

Solar Power Tree

Rohini Jadhao

Lecturer, Department of Electronics and telecommunication Engineering

Shree L. R. Tiwari college of Engineering, Mira Road, Thane, India

Abstract—Now a days with a growing population and energy demand we should take a renewable option of energy source and also we should keep in mind that energy should not cause pollution and other neutral hazards. In this case solar energy is good option for us. India is highly populated country so we should the advantage of such an energy which requires very less space to produce energy efficiently. In this case solar tree should be best one for us. The ministry of science & technology has come up with a ‘solar power tree’ an innovative way to generate electricity solar power in limited space. We can use the technique called “SPIRRALING PHYLLATAXY” to improve the efficiency of the plant. It can be applied in street lightening system, industrial power supply, etc. It is much better than traditional solar PV system in area point of view and also more efficient. So this will be a very good option and should be implemented

Keywords -- Solar Tree, Renewable Energy, Nano-wire, solar cell, Solar Energy.

I. INTRODUCTION

Solar tree sounds like the perfect solution for our future energy needs. The sun is constantly sending energy to the earth and all we need to do is to catch it and then use it. Unlike current energy sources, we are not going to run out of sunlight anytime soon, it wouldn't contribute to global warming, and it is available everywhere. A solar tree is nothing but an artificial tree with photo-voltaic cells arranged in Fibonacci series manner in place of leaves. The amount of energy produced by this tree is more than that of normal flat array of solar cells.

It is a form of renewable energy resource that is some major competitive with fossil fuels. Hydropower is the force of energy of moving water. It provides 96% of renewable energy in United States. Hydro electric power plants do not use any resources to create the electricity or they do not pollute the air. The sun is hydrodynamic spherical body of extremely hot ionized gases, generating the energy by the process called thermonuclear fusion. The temperature of interior of sun is estimated at 8×10^6 k to 40×10^6 k, where energy is released by fusion of hydrogen and helium. Solar energy is available in abundance and considered as easiest and cleanest means of tapping the renewable energy. For direct conversion of solar radiation into usable form, the routes are: solar thermal, solar photovoltaic and solar architecture. However the main problem with tapping the solar energy is the requirement to install large solar collectors requires a very big space. To avoid this problem we can install solar tree in spite of no of solar panels which requires very small space. It takes less land of only 4 sq ft for a 5 kW solar power tree as compared to 400 sq ft of land required in case of the conventional solar photovoltaic layout. It holds the panels at a higher height – thus gets more sun (by 1 hour) in a day in comparison to that of conventional layout on ground. This could also be rotated

so that the photovoltaic panel gets more sunlight. It has water sprinkler at the top for self cleaning of panels. It would be possible to harness 10% more power by rotating panel direction twice in a day by using module that aligns itself with the movement of sun. It has a capacity to generate 5 kW with a battery backup for 2 hrs when under full load. Each tree requires an area no larger than four square ft, which is half of the desk space in an ordinary office, but can produce 3-5 kilowatts of electricity. It harnesses solar energy for producing electricity with an innovative vertical arrangement of solar cells, and thus reduces the requirement of land while keeping the land character intact.

An objective of any solar tree installations is to promote awareness, understanding and adoption of renewable energy. They are not typically used as a primary source of energy for a property – that role is accomplished by rooftop solar systems.

II. SOLAR TREE

A solar tree is a decorative means of producing solar energy and also electricity. It uses multiple no of solar panels which forms the shape of a tree. The panels are arranged in a tree fashion in a tall tower/pole.

TREE stands for

T= TREE GENERATING

R=RENEWABLE

E=ENERGY and

E=ELECTRICITY

This is like a tree in structure and the panels are like leaves of the tree which produces energy.

As we know trees are present in nature and they can produce their own food material by the process called PHOTOSYNTHESIS. It is the process by which the green plant collects energy from sun and the water present in soil at the day time and can produce their own food material. By this process they are indirectly providing food to the human society because we are depending on the green plants for our food directly or indirectly.

Here we are considering the example for understanding about the solar tree. This is a tree in which the stems connected acts as the branches of the tree and the solar panels are like the leaves. Green leaves are producing food materials for human beings likewise this leaves are producing energy for the society. So it is very appropriate to call it as a tree [1].



Fig 1. Natural tree and Solar tree

SPIRALLING PHYLLATAXY

It is a technique used in designing of solar tree. It provides the way to help the lower panels from the shadow of upper ones, so that it can track maximum power from sun.

A] SOLAR CELL

A solar cell (photovoltaic cell or photoelectric cell) is a solid state electrical device that converts the energy of light directly into electricity by the photovoltaic effect. The energy of light is transmitted by photons—small packets or quantum of light. Electrical energy is stored in electromagnetic fields, which in turn can make a current of electrons flow.

Assemblies of solar cells are used to make solar modules which are used to capture energy from sunlight. When multiple modules are assembled together (such as prior to installation on a pole-mounted tracker system), the resulting integrated group of modules all oriented in one plane is referred as a solar panel. The electrical energy generated from solar modules, is an example of solar energy. Photovoltaic is the field of technology and research related to the practical application of photovoltaic cells in producing electricity from light, though it is often used specifically to refer to the generation of electricity from sunlight. Cells are described as photovoltaic cells when the light source is not necessarily sunlight. These are used for detecting light or other electromagnetic radiation near the visible range, for example infrared detectors, or measurement of light intensity.

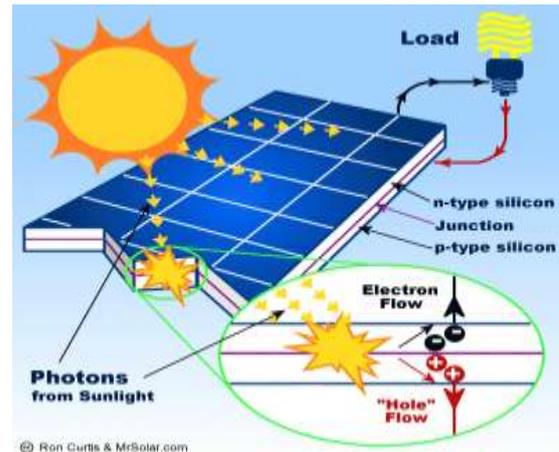


Fig 2. How solar cell works

Solar cells, which largely are made from crystalline silicon work on the principle of Photoelectric Effect that this semiconductor exhibits. Silicon in its purest form- Intrinsic Silicon- is doped with a dopant impurity to yield Extrinsic Silicon of desired characteristic (p-type or n-type Silicon). When p and n type silicon combine they result in formation of potential barrier. Working of Solar cells can thus be based on two crystalline structure intrinsic silicon and extrinsic silicon.

B] WHY IT IS CALLED SOLAR TREE

Trees produce their food by photosynthesis. In photosynthesis, Trees collect sun energy and the water from soil at the day time and prepare their food. In this way they are providing food to the human society indirectly as we depend on the green plants for our food. The working of solar tree can be understood by an example of a tree in which the solar panel acts like leaves and stems connected acts as the branches of the tree. Solar plates of solar tree are producing energy for the society like green leaves produce food for human beings. So it is called tree [3].

C] WHY IT IS NEEDED

1. Due to less land requirement:

It is the best option of energy generation because it requires very less land as compared to the traditional PV system. Now a day's land becomes the costliest commodity for the human society because of high population growth. Example – To generate 2 MW power from a PV module we require 10 -12 acres of land for housing of panels only. But for the same amount of energy we require only 0.10-0.12 acres of land in case of solar tree. So we require such a plant which can generate maximum energy using minimum land.

2. Efficient energy generation:

It can generate energy very efficiently as compare to traditional system. Due to the technique called spiraling phyllataxy its efficiency further increase. We can also use the technique called — SPIRALLING PHYLLATAXY to improve the efficiency of the plant. It can be applied in street lightening system, industrial power supply etc. It is much better than the traditional solar PV system in area point of view and also more efficient. Though it is somehow costly but as compare to all cost involve in traditional system it is more efficient.

3. It can collect energy from wind:

As the name suggest this is a device to generate energy from sun but it has some unique feature to generate energy from wind. The stem are flexible so that they can rotate in any direction and by shaking themselves they produce energy also from wind as in the case of a natural tree. The unique technique is that flexible panels connected to the stem which can be rotated as our desire. So that flexibility avoidance of wind pressure can be possible. Flexibility offers manual rotating so that maximum power can be obtained [3].

III. CONSTRUCTION & WORKING

The solar tree consists of some important parts in its design They are as follows:

1. Solar panels
2. Long tower
3. LED's
4. Batteries
5. Stems for connecting panels

Solar Tree is designed to function both autonomously and in synchronization with the public grid. Electric grid, it uses the energy generated by the solar panels during the day to recharge the batteries. At dusk, which is recognized by automatically monitoring the solar panel output, the LED sources are activated and remain lit until dawn (or as long as the batteries remain charged). Solar Tree is capable of functioning for three consecutive days of cloudy or overcast weather. When wired for coordinated functioning with the public lighting grid, it uses the energy generated by the solar panels to recharge the batteries and activate/deactivate the LED sources in synchrony with the grid, to which eventual surpluses of stored current can be relinquished.

Major problems of Power system are the storage of Electric energy. Output fluctuations of solar cell are eliminated by the day and night cycle or weather shifts. Solar tree panels can charge batteries during the day time. Solar trees automatically switches on its LED. The internal control can also regulate the amount of light produced. A sensor is used to measure the amount of light in atmosphere and triggers the solar lamps to switch ON automatically at sunset and OFF at sunset [4].

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Appearing as practical electronic components in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

When a light-emitting diode is forward-biased (switched on), electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is often small in area (less than 1 mm²), and integrated optical components may be used to shape its radiation pattern.

In this system the solar tree panels batteries charged during the day time. At dusk the solar tree automatically switch on the LED's. The internal control can also regulate the amount of light produced depending on how much charge is left in batteries. And moreover, the energy stored in the batteries can be used to store energy so that we can used it at night and in cloudy day when no sunlight is there.

A] ADVANTAGES OF SOLAR PANELS

Private home owners are discovering the benefits to our environment and a way to live happily off the grid or are considering installing a grid-tied solar power system to offset their electric bill or due to a belief in reducing their carbon emissions. These are great reasons for using the solar.

1. Ecologically Friendly - For obvious reasons, the use of solar panels is Eco-friendly and considered one of the most "green" electricity resources. Because because they operate by interacting with a renewable energy source, sunlight, there is no fear of depleting yet another natural resource.

2. Decreased Electrical Bill - By switching to solar energy, you will save money on your electrical bills every month. Even if electricity bills continue raising in the next few months you will have the peace of mind knowing that your energy source is based on solar power.

3. Low Maintenance - Solar panels have no moveable parts and are very simple to use. After being set up properly, they do not need to be tinkered with and will continuing working for many years. In fact, many manufacturers have 25 year warranties on their panels.

4. Efficiency - No matter where you live, the chances are that you can successfully use solar panels for you electrical needs. They are rugged and are very adaptable to climate conditions and the latest panel models are efficient enough to work well

without facing directly south and some will even produce electricity under cloud cover.

B] WHY IT IS BETTER THAN A TRADITIONAL SYSTEM

India is a highly populated country, so we should take the advantage of such an energy which requires a very less space to produce energy efficiently. In this case solar tree could be the best one for us. It is much better than the traditional solar PV system in area point of view and also more efficient. So this will be a very good option and should be implemented. For the traditional system we require large size of land to generate a small amount of power. It requires about 1% land as compare to the traditional system. Solar energy is available in abundance and considered as the easiest and cleanest means of tapping the renewable energy. For direct conversion of solar radiation into usable form, the routes are: solar thermal, solar photovoltaic and solar architecture. However the main problem associated with tapping solar energy is the requirement to install large solar collectors requires a very big space. To avoid this problem we can install a solar tree in spite of a no of solar panels which require a very small space.

Example – To generate 2 MW power from a PV module we requires 10 -12 acres of land for housing of panels only but for the same amount of energy we require only 0.10-0.12 acres of land in case of solar tree.

C] APPLICATIONS

The Solar Tree is suitable for remote locations or where small foot print such as area lighting, car parks and street lighting are required. With a grid connection or battery store, the Solar Tree is the solution for energy requirements.

Different applications of solar tree used for industrial power supply, house supply and for street light supply. Solar tree can be applicable in following fields

- Street Light
- New housing estates
- Recreational parks and city parks
- Golf courses and resorts
- Mountains regions
- Airports
- Highways
- Private gardens
- De-forested areas

The majority of solar trees in urban location are dedicated for following purposes i.e.

- Street lighting or powering different consumers e.g.battery chargers.
- According to the chosen aim of the tree, the final design is influenced.
- Available type and design of solar panels.
- Cost

Because panels are the most important part in a solar tree construction which influences the final design. Mass, shape, number and arrangement of the panels effects the rigidity, center of gravity i.e. which lead to the final look of the design. If the design of the tree and its look should be preferred in regard to the purpose then this will causes more complexity throughout the whole design process.

D] ADVANTAGES

- No air pollution
- We wouldn't have to worry as much about future energy sources
- People in poor country would have access to electricity
- People can save money
- Land requirement is very less

E] DISADVANTAGES

- Cost is high
- May cause hazards to the birds and insects
- Hazards to eyesight from solar reflectors

IV. CONCLUSION

Solar tree sounds like the perfect solution for our future energy needs. Solar tree is a revolutionary urban lighting concept that represents a perfect symbiosis between pioneering design and cutting-edge eco-compatible technology. The tree design made 50% more electricity and the collection time of sunlight was up to 50% longer. It helps the environment, saves money, cheap to use and you can have them on your homes .It's free and last for lifetime and environment friendly.

To fulfill the increasing energy demand of the people, saving of land, The solar tree concept is very successful one and should be implemented in India to provide electricity without the problem of power cut and the extra energy can be provided to the grid.

India is a highly populated country, so we should take the advantage of such an energy which requires a very less space to produce energy efficiently In this case solar tree could be the best one for us. It is much better than the traditional solar PV system in area point of view and also more efficient. So this will be a very good option and should be implemented Also solar botanic trees is a non conventional source having many advantages of producing electricity as compared to the other sources.

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