Btu))		**2,179,051.00**
Total Natural Gas Consumption (kBtu (thousand Btu))		**2,179,051.00**
Is this the total Natural Gas consumption at this building including all Natural Gas meters?		☐

Additional Fuels	
Do the fuel consumption totals shown above represent the total energy use of this building? Please confirm there are no additional fuels (district energy, generator fuel oil) used in this facility.	☐

On-Site Solar and Wind Energy	
Do the fuel consumption totals shown above include all on-site solar and/or wind power located at your facility? Please confirm that no on-site solar or wind installations have been omitted from this list. All on-site systems must be reported.	☐

Certifying Professional

(When applying for the ENERGY STAR, the Certifying Professional must be the same as the PE that signed and stamped the SEP.)

Name: _____ Date: _____

Signature: _____

Signature is required when applying for the ENERGY STAR.

FOR YOUR RECORDS ONLY. DO NOT SUBMIT TO EPA.

Please keep this Facility Summary for your own records; do not submit it to EPA. Only the Statement of Energy Performance (SEP), Data Checklist and Letter of Agreement need to be submitted to EPA when applying for the ENERGY STAR.

Facility
Public Works Facility
1400 Dune Drive
15th street and Dune Drive
avalon, NJ 08202

Facility Owner
Borough of Avalon
3100 Dune Drive
Avalon, NJ 08202

Primary Contact for this Facility
Jeffrey Hesley
3100 Dune Drive
Avalon, NJ 08202

General Information

Public Works Facility	
Gross Floor Area Excluding Parking: (ft^2)	18,200
Year Built	1994
For 12-month Evaluation Period Ending Date:	December 31, 2009

Facility Space Use Summary

Avalon Public Works	
Space Type	Other - Public Order and Safety
Gross Floor Area(ft^2)	18,200
Number of PCs[o]	5
Weekly operating hours[o]	60
Workers on Main Shift[o]	10

Energy Performance Comparison

	Evaluation Periods		Comparisons		
Performance Metrics	**Current** (Ending Date 12/31/2009)	**Baseline** (Ending Date 12/31/2009)	**Rating of 75**	**Target**	**National Average**
Energy Performance Rating	N/A	N/A	75	N/A	N/A
Energy Intensity					
Site (kBtu/ft^2)	181	181	0	N/A	90
Source (kBtu/ft^2)	330	330	0	N/A	189
Energy Cost					
$/year	$ 86,955.64	$ 86,955.64	N/A	N/A	$ 43,211.35
$/$ft^2$/year	$ 4.78	$ 4.78	N/A	N/A	$ 2.38
Greenhouse Gas Emissions					
$MtCO_2e$/year	286	286	0	N/A	142
$kgCO_2e/ft^2$/year	16	16	0	N/A	8

More than 50% of your building is defined as Public Order and Safety. This building is currently ineligible for a rating. Please note the National Average column represents the CBECS national average data for Public Order and Safety. This building uses X% less energy per square foot than the CBECS national average for Public Order and Safety.

Notes:
o - This attribute is optional.
d - A default value has been supplied by Portfolio Manager.

MAJOR EQUIPMENT LIST

Concord Engineering Group
PUBLIC WORKS FACILITY

Split Air Handling Unit			
Tag	**AC-1**	**ACC-1**	**DF-1**
Unit Type	Split AHU	Air-Cooled Condenser	In-Duct Heater
Qty	1	1	1
Location	Admin Offices	Outside on Pad	Admin Offices
Area Served	Admin Offices	Admin Offices	Admin Offices
Manufacturer	Trane	Trane	Trane
Model #	TWE180B4400BC	TTA180B400CA	GDND010AD
Cooling Capacity	180 MBH	180 MBH	N/A
Heating Capacity	N/A	N/A	80,000 BTUH
Approx. Efficiency	9 EER	9 EER	80%
S/A Fan	3 HP	N/A	2,460 CFM
Approx Age	15	15	3
Ashrae Service Life	20	20	15
Remaining Life	5	5	12
Comments	Runs Continuously		

MAJOR EQUIPMENT LIST

Concord Engineering Group
PUBLIC WORKS FACILITY

Gas-Fired Unit Heaters		
Unit Type	Ceiling Hung	Ceiling Hung
Qty	4	2
Location	Mech. Shop Bays & Carpenter Shop	Mech Shop Bays
Area Served	Mechanic Bays & Carpenter Shop	Shop Bays
Manufacturer	Modine	Trane
Model #	PD 200AA0111	GPND07ADC1000
BTUH INPUT	200,000	75,000
BTUH OUTPUT	160,000	60,750
Efficiency	80%	81%
Fuel	Natural Gas	Natural Gas
Electrical Power	115V, 1PH	115V, 1PH
Approx Age	3	15
Ashrae Service Life	15	15
Remaining Life	12	0
Comments		Not Operating

Gas-Fired Unit Heaters Continued		
Unit Type	Ceiling Hung	Ceiling Hung
Qty	5	1
Location	Weld Shop	Sign Shop
Area Served	Weld Shop	Sign Shop
Manufacturer	Reznor	Dayton
Model #	F-100-3	3E228D
BTUH INPUT	100,000	100,000
BTUH OUTPUT	80,000	80,000
Efficiency	80%	80%
Fuel	Natural Gas	Natural Gas
Electrical Power	115V, 1PH	115V, 1PH
Approx Age	15	15
Ashrae Service Life	15	15
Remaining Life	0	0
Comments		

MAJOR EQUIPMENT LIST

Concord Engineering Group
PUBLIC WORKS FACILITY

Domestic Hot Water Heaters		
Tag	**HWH-1**	
Unit Type	DHW Heater	DHW Heater
Qty	1	1
Location	Admin Offices	Corridor Closet
Area Served	Admin Office, RR, Lockers & Showers	Safety Building Restrooms and Kitchen
Manufacturer	A. O. Smith	Bradford White
Model #	DEN 80 102	
Serial #	MC95-0418600-102	
Size (Gallons)	80	
Input Capacity (MBH/KW)	10.0 kW total with 2 Elements @ 5 kW	
Fuel	Electric	Electric
Approx Age	15	1
Ashrae Service Life	13	13
Remaining Life	(2)	12
Comments		

MAJOR EQUIPMENT LIST

Concord Engineering Group
PUBLIC WORKS FACILITY

Make-Up Air Units Units

Tag	MUA-1, 3	MUA-2	MUA-1, 2	MUA-3
Unit Type	Rooftop	Rooftop	Ceiling Hung	Ceiling Hung
Qty	2	1	2	1
Location	Roof Over Mechanic Office	Roof Over Mechanic Office	Indoor Shop Bays	Indoor Shop Bays
Area Served	Mechanic Shop/Office	Mechanic Shop/Office	Warehouse, Lawnmower Shop	Carpenter Shop
Manufacturer	Trane	Trane	Trane	Trane
Model #	GRNC015CJC26A 1C	GRNC010CJC26A 1C	GFEA30GSJ	GFBA40GSJ
Serial #	A92107042 & A92107045	A9210044	GSBA30A0N6	GSBA80GEJA0N6
Fuel	Natural Gas	Natural Gas	Natural Gas	Natural Gas
Heating Input (BTUH)	150,000	100,000	300,000	400,000
Heating Output (BTUH)	115,500	72,000	240,000	320,000
Efficiency	77%	72%	80%	80%
Fan Power	0.5 HP	0.5 HP	1 HP	1 HP
Approx Age	15	15	15	15
Ashrae Service Life	20	20	20	20
Remaining Life	5	5	5	5
Comments	Not Operating	Not Operating		Not Operating

MAJOR EQUIPMENT LIST

Concord Engineering Group
PUBLIC WORKS FACILITY

Exhaust Fans			
Tag	**EF-1**	**EF-2,3**	**EF-4,5**
Unit Type	Centrifugal Exhauster	Centrifugal Exhauster	Centrifugal Exhauster
Qty	1	2	2
Location	Roof	Roof	Roof
Area Served	Weld Shop	Shop Bays	Shop Bays
Manufacturer	Penn Ventilator	Penn Ventilator	Penn Ventilator
Model #	CB-18	RB-30	LB-24
Fan HP	0.50	0.75	0.5
Fan CFM	3,150	5,115	3,325
Approx Age	15	15	15
Ashrae Service Life	25	25	25
Remaining Life	10	10	10
Comments			

Exhaust Fans Continued			
Tag	**EF-6,8 &9**	**EF-7**	**EF-11,12**
Unit Type	Centrifugal Exhauster	Centrifugal Exhauster	Fume Exhauster
Qty	3	1	2
Location	Roof	Roof	Roof
Area Served	Mechanic Shop	Mechanic Shop	Mechanic Shop
Manufacturer	Penn Ventilator	Penn Ventilator	Penn Ventilator
Model #	BB-531	BB 45	AT 24
Fan HP	0.33	0.33	5
Fan CFM	1,970	1,825	1200
Approx Age	15	15	15
Ashrae Service Life	20	20	20
Remaining Life	5	5	5
Comments			

Exhaust Fans Continued		
Tag	-	-
Unit Type	Upblast Roof Exhauster	Upblast Roof Exhauster
Qty	6	1
Location	Roof	Roof
Area Served	Carpenter, Lawn Care, Warehouse & Sign	Mechanic Shop
Manufacturer	Penn Ventilator	Penn Ventilator
Model #	FMX24B	FMX14QL
Fan HP	1	0.75
Fan CFM	1,226	1,585
Approx Age	15	15
Ashrae Service Life	20	20
Remaining Life	5	5
Comments		

Exhaust Fans Continued		
Tag	-	-
Unit Type	Upblast Roof Exhauster	Upblast Roof Exhauster
Qty	1	2
Location	Roof	Roof
Area Served	Carpenter Shop	Restrooms
Manufacturer	Penn Ventilator	Penn Ventilator
Model #	FMX30B	FMX11QL
Fan HP	2	0.33
Fan CFM	8,045	700
Approx Age	15	15
Ashrae Service Life	20	20
Remaining Life	5	5
Comments		

MAJOR EQUIPMENT LIST

Concord Engineering Group
PUBLIC WORKS FACILITY

Heat Pump		
Tag	**HP-1**	**HP-2**
Unit Type	Heat Pump	Heat Pump
Qty	1	1
Location	Mechanic Office	Warehouse
Area Served	Mechanic Office	Warehouse Office
Manufacturer	Trane	LG
Model #	?	LP090HED
Cooling Capacity	8.5	9.1
Heating Capacity	8	8.1
Approx. Efficiency	9 EER	9 EER
Electric Resistance Heat	3,500 Watts/5,000 Watts	3,500/3,100 Watts
S/A Fan	270/155 CFM	215/185 CFM
Approx Age	15	15
Ashrae Service Life	20	20
Remaining Life	5	5
Comments		

MAJOR EQUIPMENT LIST

Concord Engineering Group
PUBLIC WORKS FACILITY

Gas-Fired Infrared Heaters		
Unit Type	Ceiling Hung	Ceiling Hung
Qty	1	9
Location	Shop Bays	Shop Bays
Area Served	Warehouse	Carpenter/Lawn Care Shops & Warehouse
Manufacturer	Solaronics	Solaronics
Tube Length	10 ft	20 ft
Model #	STG-40-10N	STG-40-20N
BTUH INPUT	40,000	40,000
BTUH OUTPUT	36,000	36,000
Efficiency	90%	90%
Fuel	Natural Gas	Natural Gas
Electrical Power (Fan)	115V, 1PH	115V, 1PH
Approx Age	15	15
Ashrae Service Life	15	15
Remaining Life	0	0
Comments		

Investment Grade Lighting Audit

CEG Job #: 9C09187
Project: Avalon Boro Energy Audit
Address: Address
Address
Building SF: 18,200

"Public Works"

KWH COST: $0.156

ECM #1 Through 3: Lighting Upgrade

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
					Public Works Admin.																	
222.21	Reception Area	2600	12	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.70	1,809.6	$282.30	12	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Assit. Director's Office	2600	4	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.23	603.2	$94.10	4	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Director's Office	2600	6	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.35	904.8	$141.15	6	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Conference Room	2600	6	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.35	904.8	$141.15	6	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	IT Closet	650	1	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.06	37.7	$5.88	1	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
242.21	Administrative Assistant's Office	2600	2	4	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	104	0.21	540.8	$84.36	2	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Plan Room	2600	2	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.12	301.6	$47.05	2	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Men's Locker/Restroom	2600	4	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.23	603.2	$94.10	4	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Women's Restroom	2600	2	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.12	301.6	$47.05	2	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Lunch Room	2600	6	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.35	904.8	$141.15	6	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
242.21	File Room	2600	2	4	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	104	0.21	540.8	$84.36	2	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Electrical Room	650	1	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.06	37.7	$5.88	1	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
242.21	Office	2600	2	4	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	104	0.21	540.8	$84.36	2	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00

Investment Grade Lighting Audit

625		2600	2	1	Wall Sconce, (1) 60w A19 Lamp	60	0.12	312.0	$48.67	2	1	Energy Star Rated, Dimmable 13w CFL Lamp	13	0.03	67.6	$10.55	$20.00	$40.00	0.09	244.4	$38.13	1.05
121.36	Garage	2600	9	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Acrylic Lens	68	0.61	1,591.2	$248.23	9	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.52	1357.2	$211.72	$100.00	$900.00	0.09	234	$36.50	24.65
630	Exterior	3600	3	1	100w HPS Wallpack	125	0.38	1,350.0	$210.60	3	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
635		3600	3	1	400w HPS Wall Mnt "Shoebox"	465	1.40	5,022.0	$783.43	3	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
601	Various	8760	8	2	(2) 7w CFL Exit Sign	16	0.13	1,121.3	$174.92	8	1	LED Exit Sign	5	0.04	350.4	$54.66	$65.00	$520.00	0.09	770.88	$120.26	4.32
Carpentry Shop																						
241.34	Garage/Work Area	2600	20	4	1x4, 4 Lamp, 32w T8, Elect. Ballast, Pendant Mnt., No Lens	104	2.08	5,408.0	$843.65	20	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
640		2600	6	1	250w HPS Lo-Bay	295	1.77	4,602.0	$717.91	6	6	2x4, 6 Lamp, 32w T8, Elect. Ballast, Lo Bay	168	1.01	2620.8	$408.84	$220.00	$1,320.00	0.76	1981.2	$309.07	4.27
601		8760	2	2	(2) 7w CFL Exit Sign	16	0.03	280.3	$43.73	2	1	LED Exit Sign	5	0.01	87.6	$13.67	$65.00	$130.00	0.02	192.72	$30.06	4.32
242.11	Electrical Shop	2600	6	4	2x4, 4 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	104	0.62	1,622.4	$253.09	6	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
128.34	Elec. Shop - Mezzanine Storage	650	4	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Pendant Mnt., No Lens	142	0.57	369.2	$57.60	4	4	(2) 8' Lamps to (4) 4' Lamps - 32w T8, Elect Ballast; retrofit	104	0.42	270.4	$42.18	$100.00	$400.00	0.15	98.8	$15.41	25.95
121.11	Garage Storage Area	2600	3	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	68	0.20	530.4	$82.74	3	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.17	452.4	$70.57	$100.00	$300.00	0.03	78	$12.17	24.65
128.14		2600	1	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Surface Mnt., No Lens	142	0.14	369.2	$57.60	1	4	(2) 8' Lamps to (4) 4' Lamps - 32w T8, Elect Ballast; retrofit	104	0.10	270.4	$42.18	$100.00	$100.00	0.04	98.8	$15.41	6.49
Lawn Mower Shop																						
640	Garage Bays	2600	10	1	250w HPS Lo-Bay	295	2.95	7,670.0	$1,196.52	10	6	2x4, 6 Lamp, 32w T8, Elect. Ballast, Lo Bay	168	1.68	4368	$681.41	$220.00	$2,200.00	1.27	3302	$515.11	4.27
128.14	Office	2600	1	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Surface Mnt., No Lens	142	0.14	369.2	$57.60	1	4	(2) 8' Lamps to (4) 4' Lamps - 32w T8, Elect Ballast; retrofit	104	0.10	270.4	$42.18	$100.00	$100.00	0.04	98.8	$15.41	6.49
221.11		2600	3	2	1x4, 2 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	58	0.17	452.4	$70.57	3	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
Warehouse																						
121.11	Lobby	2600	1	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	68	0.07	176.8	$27.58	1	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.06	150.8	$23.52	$100.00	$100.00	0.01	26	$4.06	24.65
601		8760	3	2	(2) 7w CFL Exit Sign	16	0.05	420.5	$65.59	3	1	LED Exit Sign	5	0.02	131.4	$20.50	$65.00	$195.00	0.03	289.08	$45.10	4.32
121.11	Office	2600	4	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	68	0.27	707.2	$110.32	4	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.23	603.2	$94.10	$100.00	$400.00	0.04	104	$16.22	24.65
640	Garage Bays	2600	11	1	250w HPS Lo-Bay	295	3.25	8,437.0	$1,316.17	11	6	2x4, 6 Lamp, 32w T8, Elect. Ballast, Lo Bay	168	1.85	4804.8	$749.55	$220.00	$2,420.00	1.40	3632.2	$566.62	4.27
630	Exterior	3600	6	1	100w HPS Wallpack	125	0.75	2,700.0	$421.20	6	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
635		3600	2	1	400w HPS Wall Mnt "Shoebox"	465	0.93	3,348.0	$522.29	2	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
Bike Storage Garage/Sign Shop																						
121.35	Garage Bays	1800	6	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., White Diffuser	68	0.41	734.4	$114.57	6	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.35	626.4	$97.72	$100.00	$600.00	0.06	108	$16.85	35.61
142.21	Sign Shop	1800	12	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	144	1.73	3,110.4	$485.22	12	3	3 Lamp , 32w T8, Elect. Ballast; retrofit	86	1.03	1857.6	$289.79	$100.00	$1,200.00	0.70	1252.8	$195.44	6.14

Investment Grade Lighting Audit

Mechanics/Welding Shop & Storage Bays																						
645	Garage Bays/Work Area	2600	9	1	250w MH Down Light w/Prismatic Lens	295	2.66	6,903.0	$1,076.87	9	6	2x4, 6 Lamp, 32w T8, Elect. Ballast, Lo Bay	168	1.51	3931.2	$613.27	$220.00	$1,980.00	1.14	2971.8	$463.60	4.27
128.34		2600	3	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Pendant Mnt., No Lens	142	0.43	1,107.6	$172.79	3	4	(2) 8' Lamps to (4) 4' Lamps - 32w T8, Elect Ballast; retrofit	104	0.31	811.2	$126.55	$100.00	$300.00	0.11	296.4	$46.24	6.49
126.45	Restroom	2600	1	2	6"x4, 2 Lamp, 34w T12, Mag. Ballast, Wall Mnt., Prismatic Lens	75	0.08	195.0	$30.42	1	2	6'x4, 2 Lamp, 32w T8, Elect. Ballast, Wall Mnt., White Diffuser; Lithonia WP-2-32-120-GEB-MW	58	0.06	150.8	$23.52	$100.00	$100.00	0.02	44.2	$6.90	14.50
121.11	Storage Room	2600	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	68	0.14	353.6	$55.16	2	2	2 Lamp, 32w T8, Elect. Ballast; retrofit	58	0.12	301.6	$47.05	$100.00	$200.00	0.02	52	$8.11	24.65
645	1 Bay Garage	2600	10	1	250w MH Down Light w/Prismatic Lens	295	2.95	7,670.0	$1,196.52	10	6	2x4, 6 Lamp, 32w T8, Elect. Ballast, Lo Bay	168	1.68	4368	$681.41	$220.00	$2,200.00	1.27	3302	$515.11	4.27
645	Generator Storage Bays	2600	5	1	250w MH Down Light w/Prismatic Lens	295	1.48	3,835.0	$598.26	5	6	2x4, 6 Lamp, 32w T8, Elect. Ballast, Lo Bay	168	0.84	2184	$340.70	$220.00	$1,100.00	0.64	1651	$257.56	4.27
142.11		2600	7	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	144	1.01	2,620.8	$408.84	7	3	3 Lamp , 32w T8, Elect. Ballast; retrofit	86	0.60	1565.2	$244.17	$100.00	$700.00	0.41	1055.6	$164.67	4.25
645	Welding Shop	2600	9	1	250w MH Down Light w/Prismatic Lens	295	2.66	6,903.0	$1,076.87	9	6	2x4, 6 Lamp, 32w T8, Elect. Ballast, Lo Bay	168	1.51	3931.2	$613.27	$220.00	$1,980.00	1.14	2971.8	$463.60	4.27
128.14		2600	6	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Surface Mnt., No Lens	142	0.85	2,215.2	$345.57	6	4	(2) 8' Lamps to (4) 4' Lamps - 32w T8, Elect Ballast; retrofit	104	0.62	1622.4	$253.09	$100.00	$600.00	0.23	592.8	$92.48	6.49
645	Garage Storage Bays	900	26	1	250w MH Down Light w/Prismatic Lens	295	7.67	6,903.0	$1,076.87	26	6	2x4, 6 Lamp, 32w T8, Elect. Ballast, Lo Bay	168	4.37	3931.2	$613.27	$220.00	$5,720.00	3.30	2971.8	$463.60	12.34
650	Exterior	3600	5	1	250w HPS, Architectural Arm Mntd., Indirect Diffuser	275	1.38	4,950.0	$772.20	5	0	No Change	0	0.00	0	$0.00	$0.00	$0.00	0.00	0	$0.00	0.00
	Totals		259	94			43.22	102,391.5	$15,973.07	259	92			19.241	41086.2	$6,409.45		$25,805.00	13.10	28421.1	$4,433.69	5.82

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

CEG Job #: 9C09187
Project: Avalon Boro Energy Audit
Address: Address
Address
Building SF: 18200

"Public Works"

KWH COST: $0.156

ECM #4: Lighting Controls

EXISTING LIGHTING										PROPOSED LIGHTING CONTROLS										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. Cont.	Controls Description	Watts Used	Total kW	Reduction (%)	kWh/Yr Fixtures	Yearly $ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly $ Savings	Yearly Simple Payback
					Public Works Admin.																		
222.21	Reception Area	2600	12	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.70	1,809.6	$282.30	12	0	No Change	58	0.70	0%	1809.6	$282.30	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Assit. Director's Office	2600	4	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.23	603.2	$94.10	4	1	Dual Technology Occupancy Sensor	58	0.23	10%	542.88	$84.69	$160.00	$160.00	0.00	60.32	$9.41	17.00
222.21	Director's Office	2600	6	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.35	904.8	$141.15	6	1	Dual Technology Occupancy Sensor	58	0.35	10%	814.32	$127.03	$160.00	$160.00	0.00	90.48	$14.11	11.34
222.21	Conference Room	2600	6	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.35	904.8	$141.15	6	1	Dual Technology Occupancy Sensor	58	0.35	10%	814.32	$127.03	$240.00	$240.00	0.00	90.48	$14.11	17.00
222.21	IT Closet	650	1	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.06	37.7	$5.88	1	0	No Change	58	0.06	0%	37.7	$5.88	$0.00	$0.00	0.00	0	$0.00	0.00
242.21	Administrative Assistant's Office	2600	2	4	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	104	0.21	540.8	$84.36	2	1	Dual Technology Occupancy Sensor	104	0.21	10%	486.72	$75.93	$160.00	$160.00	0.00	54.08	$8.44	18.97
222.21	Plan Room	2600	2	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.12	301.6	$47.05	2	1	Dual Technology Occupancy Sensor	58	0.12	10%	271.44	$42.34	$160.00	$160.00	0.00	30.16	$4.70	34.01
222.21	Men's Locker/Restroom	2600	4	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.23	603.2	$94.10	4	1	Dual Technology Occupancy Sensor	58	0.23	10%	542.88	$84.69	$240.00	$240.00	0.00	60.32	$9.41	25.50
222.21	Women's Restroom	2600	2	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.12	301.6	$47.05	2	0	No Change	58	0.12	0%	301.6	$47.05	$0.00	$0.00	0.00	0	$0.00	0.00
222.21	Lunch Room	2600	6	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.35	904.8	$141.15	6	0	No Change	58	0.35	0%	904.8	$141.15	$0.00	$0.00	0.00	0	$0.00	0.00
242.21	File Room	2600	2	4	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	104	0.21	540.8	$84.36	2	1	Dual Technology Occupancy Sensor	104	0.21	10%	486.72	$75.93	$240.00	$240.00	0.00	54.08	$8.44	28.45

222.21	Electrical Room	650	1	2	2x4, 2 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	58	0.06	37.7	$5.88	1	0	No Change	58	0.06	0%	37.7	$5.88	$0.00	$0.00	0.00	0	$0.00	0.00
242.21	Office	2600	2	4	2x4, 4 Lamp, 32w T8, Elect. Ballast, Recessed mnt., Prismatic Lens	104	0.21	540.8	$84.36	2	1	Dual Technology Occupancy Sensor	104	0.21	10%	486.72	$75.93	$160.00	$160.00	0.00	54.08	$8.44	18.97
625		2600	2	1	Wall Sconce, (1) 60w A19 Lamp	60	0.12	312.0	$48.67	2	0	No Change	60	0.12	0%	312	$48.67	$0.00	$0.00	0.00	0	$0.00	0.00
121.36	Garage	2600	9	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Acrylic Lens	68	0.61	1,591.2	$248.23	9	1	Dual Technology Occupancy Sensor	68	0.61	10%	1432.08	$223.40	$240.00	$240.00	0.00	159.12	$24.82	9.67
630	Exterior	3600	3	1	100w HPS Wallpack	125	0.38	1,350.0	$210.60	3	0	No Change	125	0.38	0%	1350	$210.60	$0.00	$0.00	0.00	0	$0.00	0.00
635		3600	3	1	400w HPS Wall Mnt "Shoebox"	465	1.40	5,022.0	$783.43	3	0	No Change	465	1.40	0%	5022	$783.43	$0.00	$0.00	0.00	0	$0.00	0.00
601	Various	8760	8	2	(2) 7w CFL Exit Sign	16	0.13	1,121.3	$174.92	8	0	No Change	16	0.13	0%	1121.28	$174.92	$0.00	$0.00	0.00	0	$0.00	0.00
					Carpentry Shop																		
241.34	Garage/Work Area	2600	20	4	1x4, 4 Lamp, 32w T8, Elect. Ballast, Pendant Mnt., No Lens	104	2.08	5,408.0	$843.65	20	3	Dual Technology Occupancy Sensor	104	2.08	10%	4867.2	$759.28	$240.00	$720.00	0.00	540.8	$84.36	8.53
640		2600	6	1	250w HPS Lo-Bay	295	1.77	4,602.0	$717.91	6	0	No Change	295	1.77	0%	4602	$717.91	$0.00	$0.00	0.00	0	$0.00	0.00
601		8760	2	2	(2) 7w CFL Exit Sign	16	0.03	280.3	$43.73	2	0	No Change	16	0.03	0%	280.32	$43.73	$0.00	$0.00	0.00	0	$0.00	0.00
242.11	Electrical Shop	2600	6	4	2x4, 4 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	104	0.62	1,622.4	$253.09	6	1	Dual Technology Occupancy Sensor	104	0.62	10%	1460.16	$227.78	$160.00	$160.00	0.00	162.24	$25.31	6.32
128.34	Elec. Shop - Mezzanine Storage	650	4	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Pendant Mnt., No Lens	142	0.57	369.2	$57.60	4	0	No Change	142	0.57	0%	369.2	$57.60	$0.00	$0.00	0.00	0	$0.00	0.00
121.11	Garage Storage	2600	3	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	68	0.20	530.4	$82.74	3	0	No Change	68	0.20	0%	530.4	$82.74	$0.00	$0.00	0.00	0	$0.00	0.00

128.14	Area	2600	1	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Surface Mnt., No Lens	142	0.14	369.2	$57.60	1	0	No Change	142	0.14	0%	369.2	$57.60	$0.00	$0.00	0.00	0	$0.00	0.00
Lawn Mower Shop																						
640	Garage Bays	2600	10	1	250w HPS Lo-Bay	295	2.95	7,670.0	$1,196.52	10	0	No Change	295	2.95	0%	7670	$1,196.52	$0.00	$0.00	0.00	0	$0.00	0.00
128.14	Office	2600	1	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Surface Mnt., No Lens	142	0.14	369.2	$57.60	1	0	No Change	142	0.14	0%	369.2	$57.60	$0.00	$0.00	0.00	0	$0.00	0.00
221.11		2600	3	2	1x4, 2 Lamp, 32w T8, Elect. Ballast, Surface Mnt., Prismatic Lens	58	0.17	452.4	$70.57	3	0	No Change	58	0.17	0%	452.4	$70.57	$0.00	$0.00	0.00	0	$0.00	0.00
Warehouse																						
121.11	Lobby	2600	1	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	68	0.07	176.8	$27.58	1	0	No Change	68	0.07	0%	176.8	$27.58	$0.00	$0.00	0.00	0	$0.00	0.00
601		8760	3	2	(2) 7w CFL Exit Sign	16	0.05	420.5	$65.59	3	0	No Change	16	0.05	0%	420.48	$65.59	$0.00	$0.00	0.00	0	$0.00	0.00
121.11	Office	2600	4	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	68	0.27	707.2	$110.32	4	1	Dual Technology Occupancy Sensor	68	0.27	10%	636.48	$99.29	$160.00	$160.00	0.00	70.72	$11.03	14.50
640	Garage Bays	2600	11	1	250w HPS Lo-Bay	295	3.25	8,437.0	$1,316.17	11	0	No Change	295	3.25	0%	8437	$1,316.17	$0.00	$0.00	0.00	0	$0.00	0.00
630	Exterior	3600	6	1	100w HPS Wallpack	125	0.75	2,700.0	$421.20	6	0	No Change	125	0.75	0%	2700	$421.20	$0.00	$0.00	0.00	0	$0.00	0.00
635		3600	2	1	400w HPS Wall Mnt "Shoebox"	465	0.93	3,348.0	$522.29	2	0	No Change	465	0.93	0%	3348	$522.29	$0.00	$0.00	0.00	0	$0.00	0.00
Bike Storage Garage/Sign Shop																						
121.35	Garage Bays	1800	6	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., White Diffuser	68	0.41	734.4	$114.57	6	0	No Change	68	0.41	0%	734.4	$114.57	$0.00	$0.00	0.00	0	$0.00	0.00
142.21	Sign Shop	1800	12	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Recessed Mnt., Prismatic Lens	144	1.73	3,110.4	$485.22	12	1	Dual Technology Occupancy Sensor	144	1.73	10%	2799.36	$436.70	$240.00	$240.00	0.00	311.04	$48.52	4.95
Mechanics/Welding Shop & Storage Bays																						
645	Garage Bays/Work	2600	9	1	250w MH Down Light w/Prismatic Lens	295	2.66	6,903.0	$1,076.87	9	0	No Change	295	2.66	0%	6903	$1,076.87	$0.00	$0.00	0.00	0	$0.00	0.00

128.34	Area	2600	3	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Pendant Mnt., No Lens	142	0.43	1,107.6	$172.79	3	0	No Change	142	0.43	0%	1107.6	$172.79	$0.00	$0.00	0.00	0	$0.00	0.00
126.45	Restroom	2600	1	2	6"x4, 2 Lamp, 34w T12, Mag. Ballast, Wall Mnt., Prismatic Lens	75	0.08	195.0	$30.42	1	0	No Change	75	0.08	0%	195	$30.42	$0.00	$0.00	0.00	0	$0.00	0.00
121.11	Storage Room	2600	2	2	1x4, 2-Lamp, 34w T12, Mag. Ballast, Pendant Mnt., Prismatic Lens	68	0.14	353.6	$55.16	2	1	Dual Technology Occupancy Sensor	68	0.14	10%	318.24	$49.65	$160.00	$160.00	0.00	35.36	$5.52	29.01
645	1 Bay Garage	2600	10	1	250w MH Down Light w/Prismatic Lens	295	2.95	7,670.0	$1,196.52	10	0	No Change	295	2.95	0%	7670	$1,196.52	$0.00	$0.00	0.00	0	$0.00	0.00
645	Generator Storage Bays	2600	5	1	250w MH Down Light w/Prismatic Lens	295	1.48	3,835.0	$598.26	5	0	No Change	295	1.48	0%	3835	$598.26	$0.00	$0.00	0.00	0	$0.00	0.00
142.11		2600	7	4	2x4, 4 Lamp, 34w T12, Mag. Ballast, Surface Mnt., Prismatic Lens	144	1.01	2,620.8	$408.84	7	0	No Change	144	1.01	0%	2620.8	$408.84	$0.00	$0.00	0.00	0	$0.00	0.00
645	Welding Shop	2600	9	1	250w MH Down Light w/Prismatic Lens	295	2.66	6,903.0	$1,076.87	9	0	No Change	295	2.66	0%	6903	$1,076.87	$0.00	$0.00	0.00	0	$0.00	0.00
128.14		2600	6	2	8' Channel, 2 Lamp, 75w T12, Mag. Ballast, Surface Mnt., No Lens	142	0.85	2,215.2	$345.57	6	0	No Change	142	0.85	0%	2215.2	$345.57	$0.00	$0.00	0.00	0	$0.00	0.00
645	Garage Storage Bays	900	26	1	250w MH Down Light w/Prismatic Lens	295	7.67	6,903.0	$1,076.87	26	0	No Change	295	7.67	0%	6903	$1,076.87	$0.00	$0.00	0.00	0	$0.00	0.00
650	Exterior	3600	5	1	250w HPS, Architectural Arm Mntd., Indirect Diffuser	275	1.38	4,950.0	$772.20	5	0	No Change	275	1.38	0%	4950	$772.20	$0.00	$0.00	0.00	0	$0.00	0.00
0	Totals	0	259	94			43.22	102,391.5	$15,973.07	259	16		0	0.00		100618.2	$15,696.44		$3,200.00	43.22	1773.28	$276.63	11.57

Project Name: LGEA Solar PV Project - Avalon Public Works Facilities
Location: Avalon, NJ
Description: Photovoltaic System - Direct Purchase

Simple Payback Analysis

	Photovoltaic System - Direct Purchase
Total Construction Cost	$202,860
Annual kWh Production	27,536
Annual Energy Cost Reduction	$4,296
Annual SREC Revenue	$9,638
First Cost Premium	**$202,860**
Simple Payback:	**14.56** **Years**

Life Cycle Cost Analysis

Analysis Period (years):	25	Financing %:	0%
Financing Term (mths):	0	Maintenance Escalation Rate:	3.0%
Average Energy Cost ($/kWh)	**$0.156**	Energy Cost Escalation Rate:	3.0%
Financing Rate:	0.00%	SREC Value ($/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	$202,860	0	0	0	$0	(202,860)	0
1	$0	27,536	$4,296	$0	$9,638	$13,933	($188,927)
2	$0	27,398	$4,424	$0	$9,589	$14,014	($174,913)
3	$0	27,261	$4,557	$0	$9,541	$14,099	($160,814)
4	$0	27,125	$4,694	$0	$9,494	$14,188	($146,627)
5	$0	26,989	$4,835	$278	$9,446	$14,003	($132,623)
6	$0	26,854	$4,980	$277	$9,399	$14,102	($118,521)
7	$0	26,720	$5,129	$275	$9,352	$14,206	($104,315)
8	$0	26,587	$5,283	$274	$9,305	$14,315	($90,001)
9	$0	26,454	$5,442	$272	$9,259	$14,428	($75,573)
10	$0	26,321	$5,605	$271	$9,212	$14,546	($61,027)
11	$0	26,190	$5,773	$270	$9,166	$14,670	($46,357)
12	$0	26,059	$5,946	$268	$9,121	$14,798	($31,559)
13	$0	25,929	$6,125	$267	$9,075	$14,932	($16,626)
14	$0	25,799	$6,308	$266	$9,030	$15,072	($1,554)
15	$0	25,670	$6,498	$264	$8,984	$15,218	$13,663
16	$0	25,542	$6,692	$263	$8,940	$15,369	$29,032
17	$0	25,414	$6,893	$262	$8,895	$15,526	$44,559
18	$0	25,287	$7,100	$260	$8,850	$15,690	$60,249
19	$0	25,160	$7,313	$259	$8,806	$15,860	$76,109
20	$0	25,035	$7,532	$258	$8,762	$16,037	$92,145
21	$1	24,909	$7,758	$257	$8,718	$16,220	$108,365
22	$2	24,785	$7,991	$255	$8,675	$16,411	$124,776
23	$3	24,661	$8,231	$254	$8,631	$16,608	$141,384
24	$4	24,538	$8,478	$253	$8,588	$16,813	$158,197
25	$5	24,415	$8,732	$251	$8,545	$17,026	$175,223
	Totals:	648,637	$156,615	$5,555	$227,023	$378,083	($325,735)
				Net Present Value (NPV)		**$175,248**	
				Internal Rate of Return (IRR)		**5.3%**	

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
Public Works	1600	Sunpower SPR230	98	14.7	1,441	22.54	27,536	3,234	15.64

PVWatts

AC Energy & Cost Savings

Cautions for Interpreting the Results

Station Identification	
City:	Atlantic_City
State:	New_Jersey
Latitude:	39.45° N
Longitude:	74.57° W
Elevation:	20 m
PV System Specifications	
DC Rating:	22.5 kW
DC to AC Derate Factor:	0.810
AC Rating:	18.3 kW
Array Type:	Fixed Tilt
Array Tilt:	10.0°
Array Azimuth:	180.0°
Energy Specifications	
Cost of Electricity:	0.2 ¢/kWh

Results			
Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	2.58	1464	2.28
2	3.33	1729	2.70
3	4.31	2415	3.77
4	5.20	2750	4.29
5	5.85	3141	4.90
6	6.14	3057	4.77
7	6.06	3089	4.82
8	5.54	2838	4.43
9	4.85	2441	3.81
10	3.76	1993	3.11
11	2.65	1396	2.18
12	2.23	1223	1.91
Year	4.38	27536	42.96

.= Proposed PV Layout

Notes:

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

Energy Cost Calculator for Faucets and Showerheads

Vary utility cost, hours of operation, and / or efficiency level.

INPUT SECTION

Input the following data (if any parameter is missing, calculator will set to the default value).			Defaults	
Water Saving Product	Faucet		*Faucet*	*Showerhead*
Flow Rate	1	gpm	*2.2 gpm*	*2.5 gpm*
Water Cost (including waste water charges)	5.40	$/1000 gal	*$4/1000 gal*	*$4/1000 gal*
Gas Cost	1.60	$/therm	*0.60 $/therm*	*0.60 $/therm*
Electricity Cost	.129	$/kWh	*0.06 $/kWh*	*0.06 $/kWh*
Minutes per Day of Operation	30	minutes	*30 minutes*	*20 minutes*
Days per Year of Operation	240	days	*260 days*	*365 days*
Quantity to be Purchased	5	unit(s)	*1 unit*	*1 unit*

Calculate | Reset

OUTPUT SECTION

Performance per Faucet	Your Choice	Base Model	FEMP Recommended Level	Best Available	Self Closing Faucet (gallon per cycle)
WATER USE ONLY					
Gallon per Minute	1 gpm	2.2	2	1.5	0.25
Annual Water Use	7200 gal	15840	14400	10800	3600
Annual Water Cost	$ 39	$ 86	$ 78	$ 58	$ 19
Lifetime Water Cost	$ 328	$ 722	$ 655	$ 487	$ 160
WITH ELECTRIC WATER HEATING					
Annual Energy Use	407 kWh	895	814	610	203
Annual Energy Cost	$ 53	$ 115	$ 105	$ 79	$ 26
Lifetime Energy Cost	$ 412	$ 905	$ 823	$ 617	$ 205
Lifetime Energy and Water Cost Savings	$ 887	$ 0	$ 149	$ 523	$ 1262
Lifetime Energy and Water Cost Savings for 5 Faucet(s)	$ 4435	$ 0	$ 745	$ 2615	$ 6310
WITH GAS WATER HEATING					
Annual Energy Use	23 therms	50	45	34	11
Annual Energy Cost	$ 37	$ 80	$ 72	$ 54	$ 18
Lifetime Energy Cost	$ 307	$ 664	$ 598	$ 448	$ 149
Lifetime Energy and Water Cost Savings	$ 751	$ 0	$ 133	$ 451	$ 1077
Lifetime Energy and Water Cost Savings for 5 Faucet(s)	$ 3755	$ 0	$ 665	$ 2255	$ 5385

For electric water heating applications, your selection of an energy saving faucet with a flow rate of 1 gallon(s) per minute will have a combined energy and water cost savings (per faucet) of $ 887 over an estimated 10 year life expectancy compared to the base model.

For gas water heating applications, your selection of an energy saving faucet with a flow rate of 1 gallon(s) per minute will have a combined energy and water cost savings (per faucet) of $ 751 over an estimated 10 year life expectancy compared to the base model.

Assumptions

- "Base model" has an efficiency that just meets the national minimum standard for faucets or showerheads.
- Lifetime energy cost and lifetime water cost is the sum of the discounted value of the annual energy and water costs based on an assumed faucet or showerhead life of 10 years.
- Future gas and electricity price trends and a discount rate of 3.2% are based on Federal guidelines.
- $0.06 per kWh is the Federal average electricity price in the U.S.
- $0.60 per therm is the Federal average gas price in the U.S.
- The assumed combined water and waste-water price is $4.00/1000 gallons.

Disclaimer

This cost calculator is a screening tool that estimates a product's lifetime energy cost savings at various efficiency levels. Maintenance and installation costs do not vary significantly among the same product having different efficiencies; so, these costs are not included in this calculator tool. For a detailed life-cycle cost analysis, FEMP has developed a tool called Building Life-Cycle Cost (BLCC). This downloadable tool allows the user to vary interest rates, installation costs, maintenance costs, salvage values, and life expectancy for a product or an entire energy project.

Water Saving Product Flow Rate in gallons per minute. Default for a faucet is 2.2 gallons per minute. Default for a showerhead is 2.5 gallons per minute. Waster cost including waste water charges in dollars per 1000 gallons. Default for a faucet is 4 dollars per 1000 gallons. Default for a showerhead is 4 dollars per 1000 gallons. Gas cost in dollars per therm. Default for a faucet is 0.60 dollars per therm. Default for a showerhead is 0.60 per therm. Electricity cost in dollars per kilowatt hour. Default for a faucet is 0.06 dollars per kilowatt hour. Default for a showerhead is 0.06 dollars per kilowatt hour. Minutes per day of operation, measured in minutes. Default for a faucet is 30 minutes. Default for a showerhead is 20 minutes. Days per year of operation, measured in days. Default for a faucet is 260 days. Default for a showerhead is 365 days. Quantity to be purchased, measured in units. Default for a faucet is 1 unit. Default for a showerhead is 1 unit. Performance for faucet or showerhead, depending on selection above. Your Choice with Water Use Only Form Labels Gallons per minute based on your choice, for water use only. Annual water use based on your choice, for water use only. Annual water cost based on your choice, for water use only. Lifetime water cost based on your choice, for water use only. Base Model with Water Use Only Form Labels Gallons per minute based on the base model, for water use only. Annual water use based on the base model, for water use only. Annual water cost based on the base model, for water use only. Lifetime water cost based on the base model, for water use only. FEMP Recommended Levels with Water Use Only Form Labels Gallons per minute based on FEMP recommended levels, for water use only. Annual water use based on FEMP recommended levels, for water use only. Annual water cost based on FEMP recommended levels, for water use only. Lifetime water cost based on FEMP recommended levels, for water use only. Best Available with Water Use Only Form Labels Gallons per minute based on best available levels, for water use only. Annual water use based on best available levels, for water use only. Annual water cost based on best available levels, for water use only. Lifetime water cost based on best available levels, for water use only. Self Closing Faucet with Water Use Only Form Labels Gallons per minute based on self closing faucet, measured in gallon per cycle, for water use only. Annual water use based on self closing faucet, measured in gallon per cycle, for water use only. Annual water cost based on self closing faucet, measured in gallon per cycle, for water use only. Lifetime water cost based on self closing faucet, measured in gallon per cycle, for water use only. Your Choice with Electric Water Heating Form Labels Annual energy use, based on your choice and measured in kilowatt hour, for water use with electric water heating. Annual energy cost, based on your choice and measured in dollars, for water use with electric water heating. Lifetime energy cost, based on your choice and measured in dollars, for water use with electric water heating. Lifetime energy and water cost savings, based on your choice and measured in dollars, for water use with electric water heating. Lifetime energy and water cost savings for the number of units and item you selected, based on your choice and measured in dollars, for water use with electric water heating. Base Model with Electric Water Heating Form Labels Annual energy use, based on the base model and measured in dollars, for water use with electric water heating. Annual energy cost, based on the base model and measured in dollars, for water use with electric water heating. Lifetime energy cost, based on the base model and measured in dollars, for water use with electric water heating. 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Annual energy cost, based on your choice and measured in dollars, for water use with gas water heating. Lifetime energy cost, based on your choice and measured in dollars, for water use with gas water heating. Lifetime energy and water cost savings, based on your choice and measured in dollars, for water use with gas water heating. Lifetime energy and water cost savings for the number of units and item you selected, based on your choice and measured in dollars, for water use with gas water heating. Base Model with Gas Water Heating Form Labels Annual energy use, based on the base model and measured in dollars, for water use with gas water heating. Annual energy cost, based on the base model and measured in dollars, for water use with gas water heating. Lifetime energy cost, based on the base model and measured in dollars, for water use with gas water heating. Lifetime energy and water cost savings, based on the base model and measured in dollars,, for water use with gas water heating. 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Annual energy cost, based on self closing faucet and measured in dollars, measured in gallon per cycle, for water use with gas water heating. Lifetime

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Energy-Efficient Products
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Purchasing Specifications
Product Designation Process
Energy Cost Calculators
FEMP Standby Power Data Center
Model Language
Resources
New & Emerging Technologies
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Energy Cost Calculator for Urinals

Vary water cost, frequency of operation, and /or efficiency level.

INPUT SECTION

This calculator assumes that early replacement of a urinal or toilet will take place with 10 years of life remaining for existing fixture.

Input the following data (if any parameter is missing, calculator will set to default value).		Defaults
Water Saving Product	Urinal	*Urinal*
Gallons per Flush	1 gpf	*1.0 gpf*
Quantity to be Purchased	2	*1*
Water Cost (including waste water charges)	5.4 $/1000 gal	*$4/1000 gal*
Flushes per Day	20 flushes	*30 flushes*
Days per Year	240 days	*260 days*

Calculate Reset

OUTPUT SECTION

Performance per urinal	Your Choice	Typical Existing Unit	Recommended Level (New Unit)	Best Available
Gallon per Flush	1 gpf	3	1	0
Annual Water Use	4800 gal	14400	4800	0
Annual Water Cost	$ 25	$ 77	$ 25	$ 0
10-Year Water Cost	$ 211	$ 649	$ 211	$ 0
Water Cost Savings (for replacing existing unit 10 years early)	$ 438	$ 0	$ 438	$ 649

By replacing your existing urinal, having a flow rate of 1 gallon(s) per flush, you will have a water cost savings (per unit) of $ 438 over 10 years.

Assumptions

- "Base model" has an efficiency that just meets the national minimum standard for toilets or urinals.
- The assumed combined water and waste-water price is $4/1000 gallons.

Disclaimer

This cost calculator is a screening tool that estimates a product's lifetime energy cost savings at various efficiency levels. Maintenance and installation costs do not vary significantly among the same product having different efficiencies; so, these costs are not included in this calculator tool. For a detailed life-cycle cost analysis, FEMP has developed a tool called Building Life-Cycle Cost (BLCC). This downloadable tool allows the user to vary interest rates, installation costs, maintenance costs, salvage values, and life expectancy for a product or an entire energy project.

Gallons per Flush. Default is Urinal 1.0 gpf, Toilet 1.0 gpf Quantity to be purchased. Default is Urinal 1, Toilet 1 Water Cost (including waste water charges) amount per 1000 gallons. Default is Urinal $4/1000 gal, Toilet $4/1000 gal Flushes per day. Default is Urinal 30 flushes, Toilet 30 flushes Days per year. Default is Urinal 260 days, Toilet 260 days Performance per Gallon per flush your choice Gallon per flush typical existing unit Gallon per flush recommended level (new unit) Gallon per flush best available Annual Water Use your choice per gallon Annual Water Use typical existing unit Annual Water Use recommended level (new unit) Annual Water Use best bvailable Annual Water Cost your choice amount of Annual Water Cost typical existing unit amount of Annual Water Cost recommended level (new unit) amount of Annual Water Cost best bvailable amount of 10-year Water Cost your choice amount of 10-year Water Cost typical existing unit amount of 10-year Water Cost recommended level (new unit) amount of 10-year Water Cost best bvailable amount of Water Cost Savings (for replacing existing unit 10 years early) your choice amount of Water Cost Savings (for replacing existing unit 10 years early) typical existing unit amount of Water Cost Savings (for replacing existing unit 10 years early) recommended level (new unit) amount of Water Cost Savings (for replacing existing unit 10 years early) best bvailable amount of By replacing your existing having a flow rate of gallon(s) per flush, you will have a water cost savings (per unit) of $ over 10 years.

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Products that earn the ENERGY STAR prevent greenhouse gas emissions by meeting strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the U.S. Department of Energy.
www.energystar.gov

CHANGE FOR THE BETTER WITH ENERGY STAR

Life Cycle Cost Estimate for 8 ENERGY STAR Qualified Programmable Thermostat(s)

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors.

Enter your own values in the gray boxes or use our default values.

Number of Units	8
Initial Cost per ENERGY STAR Unit (retail price)	$180
Initial Cost per Conventional Unit (retail price)	$0
Unit Fuel Cost (Cooling) ($/kWh)	$0.000
Unit Fuel Cost (Heating) ($/Therm)	$1.64

24 Hour Typical Usage Patterns*

	Weekday	Weekend
Nighttime Set-Back/Set-Up Hours	15	20
Daytime Set-Back/Set-Up Hours	9	4
Hours without Set-Back/Set-Up	0	0

Choose your city from the drop-down menu → **City**: NJ-Atlantic City

Heating Season*

Typical Indoor Temperature w/o Set-Back	70
Nighttime Set-Back Temperature (Average)	55
Daytime Set-Back Temperature (Average)	65
Heating System Type	Gas Furnace

Cooling Season*

Typical Indoor Temperature w/o Set-Up	74
Nighttime Set-Up Temperature (Average)	85
Daytime Set-Up Temperature (Average)	80
Cooling System Type	None

**All temperatures are in degrees Fahrenheit. Setpoint is defined as the temperature setting for any given time period. Set-back temperature is defined as the lower setpoint temperature for the energy-savings periods during the heating season, generally nighttime and daytime. Set-up temperature is defined as the higher setpoint temperature for the energy-savings periods during the cooling season, generally nighttime and daytime.*

Annual and Life Cycle Costs and Savings for 8 Programmable Thermostat(s)

	8 ENERGY STAR Unit(s)	8 Conventional Unit(s)	Savings with ENERGY STAR
Annual Energy Costs			
Heating Energy Cost	$15,277	$24,563	$9,286
Heating Energy Consumption (MBTU)	*932*	*1,498*	*566*
Cooling Energy Cost	$0	$0	$0
Cooling Energy Consumption (MBTU)	*0.0*	*0.0*	*0*
Total	**$15,277**	**$24,563**	**$9,286**
Life Cycle Costs			
Energy Costs	$169,859	$273,102	$103,243
Heating Energy Costs	*$169,859*	*$273,102*	*$103,243*
Heating Energy Consumption (MBTU)	13,973	22,466	8,493
Cooling Energy Costs	$0	$0	$0
Cooling Energy Consumption (MBTU)	0	0	0
Purchase Price for 8 Unit(s)	*$1,440*	*$0*	*-$1,440*
Total	**$171,299**	**$273,102**	**$101,803**
		Simple payback of initial cost (years)	**0.2**

Summary of Benefits for 8 Programmable Thermostat(s)

Initial cost difference	**$1,440**
Life cycle savings	**$103,243**
Net life cycle savings (life cycle savings - additional cost)	**$101,803**
Life cycle energy saved (MBTU)-includes both Heating and Cooling	**8,493**
Simple payback of additional cost (years)	**0.2**
Life cycle air pollution reduction (lbs of CO_2)	**993,695**
Air pollution reduction equivalence (number of cars removed from the road for a year)	**83**
Air pollution reduction equivalence (acres of forest)	**102**
Savings as a percent of retail price	**7070%**

Assumptions for Programmable Thermostats

Category	Value	Data Source
Heating/Cooling System Efficiencies		
Gas Furnace	80.0	LBNL 2004, Average of ENERGY STAR and Conventional
Gas Boiler	82.5	LBNL 2004, Average of ENERGY STAR and Conventional
Oil Furnace	84.0	LBNL 2004, Average of ENERGY STAR and Conventional
Oil Boiler	82.5	LBNL 2004, Average of ENERGY STAR and Conventional
Baseline Energy Consumption (MBTU)		
Gas Furnace	1,423.4	DOE 2001
Gas Boiler	56.1	DOE 2001
Oil Furnace	68.7	DOE 2001
Oil Boiler	71.2	DOE 2001
Central Air Conditioner	9.5	DOE 2001
Reference Degree Days (Heating/Cooling)		
Gas Furnace	4,255	DOE 2001
Gas Boiler	4,255	DOE 2001
Oil Furnace	5,339	DOE 2001
Oil Boiler	5,339	DOE 2001
Central Air Conditioner	1701	DOE 2001
Typical Indoor Temperature (Heating Season)	72	ENERGY STAR Programmable Thermostat Eligibility Criteria. Pre-programmed settings for heating include a morning and evening temperature ≤70°F and an adjustment of at least 8°F (≤62°F) during daytime and nighttime.
Typical Indoor Temperature (Cooling Season)	74	ENERGY STAR Programmable Thermostat Eligibility Criteria. Pre-programmed settings for cooling include a morning and evening temperature ≥78°F and an adjustment of at least 7°F (≥85°F) during daytime and an adjustment of at least 4°F (≥82°F) at nighttime.
Energy Prices		
Natural Gas ($/Therm)	$1.6400 $/Therm	Energy Information Administration, Annual Energy Outlook 2009 (Early Release) edition. (converted from 2007 to 2008 dollars).
Fuel Oil ($/Gallon)	$2.6800 $/gal	EIA 2008
Electric Price (Residential)	$0.1400 $/kWh	Energy Information Administration, Annual Energy Outlook 2009 (Early Release) edition. (converted from 2007 to 2008 dollars).
Usage		
Nighttime Hours	8	Default shipped setting, ENERGY STAR specification
Daytime Hours	10	Default shipped setting, ENERGY STAR specification
Carbon Dioxide Emissions Factors		
Oil Carbon Emission Factor	161.27 lbs CO_2/MBtu	EPA 2007
Gas Carbon Emission Factor	117 lbs CO_2/MBtu	2009 EPA ENERGY STAR Factoid Workbook
Electricity Carbon Emission Factor	1.54 lbs CO_2/kWh	EPA's Climate Change Action Plan (CCAP) number for 2009.
Thermostat Savings		
Savings per Degree of Setback (Heating Season)	3%	Industry Data 2004
Savings per Degree of Setback (Cooling Season)	6%	Industry Data 2004
Thermostat Lifetime	15 years	LBNL 2007
Initial Cost		
ENERGY STAR Programmable Thermostat	$180	Industry Data 2008
Conventional Thermostat	$0	Industry Data 2008
CO_2 Equivalents		
Annual CO_2 sequestration per forested acre	9,700 lbs CO_2/acre-yr	EPA's Greenhouse Gas Equivalencies Calculator. http://www.epa.gov/cleanenergy/energy-resources/calculator.html
Annual CO_2 emissions for "average" passenger car	12,037 lbs CO_2/acre-yr	EPA's Greenhouse Gas Equivalencies Calculator. http://www.epa.gov/cleanenergy/energy-resources/calculator.html
Discount Rate		
Commercial and Residential Discount Rate (real)	4%	A real discount rate of 4 percent is assumed, which is roughly equivalent to the nominal discount rate of 7 percent (4 percent real discount rate + 3 percent inflation rate).
Climate Data Heating and Cooling Degree Days	Heating Cooling	

Assumptions for Programmable Thermostats

Category	Value		Data Source
For Selected City	4,763	832	
AK-Anchorage	10,816	0	EPA 2002
AK-Barrow	20,370	0	EPA 2002
AK-Fairbanks	14,274	70	EPA 2002
AK-Juneau	9,105	0	EPA 2002
AK-Nome	14,371	0	EPA 2002
AL-Birmingham	2,863	1,881	EPA 2002
AL-Huntsville	3,279	1,708	EPA 2002
AL-Mobile	1,695	2,643	EPA 2002
AL-Montgomery	2,277	2,274	EPA 2002
AR-Fort Smith	3,477	1,969	EPA 2002
AR-Little Rock	3,152	2,045	EPA 2002
AZ-Flagstaff	7,254	127	EPA 2002
AZ-Phoenix	1,442	3,746	EPA 2002
AZ-Tucson	1,734	2,840	EPA 2002
AZ-Winslow	4,839	1,187	EPA 2002
AZ-Yuma	983	4,244	EPA 2002
CA-Beverly Hills	1,383	729	EPA 2002
CA-Los Angeles	1,204	1,339	EPA 2002
CA-Palm Springs	1,024	3,836	EPA 2002
CA-Sacramento	2,772	1,198	EPA 2002
CA-San Diego	1,284	842	EPA 2002
CA-San Francisco	3,071	56	EPA 2002
CA-Stockton	2,674	1,448	EPA 2002
CO-Alamosa	8,717	69	EPA 2002
CO-Colorado Springs	6,346	501	EPA 2002
CO-Denver	6,014	680	EPA 2002
CO-Grand Junction	5,683	1,205	EPA 2002
CO-Pueblo	5,465	1,042	EPA 2002
CT-Bridgeport	5,501	746	EPA 2002
CT-Hartford	6,174	666	EPA 2002
DC-Washington	4,122	1,430	EPA 2002
DE-Wilmington	4,986	1,015	EPA 2002
FL-Daytona Beach	900	2,878	EPA 2002
FL-Fort Myers	441	3,699	EPA 2002
FL-Gainesville	1,259	2,599	EPA 2002
FL-Jacksonville	1,402	2,520	EPA 2002
FL-Key West	114	4,756	EPA 2002
FL-Miami	199	4,095	EPA 2002
FL-Orlando	656	3,401	EPA 2002
FL-Pensacola	1,571	2,680	EPA 2002
FL-Tallahassee	1,652	2,492	EPA 2002
FL-Tampa	739	3,324	EPA 2002
FL-W. Palm Beach	262	3,769	EPA 2002
GA-Athens	2,965	1,680	EPA 2002
GA-Atlanta	3,021	1,670	EPA 2002
GA-Augusta	2,568	1,935	EPA 2002
GA-Columbus	2,356	2,152	EPA 2002
GA-Macon	2,279	2,217	EPA 2002
GA-Savannah	1,921	2,290	EPA 2002
HI-Hilo	0	3,134	EPA 2002
HI-Honolulu	0	4,389	EPA 2002
IA-Des Moines	6,554	1,019	EPA 2002
IA-Dubuque	7,375	580	EPA 2002
IA-Sioux City	6,947	940	EPA 2002
IA-Waterloo	7,537	667	EPA 2002
ID-Boise	5,802	742	EPA 2002
ID-Lewiston	5,429	742	EPA 2002
ID-Pocatello	7,123	445	EPA 2002
IL-Chicago	6,455	740	EPA 2002
IL-Moline	6,498	899	EPA 2002
IL-Peoria	6,226	948	EPA 2002
IL-Rockford	6,952	714	EPA 2002
IL-Springfield	5,654	1,165	EPA 2002
IN-Evansville	4,729	1,378	EPA 2002
IN-Fort Wayne	6,320	786	EPA 2002
IN-Indianapolis	5,650	988	EPA 2002
IN-South Bend	6,377	710	EPA 2002
KS-Dodge City	5,059	1,479	EPA 2002
KS-Goodland	6,099	934	EPA 2002
KS-Topeka	5,319	1,380	EPA 2002
KS-Wichita	4,787	1,684	EPA 2002
KY-Lexington	4,814	1,170	EPA 2002
KY-Louisville	4,525	1,342	EPA 2002
KY-Paducah	4,283	1,491	EPA 2002
LA-Baton Rouge	1,673	2,605	EPA 2002
LA-Lake Charles	1,579	2,682	EPA 2002
LA-New Orleans	1,490	2,686	EPA 2002

Assumptions for Programmable Thermostats

Category	Value		Data Source
LA-Shreveport	2,269	2,444	EPA 2002
MA-Boston	5,593	699	EPA 2002
MA-Worcester	6,950	359	EPA 2002
MD-Baltimore	4,706	1,138	EPA 2002
ME-Caribou	9,616	147	EPA 2002
ME-Portland	7,501	254	EPA 2002
MI-Alpena	8,410	180	EPA 2002
MI-Detroit	6,563	615	EPA 2002
MI-Flint	7,068	456	EPA 2002
MI-Grand Rapids	6,927	570	EPA 2002
MI-Lansing	6,987	530	EPA 2002
MI-Marquette	9,520	148	EPA 2002
MI-Muskegon	6,925	451	EPA 2002
MI-Sault St Marie	9,305	131	EPA 2002
MN-Duluth	9,901	150	EPA 2002
MN-International Falls	10,604	216	EPA 2002
MN-Minneapolis	8,007	662	EPA 2002
MN-Rochester	8,277	479	EPA 2002
MN-St. Cloud	8,965	397	EPA 2002
MO-Columbia	5,206	1,269	EPA 2002
MO-Kansas City	5,283	1,333	EPA 2002
MO-Springfield	4,660	1,374	EPA 2002
MO-St. Louis	4,938	1,468	EPA 2002
MS-Jackson	2,389	2,290	EPA 2002
MS-Meridian	2,479	2,158	EPA 2002
MS-Tupelo	3,088	1,961	EPA 2002
MT-Billings	7,212	553	EPA 2002
MT-Glasgow	8,940	465	EPA 2002
MT-Great Falls	7,766	391	EPA 2002
MT-Havre	8,660	420	EPA 2002
MT-Helena	8,176	294	EPA 2002
MT-Kalispell	8,361	177	EPA 2002
MT-Miles city	7,891	776	EPA 2002
MT-Missoula	7,839	216	EPA 2002
NC-Asheville	4,294	842	EPA 2002
NC-Charlotte	3,342	1,546	EPA 2002
NC-Greensboro	3,874	1,303	EPA 2002
NC-Raleigh	3,531	1,394	EPA 2002
NC-Wilmington	2,469	1,904	EPA 2002
ND-Bismarck	9,075	473	EPA 2002
ND-Fargo	9,343	476	EPA 2002
ND-Williston	9,241	440	EPA 2002
NE-Grand Island	6,482	1,028	EPA 2002
NE-Lincoln	6,375	1,124	EPA 2002
NE-Norfolk	7,005	935	EPA 2002
NE-North Platte	6,909	773	EPA 2002
NE-Omaha	6,592	964	EPA 2002
NE-Scottsbluff	6,702	728	EPA 2002
NH-Concord	7,482	353	EPA 2002
NJ-Atlantic City	4,763	832	EPA 2002
NJ-Newark	4,972	1,091	EPA 2002
NM-Albuquerque	4,414	1,254	EPA 2002
NM-Roswell	3,126	1,863	EPA 2002
NV-Elko	7,248	406	EPA 2002
NV-Ely	7,700	192	EPA 2002
NV-Las Vegas	2,532	3,029	EPA 2002
NV-Reno	6,030	357	EPA 2002
NV-Winnemucca	6,409	505	EPA 2002
NY-Albany	6,927	494	EPA 2002
NY-Binghamton	7,344	330	EPA 2002
NY-Buffalo	6,798	476	EPA 2002
NY-New York	4,868	1,089	EPA 2002
NY-Rochester	6,713	531	EPA 2002
NY-Syracuse	6,787	506	EPA 2002
OH-Akron	6,241	625	EPA 2002
OH-Cincinnati	5,247	1,037	EPA 2002
OH-Cleveland	6,178	612	EPA 2002
OH-Columbus	5,686	862	EPA 2002
OH-Dayton	5,689	947	EPA 2002
OH-Mansfield	6,249	652	EPA 2002
OH-Toledo	6,570	622	EPA 2002
OH-Youngstown	6,560	485	EPA 2002
OK-Oklahoma City	3,735	1,914	EPA 2002
OK-Tulsa	3,731	2,043	EPA 2002
OR-Astoria	5,248	14	EPA 2002
OR-Eugene	4,799	261	EPA 2002
OR-Medford	4,798	645	EPA 2002
OR-Pendleton	5,263	726	EPA 2002

Assumptions for Programmable Thermostats

Category		Value	Data Source
OR-Portland	4,691	332	EPA 2002
OR-Salem	4,974	238	EPA 2002
PA-Allentown	5,815	751	EPA 2002
PA-Erie	6,768	402	EPA 2002
PA-Harrisburg	5,335	1,006	EPA 2002
PA-Philadelphia	4,947	1,075	EPA 2002
PA-Pittsburgh	5,950	645	EPA 2002
PA-Scranton	6,330	569	EPA 2002
PA-Williamsport	6,047	659	EPA 2002
RI-Providence	5,908	574	EPA 2002
SC-Charleston	1,868	2,304	EPA 2002
SC-Columbia	2,629	2,033	EPA 2002
SC-Greenville	3,239	1,501	EPA 2002
SD-Aberdeen	8,570	589	EPA 2002
SD-Huron	8,103	738	EPA 2002
SD-Rapid City	7,301	667	EPA 2002
SD-Sioux Falls	7,885	749	EPA 2002
TN-Bristol	4,356	1,066	EPA 2002
TN-Chattanooga	3,583	1,578	EPA 2002
TN-Knoxville	3,658	1,449	EPA 2002
TN-Memphis	3,207	2,067	EPA 2002
TN-Nashville	3,756	1,661	EPA 2002
TX-Abilene	2,621	2,467	EPA 2002
TX-Amarillo	4,231	1,428	EPA 2002
TX-Austin	1,760	2,914	EPA 2002
TX-Brownsville	609	3,772	EPA 2002
TX-Corpus Christi	970	3,574	EPA 2002
TX-Dallas	2,407	2,809	EPA 2002
TX-Del Rio	1,510	3,272	EPA 2002
TX-El Paso	2,664	2,096	EPA 2002
TX-Galveston	1,253	2,967	EPA 2002
TX-Houston	1,549	2,761	EPA 2002
TX-Lubbock	3,516	1,676	EPA 2002
TX-Midland	2,658	2,126	EPA 2002
TX-Port Arthur	1,477	2,861	EPA 2002
TX-San Angelo	2,313	2,596	EPA 2002
TX-San Antonio	1,606	2,983	EPA 2002
TX-Victoria	1,273	3,184	EPA 2002
TX-Waco	2,126	2,891	EPA 2002
TX-Wichita Falls	3,011	2,506	EPA 2002
UT-Salt Lake City	5,802	981	EPA 2002
VA-Lynchburg	4,323	1,074	EPA 2002
VA-Norfolk	3,446	1,458	EPA 2002
VA-Richmond	3,960	1,336	EPA 2002
VA-Roanoke	4,315	1,085	EPA 2002
VT-Burlington	7,953	379	EPA 2002
WA-Olympia	5,709	94	EPA 2002
WA-Seattle	4,681	200	EPA 2002
WA-Spokane	6,882	411	EPA 2002
WA-Walla Walla	4,807	863	EPA 2002
WA-Yakima	6,031	484	EPA 2002
WI-Green Bay	8,143	381	EPA 2002
WI-La Crosse	7,540	683	EPA 2002
WI-Madison	7,642	467	EPA 2002
WI-Milwaukee	7,326	470	EPA 2002
WV-Beckley	5,577	466	EPA 2002
WV-Charleston	4,697	1,007	EPA 2002
WV-Elkins	6,045	378	EPA 2002
WV-Huntington	4,676	1,121	EPA 2002
WY-Casper	7,642	457	EPA 2002
WY-Cheyenne	7,310	309	EPA 2002
WY-Lander	7,905	436	EPA 2002
WY-Sheridan	7,841	419	EPA 2002

For questions or comments, please send your email to: Escalcs@cadmusgroup.com
updated 04/09

REM #2 - WINDTURBINES	
Installation Cost ($):	$40,000
NJ Smart Start Equipment Incentive ($):	$21,845
Net Installation Cost ($):	$18,155
REC Revenue ($/Yr):	$171
Energy Savings ($/Yr):	$920
Total Yearly Savings ($/Yr):	$1,090
Estimated ECM Lifetime (Yr):	15
Simple Payback	36.69
Lifetime Energy Savings	$16,353

VINELAND DEVELOPMENT CENTER WIND CALCULATIONS

ANALYSIS - 1

Month	Days	Hours	Data Avg.Wind Speed, mph	Adjusted Avg. Wind Speed, mph	Adjusted Avg. Wind Speed, m/s	Rated Power kWe		Turbine #1 Generation, kWh	Turbine #2 Generation, kWh	Turbine #3 Generation, kWh	Total Generation, kWh	Electric Cost Offset	Annual Maint Cost	Wind REC Revenue
January	31	744	16.097	15.729	7.03	0.675		502			502	$68		$13
February	28	672	19.214	18.775	8.39	1.229		826			826	$111		$21
March	31	744	16.290	15.918	7.12	0.698		519			519	$70		$13
April	30	720	17.900	17.491	7.82	0.953		686			686	$92		$17
May	31	744	14.806	14.468	6.47	0.525		390			390	$53		$10
June	30	720	14.900	14.559	6.51	0.536		386			386	$52		$10
July	31	744	13.323	13.018	5.82	0.364		271			271	$36		$0
August	31	744	13.677	13.365	5.97	0.395		294			294	$40		$0
September	30	720	17.267	16.872	7.54	0.820		591			591	$80		$15
October	31	744	16.806	16.422	7.34	0.758		564			564	$76		$14
November	30	720	12.567	12.279	5.49	0.298		214			214	$29		$5
December	31	744	19.387	18.944	8.47	1.265		941			941	$127		$24
Annual	**365**	**8760**		**15.653**	**6.998**			**6,184**	**0**	**0**	**6,184**	**$833**	**$12,600**	**$140**

Wind REC	$0.0250		
Electric Cost	$0.1347		
Wind Shear Exponent alpha	0.150		
Wind Data Height (m)	11	35	feet\
Hub height (m)	9	30	

Wind Systems
Production Rebate Amount
Feasibility Study 50% of project costs up to $50,000 Incentive

1-16,000	$3.20 per kWh	$21,845.19
16,000-750,000	$0.50 per kWh	
		$21,845.19

ANALYSIS - 2

Wind Speed, mph	Hours at Speed	Adjusted Speed, mph	Adjusted Speed, m/s	Rate Output (kWe)	Generated kWh
0.00	504	0.000	0.00	0.00	0
3.00	24	2.931	1.31	0.03	1
6.00	24	5.863	2.62	0.06	1
7.00	24	6.840	3.06	0.07	2
8.00	192	7.817	3.49	0.07	14
9.00	120	8.794	3.93	0.11	13
10.00	528	9.771	4.37	0.15	78
11.00	600	10.749	4.81	0.18	110
12.00	336	11.726	5.24	0.25	83
13.00	1032	12.703	5.68	0.34	346
14.00	480	13.680	6.12	0.43	207
15.00	1032	14.657	6.55	0.55	565
16.00	432	15.634	6.99	0.66	287
17.00	1008	16.611	7.43	0.78	787
18.00	360	17.589	7.86	0.97	351
19.00	168	18.566	8.30	1.18	199
20.00	216	19.543	8.74	1.39	301
21.00	120	20.520	9.17	1.60	192
22.00	168	21.497	9.61	1.81	305
23.00	192	22.474	10.05	2.01	385
24.00	240	23.451	10.48	2.08	499
25.00	120	24.429	10.92	2.15	258
26.00	216	25.406	11.36	2.22	479
27.00	48	26.383	11.79	2.29	110
28.00	96	27.360	12.23	2.36	226
29.00	48	28.337	12.67	2.40	115
30.00	24	29.314	13.10	2.40	58
31.00	96	30.291	13.54	2.40	230
32.00	24	31.269	13.98	2.40	58
33.00	120	32.246	14.42	2.40	288
34.00	48	33.223	14.85	2.40	115
35.00	24	34.200	15.29	2.36	57
36.00	24	35.177	15.73	2.31	56
38.00	24	37.131	16.60	2.21	53
62.00	24	60.583	27.08	0.000	0
126.00	24	123.120	55.04	0.000	0
		AVG	10.68		
	8,760				6,827
					0.3247061

9900

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

	Turbine #1 Generation, kWh	Turbine #2 Generation, kWh	Turbine #3 Generation, kWh	Total Generation, kWh	Electric Cost Offset	Annual Maint Cost	Wind REC Revenue
Annual	6,827			6,827	$920	$12,600	$171

Description	Qty	$/Unit	Material Cost	Labor Cost	Total
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	$0	$0	$0
Sub-Total			$30,000	$10,000	$40,000
NJ Incentive					$21,845
Total Cose Less Incentive					$18,155
					$61
Annual Maintenance	1	$250	$250		