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A Comprehensive Paper on Solar Power Generation for Home

Sunita Kumari
SET, Mody University, Lakshmangarh (Sikar), Rajasthan

ABSTRACT
More and more of the world's energy needs are being met by solar energy. Its significance in decarbonizing the electrical supply will be significant because it is a renewable source of energy. An economic overview of the solar industry is presented in this paper. It discusses how the technical aspects of concentrated solar power and photovoltaic power affect the economic viability of solar energy. The author describes how this sporadic energy source might be incorporated into a power grid and outline advancements in the solar industry. That's how solar power's unique qualities might be taken into account when designing renewable energy assistance schemes to encourage the development of solar power.

Keywords: - Solar Photovoltaic, Power generation, Electricity etc.

I. INTRODUCTION

The annual energy needs of all the world's economies are met in less than two hours by the amount of sunlight that strikes the planet. Despite the abundance of solar energy, just a small portion of the world's current energy supply is produced by turning sunlight into useful energy forms. However, solar energy is increasingly contributing to the world's energy supply, particularly in the area of electricity. The previous ten years have seen unprecedented deployment as a result of initiatives to increase energy access, supply security, and combat climate change. According to IRENA 2020, the installed capacity of solar power worldwide increased from 34 GW to 437 GW between 2010 and 2017. As of Dec 2023, Renewable energy sources, including large hydropower, have a combined installed capacity of 180.79 GW. The following is the installed capacity for Renewables: Wind power: 44.73 GW. Solar Power: 73.31 GW. Technological advancements were made possible by steep learning curves and economies of scale, but as a result, there have been enormous costs. When used for the first time in astronautics in the late 1950s, solar photovoltaics (PV), which uses semiconducting materials to convert light into power, was one of the most expensive electricity-generating technologies. It will be a financially viable energy source for many applications by 2020. Concentrated solar power (CSP) is an alternative technical method for producing energy from solar radiation. However, according to IRENA 2020, the latter generated less than 3% of all solar energy used to generate electricity globally in 2017. After hydro and wind power, PV is the third most significant renewable energy source in terms of worldwide capacity. Globally, Asia, Europe, and North America are where solar energy is most commonly used, with Asia experiencing the fastest growth, largely due to China and India Solar PV might surpass all other

technologies in terms of total installed capacity by 2035, according to the International Energy Agency's World Energy Outlook (IEA 2019).

II. Technical Characteristics of Solar Energy

The basic knowledge required to comprehend the economics of solar energy is provided by a brief overview of its technical properties.

The main building blocks of solar cells are semiconductor materials such as silicon and germanium. In these materials, sunlight releases charge carriers (electrons) and creates an electric field. As a source of electricity, this field induces a direct current. This process is known as the photovoltaic effect. Power generation using this effect is possible not only from direct sunlight, but also from its diffused part, and solar cells generate electricity even under cloudy skies. The solar cell is built into the solar cell system. The inverter (to convert the direct current from the solar panel to alternating current), transformer, electrical protection device, wiring and monitoring device are grouped together as the balance of the system "BOS". Some of his BOS also include a sun tracking system that aligns the panels with the sun to increase yield. The three main types of photovoltaic technology are monocrystalline cells, polycrystalline cells, and thin solid-state cells, with his first two accounting for over 95% of global module production.

III. Description Table

S.No.	Name of the Element	Value
1.	IR Radiation	1500 W/m^2
2.	Temperature	25^0C
3.	Inductor	0.02 H
4.	PWM Generator Modulation Index	0.8
5.	Pulse Generator amplitude	1
6.	Parallel strings for	20
	PV array	

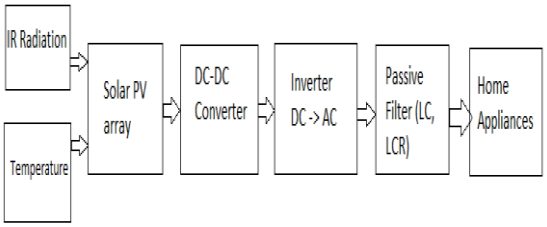

Fig.1: Flowchart

This flowchart gives the basic idea of our project we have designed a power system by using various components such as infrared radiations, temperature, solar photovoltaic panel, boost converter, inverter, passive filter and the home where the supply is provided. we have defined the various component for each and every component by using component editor. We have found the waveform with the help of scope and we have found that our home requires 240 volts of ac supply but from the solar panel we are getting near about 120-150 volts of dc supply so the conversion of dc supply to ac supply is done here with the help of various components. We have used the capacitor also between the solar panel and the boost converter so that with the help of capacitor we can avoid the ripple factor here. Instead of using the inverter here we can also use the transformer also but the only reason for using inverter is that the transformer requires more space and the cost of transformer is very high. Another figure shows the simulation of all the components that are taken together from the component editor and all the components are combined together with the help of MATLAB simulation. And the graph for the waveform is given by using the scope.

Advantages of the solar power system:

- Solar energy is a sustainable resource that everyone can use. Continuing to use solar power will reduce fossil fuel consumption. Combustible resources are required to manufacture modules that harvest energy from the sun, but modern manufacturing processes can reduce net

greenhouse gas emissions within five years. The sun does not have the same expiration date as oil, natural gas and coal.

- It has less environmental impact than other forms of energy production. The use of solar energy has a significantly lower environmental impact compared to other sources, including those in the renewable energy spectrum.
- Solar energy makes the world energy independent. The sun illuminates our planet every day. The extreme north and south of Antarctica are the only exceptions to this advantage, but there are times of the year when sunlight is accessible.

IV. Matlab Software

MATLAB is an interactive system whose basic data elements are arrays that do not require dimensions. This allows many technical computational problems, especially those involving matrix and vector formulations, to be solved in a fraction of the time it takes to program in a scalar, non-interactive language such as C or FORTRAN. The name MATLAB stands for Matrix Laboratory. MATLAB was originally created to provide easy access to the matrix software developed by the LINPACK and EISPACK projects, together representing the state of the art in matrix computation software. MATLAB has evolved over the years with contributions from many users. In university settings, it is a standard teaching tool for introductory and advanced courses in mathematics, engineering and science. In industry, MATLAB is the tool of choice for productive research, development, and analysis. MATLAB provides a family of application-specific solutions called toolboxes. Importantly for most of her MATLAB users, the toolbox allows her to learn and apply specialized technology. A toolbox is a comprehensive collection of her MATLAB functions (M-files) that extend the MATLAB environment to solve a specific class of problems. Areas where toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, and simulation

V. Power system design and Simulation

The temperature in the atmosphere is not constant and varies from morning to evening. Of maximum temperatures are reached in the afternoon. Power drops at night. He must supply the load with a constant power supply of 240 volts 24 hours a day. But with the solar panel, you get maximum power in the afternoon, but not accurate power during moving/evening/cloudy days, so you need to increase the voltage for more purposes. To get that much voltage from the solar panel for cloudy or rainy days, a boost converter is connected as the grid and load may not get exactly the voltage required. Therefore, a boost converter must be connected to handle the load. After converting to pure AC, you can connect a transformer to boost the voltage. If you connect a transformer, you don't need to connect a boost converter. The operation is the same, that is, it boosts the voltage. Comparing boost converter and transformer, transformer is very costly and need more space, but in boost converter we use only one inductor and one diode with the help of switch Therefore, the design of a boost converter can be very simple compared to a transformer. The step-up transformer is not connected, but the voltage must be stepped up at the end. The boost converter has a switch and so does the inverter, so it needs a pulse to turn it on and off. Therefore, we use the first generation for both the inverter switch and the boost converter switch. These are the necessary elements for photovoltaics and a capacitor should be placed between the solar panel and the boost converter. After running the system, I get 110-120 V DC, but at home I need 240 V, and connecting a boost converter provides 240 V DC. In this project, we designed the system using the infrared and temperature falling on the photovoltaic panel, and placed a capacitor between the PV panel and the boost converter to avoid the ripple factor. A boost converter is applied to boost the voltage. Inverters are also applied to convert DC form to AC form power. Passive filters like LCR can be applied to get a pure form of AC power. A boost converter configuration requires an inductor, a diode, and a switch, so I used an IIGBT diode instead of a switch. After running the model, three different waveforms are displayed on the oscilloscope. The first waveform is intended to provide a DC voltage of 120-150 volts, the second waveform is intended to provide an AC voltage of 220-240 volts, but not in pure form. But after applying

a passive filter, we get a pure AC domestic voltage of 240V.

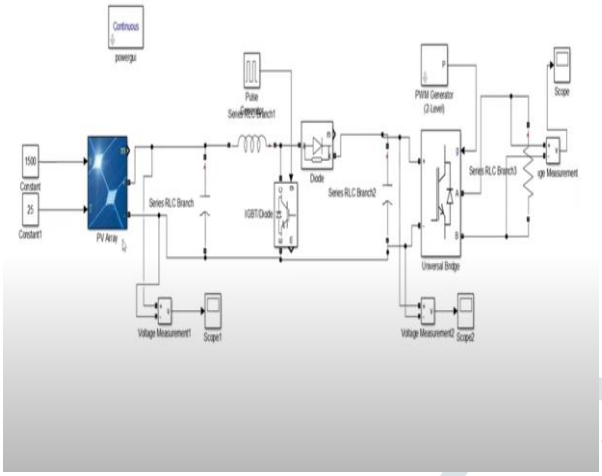

Fig.2: Power System

The components used in power system are:

(i) Infrared Radiation:- The visible light we see daily is a small portion of the electromagnetic spectrum. The electromagnetic spectrum includes all types of radiation, ranging from the X-rays used at hospitals to radio waves used for communication.

(ii) Photovoltaic Panel:- Solar PV panels convert the sun's energy into electrical energy. Even though the primary energy (solar irradiation) is free, the conversion efficiency of PV panels plays an important role in their development, market penetration, and energy share.

(iii) Boost Converter:- A boost converter is one of the simplest types of mode converters. As the name suggests, it takes an input voltage and boosts or increases it.

(iv) Inverter:- A power electronic device or circulatory that convert direct current into alternating current.

(v) Passive Filter:- A passive filter placed between a nonlinear load and a series-connected active line filter plays an important role in compensating for harmonics of the load current. With a passive filter connected, the series connected active power supply filter acts as a harmonic isolator.

Here there are getting the dc supply near around 120-150Volts. But our home requires ac voltage i.e. 240Volts. The power system was connected by the solar panel on which we are supplying temperature and infrared radiations and that is connected to the boost converter that is used to boost up the voltage and the capacitor is used between solar panel and boost converter to boost converter to avoid the ripple factor. There is an inverter used to convert the dc voltage to ac voltage that is again connected to the passive filter because we are getting the ac but that is not pure so passive filer is connected to get the pure form of ac. And here we are getting the supply for 240Volts for the home.

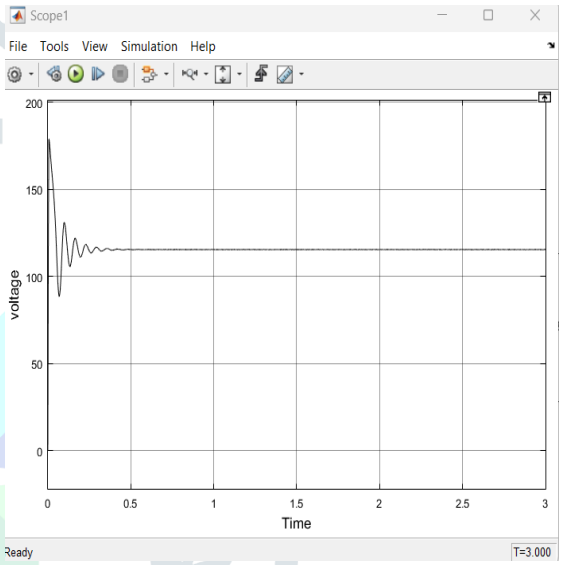

Fig 3: Waveform for DC voltage

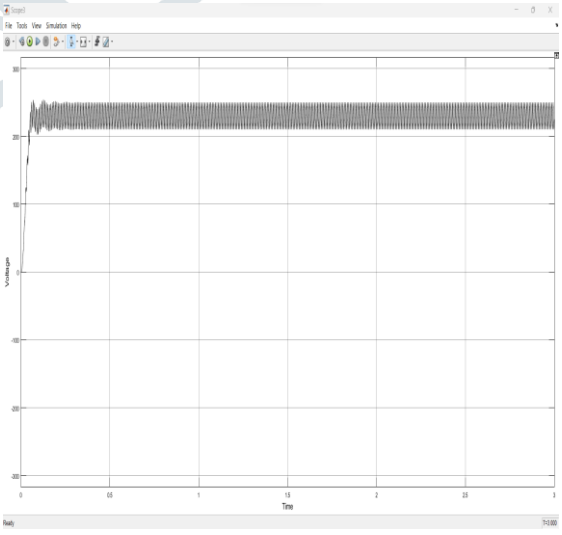

Fig. 4 : Waveform for the ac voltage

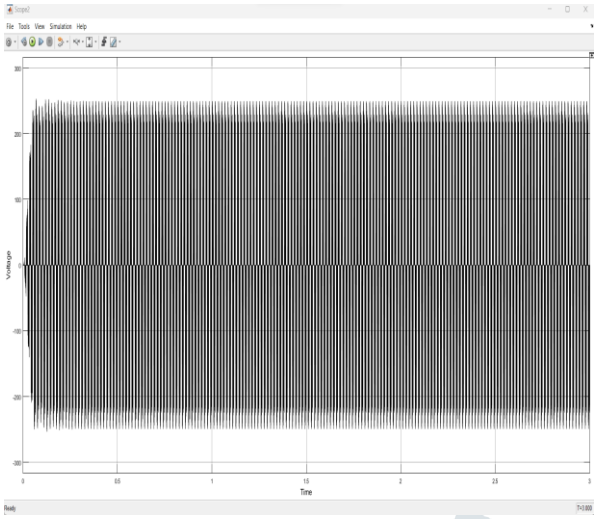

Fig 5: Waveform for the pure AC

The above figure shows the transformation of the dc voltage from the solar energy to the pure form of ac voltage.

VI. Conclusion

Solar power is a very important source of direct useable energy and creates another energy resources: biomass, wind, hydropower and wave energy. Most of the earth surface receive heat energy from the sun. So, gaining increased attention in recent years. Solar energy is plentiful it has the greatest availability compared to other energy sources. The amount of 20% solar energy is supplied in the earth. The sun is sufficient to power the total energy needs of the earth for one year .The conversion of solar energy into electrical energy has many application fields. Residential, space and aircraft and naval applications are the main fields of solar energy. Solar energy quite simply the energy produced directly by the sun and collected where, normally the Earth. The sun creates its energy through a thermonuclear process that converts about 650,000 tons of hydrogen to helium. Solar power has two big advantages over fossil fuels. The first in the fact that it is renewable energy it is never going to run out. The second is its effect on the environment. Energy generation using solar photovoltaic requires large area. As cost of the land are growing day by day, there are some strong requirements to use the available land as efficiently as possible. Due to the nature of , two components are required to have a functional solar energy generator. These two components are collector and a storage unit. Solar energy has experienced phenomenal growth in recent years due to both technological improvements resulting in cost reductions and government policies supplies.

VII. Future Scope:

The solar panels used for converting sunlight to electric power usually have a lifespan of many years and maintenance is also easier. The future of solar energy in India looks very bright because of the number of ways in which solar power can be put to use. Today, we have solar-powered equipment and appliances that can function with the help of solar energy. This includes lights, fans, inverters, cables, power conditioning units, home appliances, solar road safety equipment, and street lights. The electric energy produced from solar power will be used to run electrical appliances without any dependency on the steady supply of electricity. Solar power can help reduce electricity consumption and the cost of electricity for domestic and industrial use. At present, there are some best solar projects in India and more are coming up.

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