

A STUDY OF SOLAR STREET LIGHT AND OPTIMIZATION FOR SPACING IN POLES AND COST

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ABSTRACT

In this paper we are studding the convectional led light of renewable energy of electrification. Now the India has been using the remote control of energy in solar power. Solar electrification is the most important part of the developing in India as it is urban area or rural area. In this paper, we are focusing the optimization of solar electrification to charge of power, cost efficient and efficiency effect. Also discuss the how LED light is more efficiently as compare to the CFL light in solar street light. We will discuss the study of LED light and CFL light about access the energy in solar project. Solar street light project has developed by new technology as automated control system, tubular battery, panel's type. India is using the solar street light in rural areas because of the less transportation of electricity in rural areas. We are studding the rural street light in Rajasthan to generate the solar electric light in road. Solar Street light is friendly behavior of human being to save the energy and reduces the criminal cases on road in night and also reduced the accident in night. Street light optimization is discussing the sufficient of street light in an area of road in INDIA.

We are discussing the population of rural area and use the street light to evaluate the effect on environment by the different type of light.

KEY WORDS: Solar street light, rural development, Renewable energy, Energy conservation, Distance optimization.

1. INTRODUCTION

Theoretical work

The research of light has been crucial in solar power system. It is work on sun light to photovoltaic cells. The natural lights which come from sun rays is absorbed by the solar photovoltaic and create the energy into the electric energy. Electric energy is stored in batteries and flow the current in CFL or led light. Now these days, the improvement of the research in electricity by the sun rays is the more efficiently and less light pollution. In present day, we are using the CFL and Led light in street light system. CFL and LED light has less maintenance cost, but the led light has high installation charge. But the maximum efficiency of the LED light is good by its given luminance and a better illumination comparison to CFL light.

The source of light sun which provides the illumination is conducting the semi conductor material. The solar panels are the device which converts the light energy to the electric energy. Mono-crystalline and Polycrystalline are the basic type of solar panel. Mono-crystalline has more efficiency as compare to Polycrystalline. Mono-crystalline panel has some demerit it stops when the any part of crystalline in shadow.

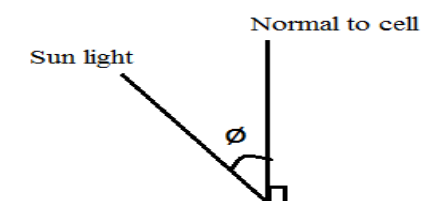


Fig. 1- Sun rays on solar panel

Table 1: Solar electrification in rural area in mw

YEAR (data up to 2011)	electrification in rural areas covered	Solar lightning system (million)	Solar electrification in rural areas covered	Solar system (mw) given in rural areas
Till 2011	7500	0.2	30	132
2011 - 2012	500	0.6	30	68
2012-2013	.	1.2	40	100
2013-2014	.	1.2	40	150
2014-2015	.	1.2	50	200
2015-2016	.	1.3	50	200
2016-2017	.	1.3	60	250
TOTAL	500	6.8	270	968

Source: MNRE, 2011_17.

Solar energy convert of electric energy is stored in battery in power which gives the current of light bulbs. Battery is supported to load of the invertors to carry the control of charge the battery. We use the tubular battery in the solar system to reduce the resistance in battery and the wires. Solar heat to electricity is no convectional recourses. Solar panel are fixed in series and in parallel, each cells are made on silicon to increase the current. The crystalline silicon as like ribbon and thin silicon are most popular in solar system. Led light are based on silicon carbide and it is less emitted diode. In rural areas are using the led much better than other lamp. Led save not also power but also money standard all other current and consume the 50% power saving. Led has the good white brightness and it's available in large production. Cause of much appliance it's shipping in large amount of production for the consumer. Solar power system has take place the fossil fuel in some area as well as home power, street light, industries etc. Renewable energy has adoption the some type of power like water power, wind turbine, tidal power, and solar technologies.

Table2: Electricity generation in India

YEAR (data up to 2011)	Solar electricity generation SHP (medium capacity) (300 MW)	Solar power generation large capacity (MW)
TILL 2011	3040	35
2011-2012	350	300
2012-2013	300	800
2013-2014	300	400
2014-2015	300	400
2015-2016	350	1000
2016-2017	360	1100
TOTAL	1960	4000

Source: MNRE report, 2011_17.

Solar trackers are the work in the clean sky and track the sun rays for the good output. It tracks the one and two axis the sun rays. When tracker is track the sun rays it passes the one axis east to west throughout the whole day and the module of cells and the light do not change it direction it always fix on its angle. Controller is the device which controls the dc electricity and command to the device which control the electric gear machine to generate the electricity. It is used for the collecting on sun rays by the solar panel.

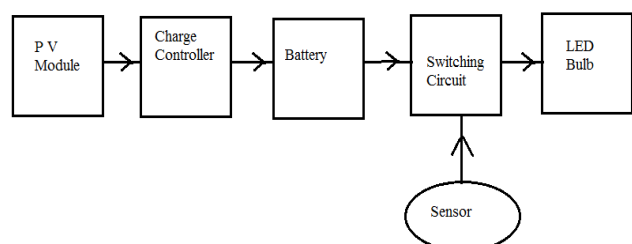


Fig.2- The block diagram of the solar street light system (IJESRT)

The rural area has developed the using the solar electrification and willingness to pay the charge of electricity. Solar electrification has less bill charge and less use of fossil fuel, great brightness of light. Street light turn off and on automatically by the sensors. In winter season when sun does not arise it can maintain automatically. Now the available of latest technology of street light we found the new types of installation of street light like wireless technology, fuzzy method. Street light has neither pollutants nor rotating parts and no moving parts causes of this government approved the authorized of street energy to research of solar projects.

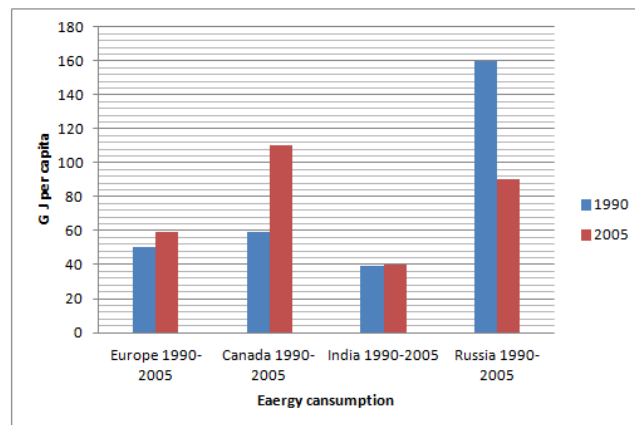


Fig 3- Energy consumption in countries

In India has become the major problems of the supply of fuel and it is also going to be misbalanced to supply the energy. India is importing the 80% of fuel in couple of year so it is becoming the major roll of problem in security of energy. The uses of large amount of energy in electricity has needed the new generation of production of electrification. The demand of light in industry, institute and residence is increasing the value of thermal plants in using fuels and the demand. The rural areas where the lack of electricity is using the more amount of kerosene. This is all decreasing the value of subsidies of government and increasing dependence the important of fuel.

Energy Consumption

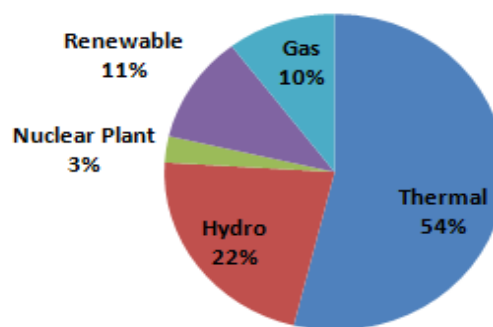


Fig.4 - % in energy consumption

The renewable of energy has supporting in area of energy in residential, industrial, commercial and rural area. The renewable energy has less effect of environment. Government has approved the power of the energy resources in the basic plans and change to the

ministry of using of the renewable energy in large amount. The renewable energy is using the grid/off-grid distribution of light in resources in the rural areas. The vision of the government to use of next generation of electricity has prepared the affects of the atmosphere in local area, national and worldwide energy consumption. To calculation of development, decreasing, the total use and the going to be use of energy are measuring by the scientific, numerically and the technical equations solution now available.

Table3: Efficiency of solar panel

Common Solar Cell Material	Efficiency in %
Single Silicon(Si)	15% -20%
Poly/mono Silicon (Si)	10%-15%
Amorphous Silicon (A-Si)	5%-10%
Gallium Arsenide (GaAs)	25%-30%
Cadmium Telluride (CdTe)	7%
Copper Indium Diselenide (CIS)	10%

The important principal of street light has become the requirement of safety, security, environmental issue and the cost effectiveness of the road lights. Te government takes place in rural area and urban area to use the street light by the help of solar renewable resources. This is the awareness of the accident which is harmful for the human being and pedestrianism of the road side in rural areas for drivers. It has created the main roll of stop the criminal activities on road. When we design the any type of light we must consider the round of the area like residential, commercial, street light and the industrial. Different area wants the different type of design in street light as it airport or road way street light. The changing of vision of light has become the growth of the rural street light or urban street light. There are many segment types of situation of read as it is single road then the one side road electrification and the double road in the double side road electrification. The strategy of the road is depend of the road as it is single or double. The distribution of light is calculated of the distance and height in short size, medium size and high side of the strategy of road.

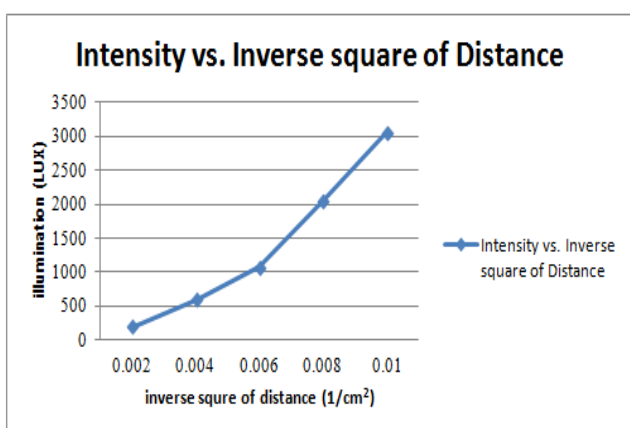


Fig.5- Intensity vs. distance (1/cm²)

Rajasthan has the big area of India’s map and the deserts have the large ball of this state. Rajasthan has parted with 33 districts, 244 Tehsils, 249 panchayat and 184 urban cities. The area of lighting in Rajasthan has forward in urban states and the rural states. Rajasthan are using the non convectional of solar resources of solar photovoltaic products in street light. Now the Rajasthan is using the solar products in street light, historical buildings, residential areas, commercial areas and the industrial areas where the electric light is being more costly. This type of solar street light has possible to good achievement to result of energy cost, consumption and the maintenance. And the color of light is choosing by the selection of area.

2. OBJECTIVE AND MATERIAL

2.1 Objective

The objectives of solar street light are using optimization of cost in the rural area of India with LED light. The calculation of LED and CFL light in street light are servicing with efficient and less of cost use. The major objectives of solar street light have promoted the reducing of fossil fuels and increase the using of new technology of renewable energy sources. The mobilization of financial report of rural areas has implemented in renewable energy sources and generating of electricity by the renewable energy.

The electricity is using in the rural areas increase continuous day by day so the developing of energy resources by appreciate the demand and need of them street light system. To increase the energy efficiency and avoid the other generating energy sources. The focus of renewable energy has developing of the village street lighting system.

The further use of solar street light system has removed the many problems of the rural area like that crime rate, increase the community of people at work etc. The solar street light system has no pollution like other power generation plant and it is non-convectional system to less space and efficient electricity output.

2.2 Problem definition

The rural areas have no solar street light system, the rural areas of people has difficulties of late night working. The rural area is far from the main cities so supply of electricity is not possible to every village. The resources of electricity are also less than the demand which is increasing continuous every year. This research focus on sustainable development in rural areas through solar street lights this research focuses on the latest eco-friendly technology and its suitable use for rural development.

Problem assumption

- To keep the various parameter in street light to installation in the rural area in India.
- To optimize the cost of the solar street light and distance between the two pole.
- To optimum area of the installation of street light in villages of India.

- To calculation of the battery and panel in using of street light by according of the use of light (CFL & LED).
- To show the effect of the emission of pollution and heat effect on the environment.
- To doing the economy and good payback period of the solar street light.

Problem limitation

- 9 watt, 18 watt, 15 watt and 30 watt light use in the solar street CFL and LED light.
- Take the energy efficiency of solar panel in 14% efficiency of the available in India.
- 12 volt battery in the nominal voltage and tubular battery use in the street light installation system.
- G. I. pole in the nominal height in 4m and 5m with the 2 core 2.5 segment wire.
- Polycrystalline solar panel is used in the 12 volt and 25^o C temperatures.

3. MATERIAL AND METHODS

3.1 Solar cell working principle:

Solar panel is the device which converts the solar energy to the electric energy by the help of semiconductor. Solar panel has made of thin silicon plate. This silicon plate is working in the mono-crystalline and the polycrystalline. Solar panels are connected to the series and parallel when they fix in series and parallel it called module. Solar cell module produced the DC electricity according to the STC (Standard Test Condition). Solar cell efficiency depends upon the module by given area for its output. Solar cell produced the limited electricity for the single function. There are many types of power wants the multiple modules for multiple outputs.



Fig 6- solar cell 74 watt

Solar cell module plates are made on crystalline cell (wafer based) and the thin film cell (cadmium telluride and silicon). Solar cell module can take load on the top of the plate and back of the plate and it has the safety protection based on the mechanical and moisture for its damaging problem. Solar module's structure has rigid body and the thin film plate solar module are flexible available in the market also. We can find the easily solar module according to its desired voltage or current. Solar

panel module use the connection of the MC3 and MC4 are available easily with the weatherproof and the free from the moisture.

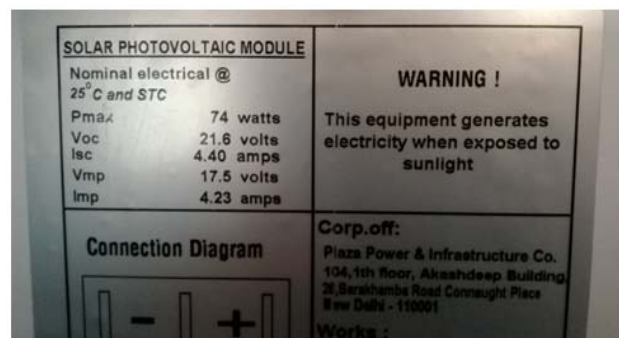


Fig 7 specification of solar cell

Solar panel modules are the fix on the fixed rack above the pole and fixed across the sun. Now the solar module can be recycle and the produced the power throughout the end of life.

3.2 Materials

Silicon is the most admired material for solar panel it is semiconductor material and with the evolution of nanotechnology efficiency of solar panel get increase. Doping is done in silicon cell to increase the efficiency of solar panel.

Different material through which solar cell is made are:

- Silicon
- Amorphous Silicon (A-Si)
- gallium arsenide(GA As)
- cadmium telluride (CdTe)
- Copper indium Diselenide (CIS).

3.3 Types of solar panel

There are three types of solar panel which are following:

1. Polycrystalline solar panel
2. Mono-crystalline solar panel
3. Hybrid solar panel



Fig.8- solar panel 20 watt

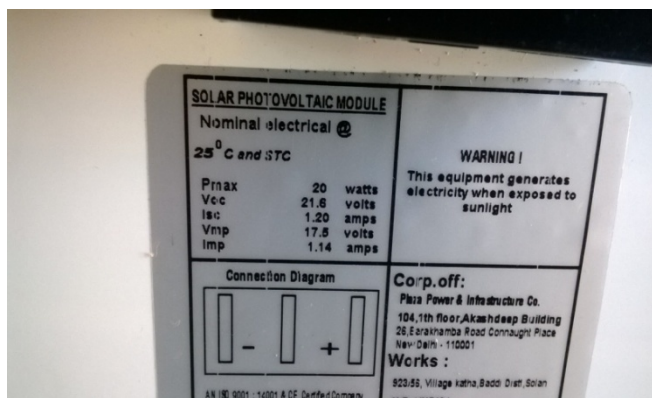


Fig.9- Technical specification of 20 watt solar panel

3.3.1 Polycrystalline solar panel

Polycrystalline solar panel is also called the Poly-silicon. The material of polycrystalline is use of small silicon crystals which are different from the single crystalline silicon. Polycrystalline material has contained the small crystals of silicon. Polycrystalline is made of 99% pure silicon.

3.3.2 Mono-crystalline solar panel

Mono-crystalline solar panel is the single crystal panel which is based on the industry composition. Mono-crystalline solar panel is made of the single crystalline on the entire of solid plate continuously. Mono-crystalline solar panel is more efficient to the polycrystalline but behavior of the work polycrystalline is much better than the mono-crystalline.

3.3.3 Hybrid solar panel

Hybrid solar panel is the made of both combinations organic and inorganic. These organic and inorganic structure is worked in hybrid for the donor and acceptable. The organic structure donates the power and it is made of conjugate polymer materials. The inorganic structures are accepting the power in form of electricity. Hybrid solar panel is the latest technology in the industries for providing the better efficiency to other solar products. Hybrid solar system is not only the purpose of solar collecting but also it scales the power of panel collecting.

Table 4: Solar panel rupees per watt

Products	Inputs / Watt	Price / INR
Special SPV Mono	180W / 190W	Rs. 34/W
Special SPV Multi	230W, 240W, 245W, 280W, 290W	Rs. 32/W
SPV Mono	10W	Rs. 53/W
SPV Mono	20W - 30W	Rs. 43/W
SPV Mono	30W - 300W	Rs. 41/W
SPV Multi	10W	Rs. 50/W
SPV Multi	20W - 30W	Rs. 40/W
SPV Multi	30W - 300W	Rs. 38/W
Thin Film Multi SPV	100W	Rs. 32/W

Source: Market cost per watt

Efficiency Table

Table 5: Showing solar cell efficiency for different material

Common Solar Cell Material	Efficiency in %
Single Silicon(Si)	15% -20%
Poly/mono Silicon (Si)	10%-15%
Amorphous Silicon (A-Si)	5%-10%
Gallium Arsenide (GA As)	25%-30%
Cadmium Telluride (CdTe)	7%
Copper Indium Diselenide (CIS)	10%

Sources: MNRE report, 2011_17.

3.4 CFL LIGHT

CFL (compact fluorescent light) is made for the interchange of the incandescent light. It is more capable and efficient to the incandescent light. According to the power saving, compact fluorescent lamp takes the one third or one fifth part of power save compared to the incandescent light. Compact fluorescent lamp takes the eight times extra in compared to the incandescent lamp also. Incandescent lamp is less leverage cost then the compact fluorescent light but the compact fluorescent light has the extra lifetime and less electric bill then he incandescent light.

Types of compact fluorescent light

Compact fluorescent light are two types:

1. Integrated compact fluorescent lamp
2. Non-integrated compact fluorescent lamp

3.5 Integrated compact fluorescent lamp

Integrated compact fluorescent lamp is the mixing of light tube and bed in the single unit. Compact fluorescent lamp has available in the market and reduced the price of electric bill more than the incandescent lamp. Integrated compact fluorescent lamps are available in the market in form of 3-way light tube.

3.6 Non-integrated fluorescent lamp

Non-integrated compact fluorescent lamp has the permanently installed the ballast in the form of lumens and light bulb tube depended to end of life of the bulb. Non-integrated lamp is the greater than the integrated light. It has larger size of tube to the show the better luminaries.

Table 6: CFL required cost of battery with volt and AH

CFL (watt)	Volts required	AHrequired	Cost of battery (Rs.)
9	12	37	2890
15	12	62	3670
18	12	75	4338

It has fix of ballast in internal of the fixture. Non-integrated lamp does not replace the light bulb. Non-integrated lamps have not good efficiency in compared to the integrated lamp and it is costly.

CFL light are using in the street light projects. CFL light has replaced the incandescent lamp in street light area causing the saving of the energy and the control the resisting of power of the battery.

CFL keep the adjustment of the power of street light on the basis of battery backup. Many countries have used the CFL in street light at the urban and rural area. Fluorescent tube is also used in street light. CFL light has removed the high pressure mercury lamp and use the slow light wattage bulb and accomplish to 20-25% electric saving.

Table 7: CFL in average lumen in watt per day

CFL (watt)	Average lumen	Watt per day (10 hour glow)
9	436	7
15	811	12
18	1011	16

3.7 Calculation of CFL for life

Total life of CFL = 6000 hours

CFL will glow 10 hour in a day

So no of days are $6000/10= 600$ days

To convert into year $600/ 365= 1.6$ year

Table 8: CFL life in hour and years

CFL(watt)	CFL life (hours)	CFL life (years)
9	6000	1.6
15	6000	1.6
18	6000	1.6

3.8 Light emitting diode (LED Light)

Light emitted diode is the light source in the integrated light. Light emitted diode has the fixture and ballast in the same circuit. Light emitting diode has emitted the light because of the activation of resembling in the PN-

junction and two lead semiconductors. Led light has made of 1mm2 area bulbs in a series.

Led light has discovered in normally 5mm and T1/4, but it is more powerful in brightness of light. Blue and white light has made on the vital different crystal segments of nucleon but the causes of the high brightness and high efficiency it has replaced the CFL, Incandescent lamp and fluorescent lamp.

Table 9: LED light average lumen in watt per day

Led (watt)	Average lumen	Watt per day (10 hour glow)
9	1000	12
15	1600	16
18	1800	19

3.8.1 Type of led light

There are four types of led light.

1. Miniature led light
2. Mid-range led light
3. High power led light
4. Ac driven led light

1. Miniature led light

Miniature led light mount of the single die led which used in the indicator. The manufacturing of the miniature led light is 2mm to 8mm and in the distinctive current.

2. Mid-range led light

Mid-range led light is use in the behavior of holes and produced of barely o/p of lumens of light. Mid-range led light wants the four diodes two anode and two cathode diode become a suitable heat acquit.

3. High power led light

High power led light is need of the more than 100mA and current.

4. Ac driven led light

Ac driven led light works on the ac current it does not need the dc current. Air conditioner light needs the ac driven light. Ac driven light control in the ac circuit and the very simple circuit for driven the ac driven led light.

3.8.2 Application of led light

The applications of led light are following:

1. Ac driven led light are widely use in traffic signals and the automobile indicators.
2. Street light for rural and urban area.
3. To communication the data and other signal resources.
4. In basic light and other lighting resources.
5. For saving the energy utilization.
6. To show the data in machineries.

7. In electronic contact lens.

3.8.3 Calculation of led for life

Total life of led = 20,000 hous (syska led life = 60,000)

LED will glow 10 hour in a day

So no of days are 20,000/10= 2000 days

To convert into year 2,000/365= 5.5 year

Table 10: Led life in hour and year

LED (watt)	LED life (hours)	LED life (years)
9	20,000	5.5 year
15	20,000	5.5 year
18	20,000	5.5 year
30	20,000	5.5 year

3.9 Control system

Automated control system is using the street light to switching ON and OFF instead of work manually. The organization of energy has worked on the street light to generate the automatic control system. They have not worked other area in street light but choose the system to make effective and efficiencies. So, they have developed the automatic control system in street light. To changes of economic problems dynamic, using the national and international of modernization has prepared the supply cost of energy, effectiveness become the major roll of the street light. Then need to be the quite acceptable function in street light. As like to consideration of traffic problems and reducing the energy consumption is changing the value of street light. The reduction of operational cost in automated system has made the main function of solar street light. It does not affect the any emission in environment.

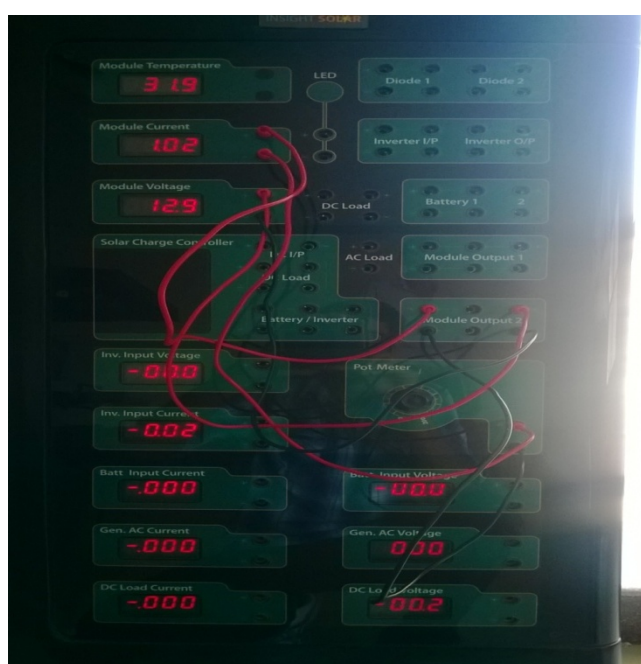


Fig.10- Reading of panel in ecosense solar meter

Automated control system in sensors which works measured responsible to the changes in physical condition like the temperature and thermal conductivity. Microcontroller is the device which analyzed the data inputs by the IR and light dependent resistance. The microcontroller street light automated system is not only the up and down system but it is made a valuable product in market. Automated street light has become the efficient valuable energy saving in the every area on streets like traffic lights, street light, communication, and the solar resources. The outcome of the automated street light has major result of the market and expected to grow up the outcome result will increase dramatically with the new generation of street light.

3.10 Battery

Battery is an electric cell or a device which convert the chemical energy into the electrical energy. Battery is the device which connected to the two or more cells in the series and the parallel. Battery is also the power of single cell. Each cells are consist the liquid, gas and solid electrolyte to connect the positive electrode and the negative electrode. Battery is working as the electrodes in form of power then the electrons are work throughout the cells and the electric current flow in the system. The positive electrode is work on the cathode rod and the negative electrode work on the anode rod.

3.10.1 Types of battery

There are two types of battery:

1. Primary battery
2. Secondary battery

3.10.1.1 Primary battery

Primary battery or single cell battery are used as the irreversible cells once electrode materials during the discharged. The alkaline batteries are use in the portable device. Primary battery does not charge after the discharge of any system.

3.10.1.2 Secondary battery

Secondary battery is performing as the reversible battery. Secondary battery can be discharge and the charge as it current at the multiple times. The composition of the anode and cathode can be restoring the current. The secondary batteries are like the lead-acid battery which is using the many areas like the vehicles, wrist watches, computers and the solar power projects. The worldwide battery companies has generated the more efficiently battery in the market. Batteries have more specified fuel used like the gasoline. Battery has the voltaic cells who converts the directly the chemical energy to the electrical energy.

3.10.1.3 Calculation

We are discussing about the calculation of street light in luminaries of LED and CFL bulbs. The calculation of solar panel has defended to the watt per uses in street light and how is it effective. Solar Street light is the friendly technology to produce the efficient energy in rural areas in Rajasthan. In this research, we are finding the using of

street light by the calculation and cost effect on electric bills. If we calculate the theoretically values of the battery, volts, solar panel and flow of current then we take the following calculation:

Calculation for 15 watt luminary

Luminary = 15 watt

Battery used for this solar street light system = 12 V

Watt hour = 15 × 20
= 300 Wh

(15watt luminary and 2 day autonomy = 20hours)

Total load in milliamp-hour (mAh) = (watt hour × 1000) /volts (V).2

= (300 × 1000) /12

= (300,000) /12

= 25,000 mAh

= 25,000 /1000

(1 Ampere =1000 Milliamps)

= 50 Ah (Ampere-hour)

Efficiency of sealed tubular battery is 80 % so 80 % of 50 = 40 Ah

After consideration of losses battery required is 62 Ah

Battery required for 15 watt luminary is 12 V and 62Ah.

Charging current required for 12 V and 62Ah = 10 % of its Ah.

= 10/100 × 62

= 6.2 Ampere (A)

Solar charge controller must be of 12 v and 6.2 ampere

Theoretical watt required to charge the battery (P_{min})

Solar panel required for 12 V and 62Ah battery = Volts × charging current

= 12 × 6.2

= 74 watt

Practical watt required to charge the battery (P_{min})

Total losses =15%of 74 = 11 watt

Practical watt = theoretical + loss

= 74 + 11

= 85 watt

Solar panel of 85 watt with charging current of 6.2 Ampere is required.

Table11-Luminary battery cost

LUMINARY (WATT)	WATT HOUR EFFICIENCY	VOLTS REQUIRED	AHREQUIRED	COST OF BATTERY (RS.)
9	75%-81%	12	37	2890
15			62	3670
18			75	4338
30			125	6500
5			20	1290
11			45	2851
17			68	4070

Table12- Battery, charging current and solar panel required for luminary

CFL AND LEDWATT	AUTONOMY	BATTERY (AH)	CHARGING CURRENT (A)	SOLAR PANEL (W)
9	2days	37	3.7	50
15	2 days	62	6.2	85
18	2days	75	7.5	104
30	2 days	125	12.5	172
5	2 days	20	2.0	28
11	2 days	45	4.5	62
17	2 days	68	6.8	94

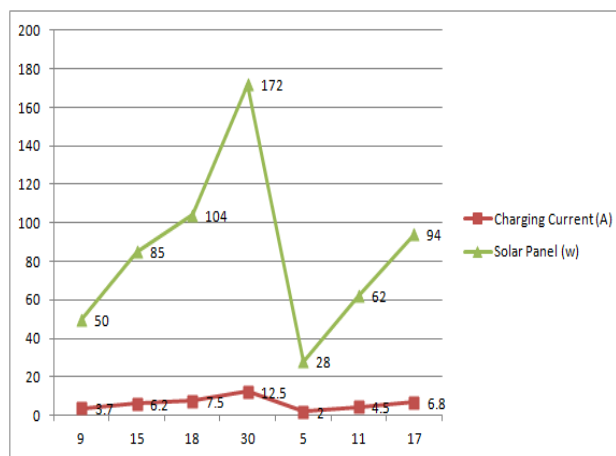


Fig 11- Battery, charging current and solar panel required for luminary

Table 13: CFL light in expensive (Rs.)

CFL (w)	Electricity consumption for 1 unit (hrs.)	No. of days	Monthly unit	Monthly charge 1 unit=10 Rs.	Yearly expense Rs.
9	111	11	3	30	360
15	67	7	5	50	600
18	56	6	6	60	720

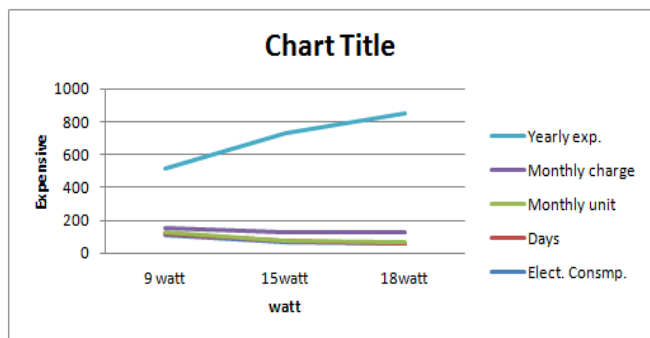


Fig.12- CFL light in expensive (Rs.)

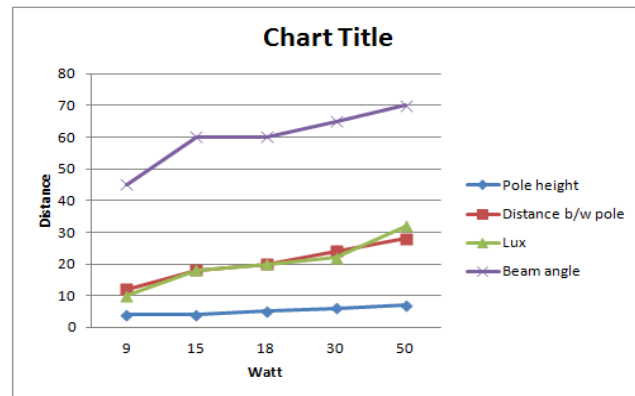


Fig.13- Distance b/w pole in solar street light pole

Table 14: LUX with pole height

LED wattage	Pole Height				
	4.5 m	5.25 m	6 m	6.50 m	7.25 m
9	10 lux	8 lux	2 lux	N.L	N.L
15	18 lux	14 lux	5 lux	2 lux	N.L
18	21 lux	17 lux	9 lux	3 lux	N.L
30	34 lux	29 lux	22 lux	10 lux	2 lux

Calculation of spacing of street light for 9 watt LED light

Calculation of space of two street light poles having the fixed wattage is 9 watt. The luminaries of street light 819 lm. For the sufficient road which has width of 12 foot in rural areas.

Lux (E) = 10 lux

Coefficient of Utilization Factor (Cu) = 5.3

Light lumen depreciation factor (LLD) =.8

Luminaries dirt depreciation factor (LDD) = .9

For distance between two street light = $LM \cdot CU \cdot LLD \cdot LDD / E \cdot W$

= $1000 \cdot 5.3 \cdot .8 \cdot .9 / 10 \cdot 12$

= 3816/120

= 32 ft. [1 meter = 3.2 ft]

The distance between two streets light is 10 meter

Table15: Distance b/w pole

Solar Street Light	Pole height (meter)	LED street light (power)	Optimum Distance b/w pole (meter)	Max. (illumination) lux	Beam Angle
1.	4	9	10-12	10	45
2.	4	15	12-18	18	60
3.	5	18	14-20	20	60
4.	6	30	18-24	22	65
5.	7	50	21-28	32	70

Calculation for cost of solar panel by considering the losses

As no system is 100 % efficient and each component of the system have certain due to which efficiency of system get decrease, economy of the system get increase. solar street light system also have losses associate with each component .we generally study losses in battery, panel and in wire .Our calculation is done by taking necessary losses for practical economical of our solar street light .

The efficiency of solar cell is 35 % in India, the power output of solar panel as per watt follows:

20 watt solar panel cost 12v poly generated electricity = 55 w/p (Rs.)

= 1500(Rs.)

50 watt solar panel cost 12v poly generated electricity = 55 w/p(Rs.)

= 2750(Rs.)

74 watt solar panel cost 12v poly generated electricity = 75 w/p(Rs.)

= 4070(Rs.)

100 watt solar panel cost 12v poly generated electricity = 75 w/p

= 5500(Rs.)

Table16: Cost of panel

LED (watt)	Cost of Panel up to 50 watt (Rs.)	Cost Panel greater than 50 watt(Rs.)
18	1650	-
30	2750	-
36	-	4500
60	-	7500

Table 17: LED and CFL lumen comparison

CFL		LED			
(watt)	Average lumen	Watt	Average lumen	Battery	Panel required
9	436	5	455	9 Ah	10 watt
15	811	9	1000	15 Ah	18 watt
18	1011	11	1100	19 Ah	22 watt
30	1581	17	1541	27Ah	35 watt

Table 18-Comparison of cost

CFL				LED					
luminary	Cost	Battery required	Battery cost	luminary	cost	battery	Battery cost	Panel required	Panel cost
9 watt	110	37 ah	1700	5 watt	1100	20ah	1205	15 watt	1540
15 watt	120	62 ah	3670	9 watt	2020	37ah	1700	28 watt	2750
18 watt	170	75 ah	4138	11 watt	2851	45 ah	3151	34 watt	4650
30 watt	399	125ah	6500	17 watt	3900	68 ah	3970	54 watt	7050

Table 19-Specification of minor component with cost

COMPONENT	SPECIFICATION	COST IN RS.
REFLECOR SPECIFICATION	ALLINIUM, CANOPY, STARTER HOLDER WITH INSULATION	1551
NUT AND BOLT	32 MM × 3MM GALVANISED STEEL POLE CLIPS WITH NUT AND BOLT	76.2 KG × 5 = 381
WIRE	2CORE 2.3 SEGMENT WITH SLEEVE	170
POLE (BATTERY BOX ,PANNEL STAND)	8 METER	2100
FOUNDATION	GI STEEL ROD WITH ISI SPECIFICATION AND ALSO FOR TIGHTENING RODS 1.2 LOG ,DIA 11MM WWITH CEMENT CONCRETE RATO OF 1:3:6	656

Table 20 Cost comparison for street light

CFL COST in (Rs.)		LED COST in (Rs.)		
9 watt	10707	11676	5 watt	8551
15watt	16322	18151	9 watt	11676
18watt	18244	21844	11watt	15458
30watt	26586	33016	17watt	20926

4. RESULTS AND DISCUSSION

All above data of solar street light in rural areas in India has shown in optimum value of the solar street light. In this solar street light system led is used to conserve energy and to bypass the use of conventional lamp (CFL) which decreases the life and efficiency of battery. In this solar street system inverter is not used instead of it dc lamp are used the result is analyses with the help of data as shown and also with the help figures .The optimization in street light system is depend upon the type of lightning required .Which is analyses through the

data and graph .It is seen that led have numerous advantage if used in street light system with cost and energy usage reduction. It is seen that if we replace CFL with LED the consumption of energy get reduce with proper optimization of height .The main aim of this study was to reduce the cost and energy consumption in solar street light system; from the graph we conclude that the replacement of CFL with the LED is efficient with decrease in consumption of electricity .Led shows adventurous for every parameter we discus in terms of lumen , cost, height etc than CFL Consideration and analysis between the two above solar street light systems has been formulated. By economy analyses it is found that solar street light system with LED have capability to reduce considerable energy consumption which is more desirable and economical to be used in rural areas.

5. CONCLUSION

The renewable energy sources have implementation of the solar street light. Solar Street light is achieves the good position of the global market. Solar street light has become the friendly and economically for the streets of rural and urban areas in India. We have studied about the solar panel, LED light, CFL light, chargeable battery, control charge and the calculation of needs of solar panel. Now the street light has become the main power of the renewable energy sources. We have studied in this project how street light is beneficial and efficient to the government of India in Rajasthan. Rajasthan is using the high present technology in solar street light in rural and urban area.

Solar Street light in LED light is best for installation and high efficiently. LED light is increasing and good for cost effectiveness. LED street light has less maintenance and the save electricity in actual due to this it has become the motivation part of the solar street light. We have also discussed about the how street light reduced the criminal cases in rural area and urban area in night.

In this paper we have replaced the fluorescent lamp to the CFL and study how efficient CFL as compare to the fluorescent lamp. And also replace the CFL to the LED light and calculate the efficiency each other. The calculation of LED light is show the life more time period as compare to another lamps.

RECOMMENDATION

The major roll of the renewable energy in solar street light has the best technology of the rural street light area. We can study in the various parts of street light and solve the problem in energy sector. Many parameters works in the solar street light which can change the life of rural people. Solar Street lights are the best technology to save the cost and easy to installation. We can recommend the SPV Street light in the rural areas in India. Solar Street light has the good efficiency and we can modify the street light in future. The various modifications of solar street lights are following:

- We can use electricity transmission pole to reduce the cost of pole. Electricity transmission pole are

available in all over rural areas can be used to reduce the overall cost of the system.

- Solar Street light has increased the battery to increase the output of the light. Tubular battery is the non-leakage battery and less then to another battery and the more power supply in the connections.
- To increase the efficiency of the solar panel and the use of panels should be non reflective. The efficiency of the solar street light is less than the 40%.
- LED are energy conserving light which must be used in solar street light system consumption of electricity in case of led is very less than that of CFL and any other light source .Life of LED is also greater than CFL.
- Solar Street light is the non pollutant technology and it is eco-friendly which saves the global warming.
- To increasing the lumens of the LED and CFL in the street light give the result of rural areas road.

Solar Street light is growing the living life of the rural area in India. The area of rural where electricity cannot be available, the renewable energy serves the solar energy for that type of areas and it is save the cost of the energy. The LED Street light based on the more lifespan of the installation and gives the vast performances of the street light.

The village of the Rajasthan has the installation of the street light in the sq meter area. The survey of the report of rural area has the installation of street light in needed to the good efficiency and best payback period of the solar projects.



Fig.14: Solar street light in rural area

Economy 3 days we have taken 2 days to compare with our system calculation

Table21: Report of street light port

Lamp	11 watt
Battery	12 v 74 Ah
Solar panel	75 watt
Pole	M.s with nut and bolt foundation
Wire	2 core 2.5 segment with sleeve
Height	18.8 feet

The above table shows the 20 watt CFL need the 40 ah battery and 50 watt panel which can be replaced according to the lumens in LED light.

Table22: Solar Street light installation

Lamp	15 watt
Battery	12 v 25 Ah
Solar panel	30 watt
Pole	M.s with nut and bolt foundation
Wire	2 core 2.5 segment with sleeve
Height	18.8 feet

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