

Analysis 3: Solar Parking Lot Lighting

Introduction

Renewable energy such as sunlight can be a great alternative to non-renewable energy that is commonly used to generate electricity. Non-renewable resources are lessening and we need to begin to use other sources for energy, especially in the use for buildings.

Renewable energy can provide benefits such as having a lower impact on the environment than non-renewable energy sources and lessening monthly electric bills. Also since renewable energy usually comes from a local source close to the building's site, it is great for the local economy. Finally it decreases our support for foreign oil supply which is a crisis our country is facing today.

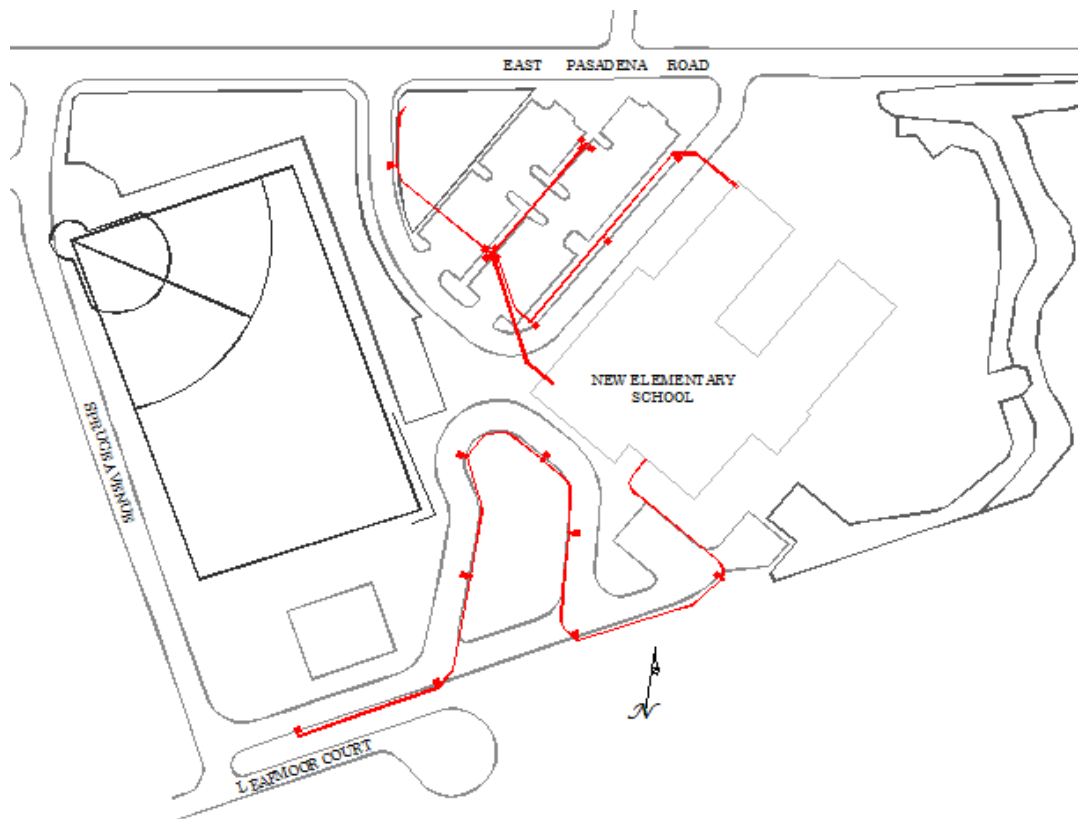
Solar lights can have high initial costs compared to conventional lights, but they can have considerable lifetime savings.

Original Exterior Lights

In the original design there are 14 light fixtures in the school parking lot with the following characteristics:

- Lamps: 1-400 Watt Metal Halide (MH)
- Manufactured by Gardco, a Phillips group brand
- Catalog Number: G18 – 1 – 2XL – 400MH – 277/SSA5 – 28M
- Single High Intensity Discharge (HID) Unit
- Type II Distribution
- http://www.sitelighting.com/brochure/g_gullwing_broc.pdf

Notice below a siteplan showing the location of exterior lights.



Site Plan Showing Location of Exterior Lights

Previously metal halide lamps (will be referred to as MH from now on) have been used in many commercial applications. However, solid state lighting including light-emitting diode lamps (will be referred to as LED from now on) are increasing in numbers of applications due to their advantages over high intensity discharge lamps, which is the family that metal halide lamps belong to. Below is a comparison between LED lamps and MH.

MH

- Requires start-up time
- Life span around 20,000 hours
- Causes light pollution
- Contains gases at high pressures

LED

- Does not require start-up time
- Lifespan around 100,000 hours
- Reduces light pollution
- Contains no mercury or halogen gases

In addition, LED lamps generate less heat and have overall greater system efficiency than MH.

Proposed System

Below is information about the proposed solar parking lot lights to replace the lights from the original design:

Manufacturer	Solar Illuminations
	744 LED
	4500 lumens
Lifespan	100,000 hours (22 years)
Power	140 Watts
	24 Volt system
Finish	Silver/Gray
Price	\$3,325 with 26' pole

Refer to Appendix E for further product specifications.

The lights are automated by photocells or light sensors and are able to reserve power for about 5 days in case of bad weather situations.

The lights come complete and ready to install with a battery box, 2-12 volt batteries and an installation kit. The light output is similar to that of a conventional exterior light produced by 200-400 watts which corresponds to the original design.

LED lamps do usually require a higher initial cost than other lamps due to a greater difficulty in their manufacturing process. The original schedule shows the site lights being installed from 13 June 2007 to 03 July 2007 for a total of 15 working days.

Lifetime Cost Savings Analysis

The average retail price of electricity was 11.39 cents/kilowatt hour for Maryland as of December 2007. Assuming the lamps will run for 12 hours each night a cost savings analysis is listed below.

Solar Lights (140 Watts)

$$\begin{aligned}
 &12 \text{ hours} \times 0.14 \text{ kilowatts} = 1.68 \text{ kW hour} \\
 &11.39 \text{ ¢/ kW hour} \times 1.68 \text{ kW hour} = 19.135\text{¢ /lamp/day} \\
 &19.135\text{¢} \times 14 \text{ lamps} \times 30 \text{ days/month} = \mathbf{\$80.37 \text{ per month}}
 \end{aligned}$$

Original Metal Halide Lamps (400 Watts)

$$\begin{aligned}
 &12 \text{ hours} \times 0.400 \text{ kilowatts} = 4.8 \text{ kW hour} \\
 &11.39\text{¢/kW hour} \times 4.8 \text{ kW hour} = 54.67\text{¢ /lamp/day}
 \end{aligned}$$

$54.67\text{¢} \times 14 \text{ lamps} \times 30 \text{ days/month} = \mathbf{\$229.61 \text{ per month}}$

Monthly savings = $229.61 - 80.37 = \$149.24$

$\$3,325 \times 14 / 149.24 = 26$ years initial costs will be paid in full

This amount of time is only a small amount greater than the lifetime of the product and therefore the product basically pays for itself.

Conclusions

It was found that solar lights for the use of exterior lighting in the parking lot would have been a great alternative to the original design that uses metal halide lamps.

The solar lights use less energy than the conventional lights and provide the same atmosphere. Although they require a higher initial cost, there would have been a monthly savings of \$149.24 in the electrical bill. The solar lights would have taken 26 years to completely pay themselves off which is only 4 years longer than their lifetime of 22 years.

Solar lights are beginning to gain popularity, but are not yet accepted fully or considered the norm in commercial buildings. It would most likely be hard to convince the owner of this option for use in their parking lot, but these lights provide a great savings in energy and use renewable resources that cannot be compared to the slightly higher initial cost of the product.