

SOLAR STREET LIGHT

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Abstract: The demand of energy has increased in the world now. So, to fulfil the demands of energy more and more fossil fuels are used, as a result fossil fuels will extinguish in future if they are used at such a rate. To replace the loss of fossil fuels we can use renewable energy as they are freely available and adequate. Today, LED (light emitting diode) lamps have replaced the HID (high intensity discharge) lamps that were used in urban street lights. Solar street lights work on the principle of photovoltaic cell or solar cell. In short, this paper is based on the idea of maintaining the maximum utilization and minimum loss of available energy.

Keywords— Demand Energy, Fossil Fuels, LED

1. Introduction

Solar energy is the radiant energy emitted by sun. Solar energy can be converted into electricity in two ways:

1. Using photovoltaic, or
2. Indirectly using concentrated solar power.

a. Objective

1. To replace the growing energy demand by using renewable energy source as solar.
2. To light up the areas where there are many power cuts.
3. Solar lights use low power consumption.
4. Solar energy can be used for long term.
5. Solar energy is reliable in nature.
6. Solar energy requires low maintenance.

2. Components of Solar Street Light

1. Solar Panel

This is the prerequisite part of solar street lights, as solar panel will convert solar energy into electrical energy. Solar panels are of two types:

- Mono-crystalline, and
- Poly-crystalline.

Note: conversion of mono-crystalline solar panel is much higher than poly-crystalline.

2. Lighting Fixture

LED is used as lighting source of modern solar street light as it provides much higher Lumens with lower energy consumption which is around 50% lower than HPS fixture.

Note: HPS fixture is high pressure sodium vapour lights. It is a specific type of gas discharge light and is also known as **High Intensity Discharge (HID) or Arc Light.**

3. Rechargeable Battery

A rechargeable battery stores the electricity from solar panel during the day time and provides energy to the fixture during the night. The rechargeable batteries usually are of two types:

- Gel cell deep cycle battery
- Lead acid battery.

4. Pole

Street poles are mandatory part to all street lights. This is because there are often components mounted on the top of the pole like:

- Fixtures,
- Panels, and
- Batteries.

3. Solar Power System

This system is classified in two broad categories as shown in the Figure 1 diagram

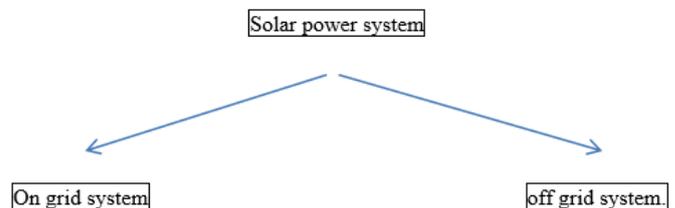


Figure 1 Solar Power System

NOTE: 1. On grid power system is power system energized by photovoltaic panels connected to the utility grid.

2. The term off grid system means self-sufficient living without depending on one or more public utilization.

4. Solar Street Light Controller

Though solar lighting system is cost efficient and eco-friendly, some people are still hesitant to shift from regular lighting system to solar lighting system because initial investment is required. Let's now understand how solar control system works which will help you understand the merits of using the solar lighting systems.

1. Control Center

The main monitoring platform of the control system is the control center consisting of PC, server, solar streetlight control software, web server, and many more devices which

enable it to receive data from GPRS/CDMA module of data center.

2. Gateway

Gateway's main function is to collect the terminal controller's data collected from the solar lights. The **ZIGBEE** signal is converted to GPRS/Ethernet signal which are forwarded to control center.

3. Terminal Controller

It works on managing, charging and discharging solar system batteries.

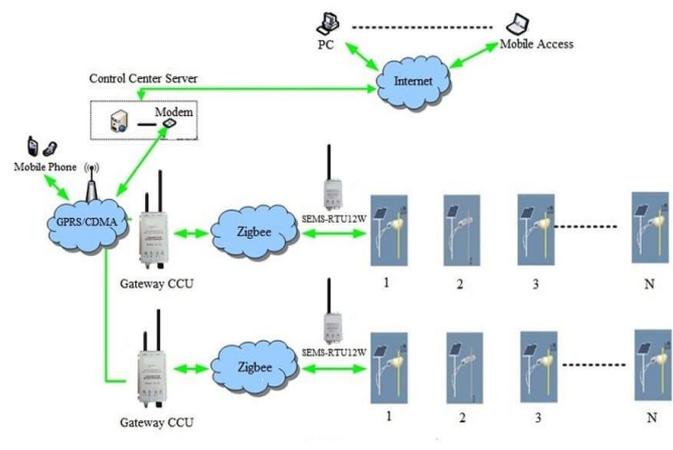


Figure 2 Control system for solar street lights

LDR (Light-Dependent Resistor)

Light dependent resistor is also known as photo resistor or photocell is a light controlled variable resistor. This is especially useful in dark/light sensor lights. The resistance of LDR is very high, 1000000 ohms at times.

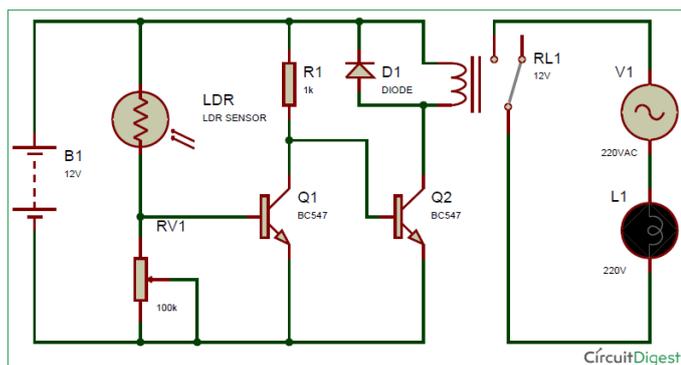


Figure 3 Automatic street light using LDR

LIGHT EMITTING DIODE (LED)

In modern solar street lighting the main lighting source are the LEDs as it will provide much higher lumens with lower energy consumption. It is note-able that LED fixtures use 50% less energy than HPS (high pressure sodium) fixtures. LEDs have more lifespan than CFL lamps. They consume less energy. Unlike conventional Lamps they can be recycled. It requires low maintenance and generates less heat. LED has the chemical compound that gives light when direct current

(DC) from the battery passes through it. Solar LEDs are available in different sizes, shapes and styles from different companies. The life of LED extends up to 50,000 hours which is usually very high. Very little current is required by the LEDs hence small sized solar panels are required for the solar lights with LED lamps.

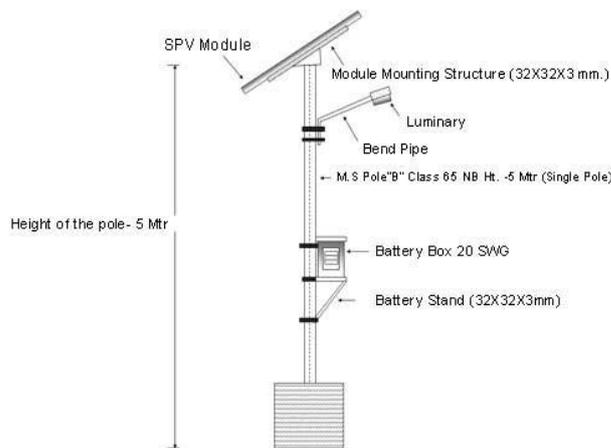


Figure 4 Solar panels

5. Working of Solar Street Lights

Solar energy in a form of the renewable energy is used in solar street lights. Today it is common to see the solar street lamps along the sides of roads. The solar street lights absorb the solar energy during daytime. The solar energy gets converted into electrical energy by the photovoltaic cells, which is stored in the battery. During night-time the lamp starts automatically and the electricity already stored in the battery gets consumed. The battery gets recharged during the day-time and the process keeps on repeating every day.

The **Regional Engineering College Warangal (RECW)** has provided complete solar street lighting system which included installing, design and the technique. They have designed the system with their own in-house solar DC luminary, pole and other accessories. They have some standard street lighting system mentioned below in Table 1:

Table 1: Standard street lighting system

| Model | Solar Panel | Battery | Operation Time | Autonomy |
|------------|-------------|---------|----------------|----------|
| RBFNSL-9W | 40 Watt | 40 Ah | 12 Hrs | 2 days |
| RBFNSL-12W | 50 Watt | 60 Ah | 12 Hrs | 2 days |
| RBFNSL-18W | 75 Watt | 80 Ah | 12 Hrs | 2 days |

These System Consists materials shown in Table 2 –

| S.No | Item | Description | Unit |
|------|-------------|------------------------------|--------------------|
| 1 | Luminary | Led technology Dusk to dawn | 1 |
| 2 | Pole | GI or MS | 1 |
| 3 | Battery | dry Battery maintenance free | 1 |
| 4 | Battery Box | MS, GI | 1 |
| 5 | Solar panel | Polycrystalline panel | 1 |
| 6 | Wire cable | 2 core Dc cable | As per requirement |

As per the requirement of customer they can also provide customized system. Type of Designs for Standalone Street lighting System.



Figure 5 Standalone street lights

6. Advantages and Disadvantages

a. Advantages

1. Solar street lights require less maintenance.
2. Minimum risk of accidents since external wires are absent.
3. It is eco-friendly i.e., non-polluting source of electricity.
4. Separate parts of solar lighting system can be easily carried.
5. Energy saving and cost efficient plan.
6. Operation costs are minimum since the solar street lights are independent of utility grid.

Note: Utility grid is usually a commercial electric power distribution system.

b. Disadvantages

1. Initial investments are higher.
2. High risk of theft.
3. Energy production can stop when snow or dust combined with moisture can accumulate on horizontal PV-panels.
4. Rechargeable batteries are needed to be replaced several time.

7. Conclusion

This paper of SOLAR STREET LIGHTING SYSTEM is cost efficient, practical and eco-friendly and very safe way to save energy. It very efficiently tackles with two main problems of today: saving of energy and disposal of incandescent lamps. Energy consumed by the highways now-a-days can also be saved that is the electrical energy by replacing it with solar energy.

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