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A Review on Techno-Commercial use of Solar PV

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Abstract: ***Solar Energy is produced by Sunlight is a renewable source of energy which is free. Every hour enough solar energy can be produced to meet the world's energy demand for a whole year. Solar Energy is generated as per applications like industrial, commercial, and residential as of its advantage of the easy generation of energy. So it is very efficient & free environment pollution for surrounding. In this article, I have also reviewed Solar Energy produced from Sunlight and also studied its future trends and advancements. The paper also tries to discuss the working of a solar power plant along with its different types and tried to explain various methods to promote the benefits of solar energy. India is endowed with vast solar energy sources. From an energy security view, solar is the most secure and safe of all sources, since it is abundantly available. Off-grid decentralized and low-temperature applications are going to be advantageous for rural areas. In this paper, I have also reviewed some policies and schemes introduced by the government to increase the use of solar energy to avoid any unfavorable energy crisis in the future.***

Keywords: Solar power generation; Photovoltaics; Solar PV, Renewable Energy, solar power concentrators, schemes;

I. INTRODUCTION

Nowadays, due to the decreasing amount of renewable energy resources and increased usage, the last ten years become more important for the per-watt cost of solar energy devices. It is set to become economical in the coming years and growing as better technology in terms of both cost and applications. Everyday earth receives a huge amount of sunlight above (1366W), This is an unlimited and a great source of energy that is available at no cost. The major benefit of solar energy over other conventional power generators is that the sunlight can be directly converted into solar energy with the use of the smallest PV solar cells.[7](pg. 1884-1888) There have been a large number of research activities going on to combine the Sun's energy process by developing new forms of solar energy materials, solar panels, and modules. The geographical location of India is one of the best advantages of solar energy implementation. In January 2010, the Government of India launched the Jawaharlal Nehru National Solar Mission (JNNSM)[2] (pg 2-3) as part of its National Action Plan on Climate Change (NAPCC) and set out a target to achieve 20 GW of grid-connected solar power by 2022 as shown in figure 1.[6](pg 5-10) This target was revised to 100 GW by 2022 in late 2014. The 40 GW target is to be achieved through grid-connected solar PV.

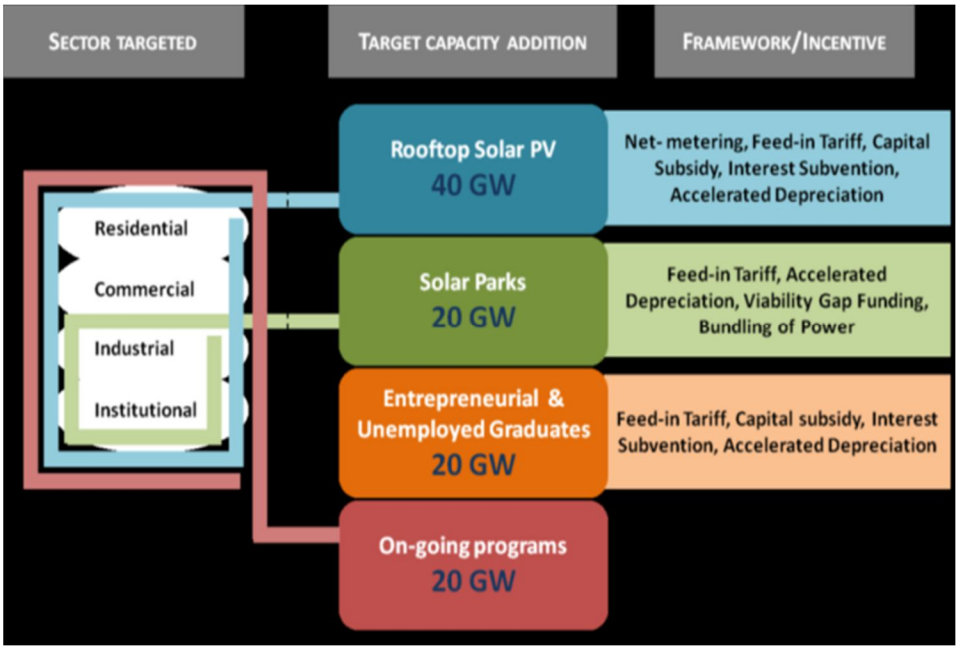


Figure 1: Break-up of the 100 GW solar power target set by the Government of India for 2022

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II. EXPLAINING GRID-CONNECTED ROOFTOP SOLAR PV SYSTEMS:

A. Solar PV

A solar photovoltaic (PV) system is a renewable energy power generation technology that uses photovoltaic modules to generate electricity directly from solar radiation, using a phenomenon called the **photovoltaic effect.** [7](pg. 1884-1888)The electricity generated can be stored, used directly, or fed back into the grid. Solar PV is a reliable and clean source of electricity that is best for a wide range of power generation applications for residential, industrial, agricultural, etc. consumers. Some common applications include solar generation for grid consumption, power sale, and savings in electricity costs. A grid-connected solar rooftop system refers to a system that is located on the roof of a building and is connected to the local power distribution grid. It is a form of distributed power generation. The general working of the system is explained with some figures.

A grid-connected rooftop solar PV system consists of different parts and components that depend upon the location and site, type of the system, and application. In the Indian context, system components generally comprise of the following components: PV modules, mounting structures, inverter, and BOS as shown in figure 2. [2] (pg 5)

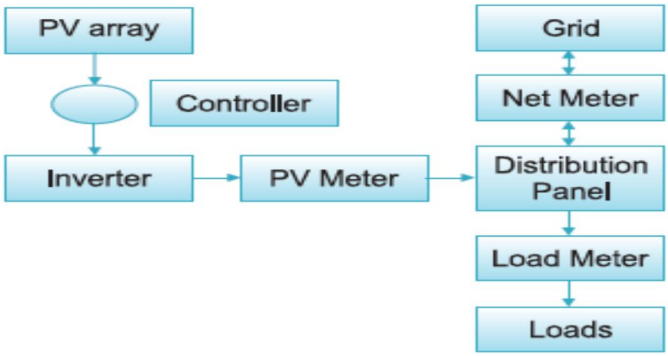


Figure 2: General working schematic depicting energy flow in a grid-connected rooftop solar PV system

B. The Operation Of A Photovoltaic (PV) Cell Requires 3 Basic Attributes

1) Photons in sunlight hit the solar panel and are absorbed by photovoltaic materials, such as silicon.[1] (pg 4-5)

2) Electrons that are also known as negatively charged, are excited from their current atomic orbital state. When it gets exciting, The current starts flowing through the material to cancel the potential, and this electricity is stored. [1] (pg 4-5)

3) An array of solar cells, known as the panel, converts the solar energy into the direct current (DC) electricity.

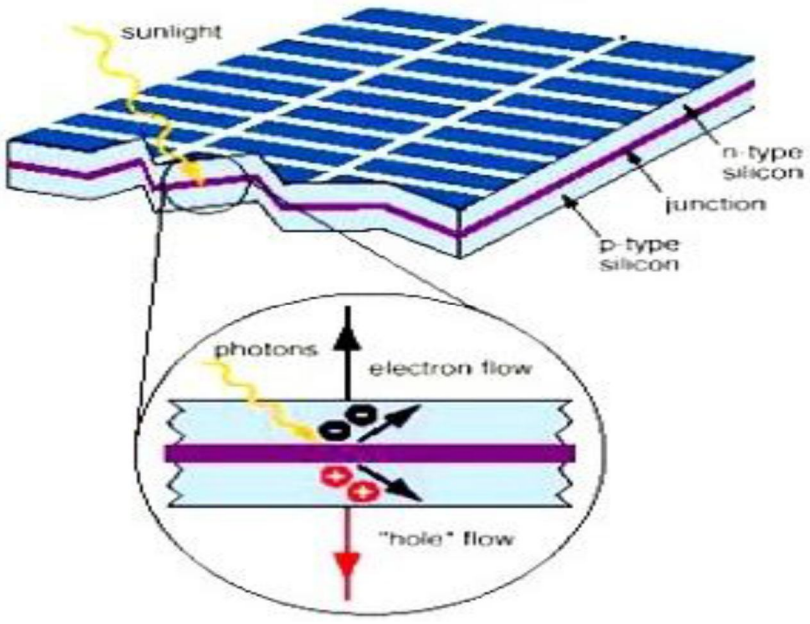


Figure 3: Internal of Reaction of Solar energy

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C. Working Of Solar Energy

PV cell(s) Convert Sunlight into Direct Current (DC) electricity. Charge Controller works as control of the power from the solar panel which reverses back to solar panel get the cause of panel damage. Battery Systems act as storage of electric power is used when sunlight not available[7](pg. 1884-1888) (i.e. night) as shown in figure 4. From this system connected to the inverter.

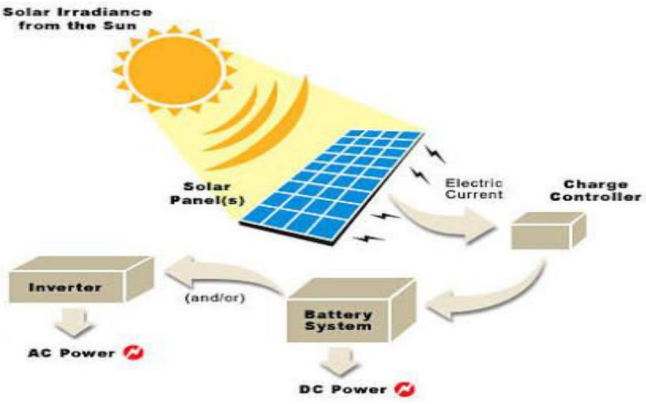


Figure 4: Working on solar energy

D. Modeling Of PV Panel Solar Cell (Photovoltaic Cell)

It consists of various kinds of semiconductor materials. It has two types: positively charged particles and negative charge particles. This cell technology is used to design solar cells with low cost as well as high conversion efficiency. When the cell absorbed photons from sunlight, electrons get separated from silicon atoms and are drawn off by a grid of metal conductor, which lets the flow of direct current. Solar cell PV made up of many chemicals.

1) *Photovoltaic Module:* A PV module consists of solar cell circuits that are packed in an environmentally protective laminate case and are also known as the building blocks of the grid-connected solar PV system. Generally sizes from 60W to 170W. Usually, many PV modules are arranged in series and parallel to meet the energy requirement.[3] (pg 8-9)
2) *Photovoltaic Panel:* It includes one or more solar PV modules that are assembled as a whole pre-wind, field instable unit. In this panel PV cell is series connections. Solar panels are made up of several solar PV cells connected.
3) *Photovoltaic Array:* Array It contains several amounts of PV cells in series and parallel connections. Series connections are one of the main factors for increasing the voltage of the module whereas the parallel connection is used for increasing the current in the array. It generates a maximum of 180W in full sunshine. [13] (pp. 94-113)Large the total surface area of the array, more solar electricity it will produce.

III. ADVANCEMENTS IN SOLAR PV

A. Transparent Solar Cells

A transparent solar panel works on the basic principle of solar PV but allows all the visible light to pass through it and absorbs the infrared and ultraviolet light. A transparent solar cell **(figure 5)** provides an efficiency of 2% which is very less than a conventional solar cell which provides about 15-18%.[4] (pg 116-118) But this problem is often solved by "stacking" wherein an outsized number of transparent solar cells are often put together in an exceedingly single module which ends in increasing the efficiency of solar cells. A study shows that the United States produces 1.4% of its electricity through solar cells. As of now the usage of transparent solar panels is very less as compared to that of the conventional energy sources.

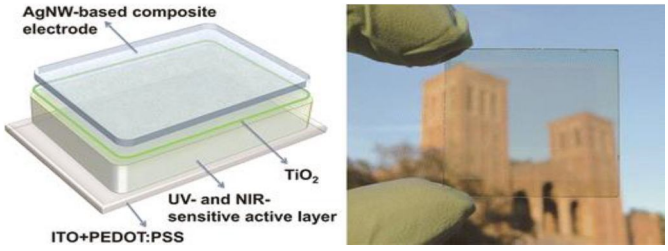


Figure 5: Cross-section of polymer solar cell

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B. Wireless Power Transmission of Solar Energy from Space

The beam and microwave power transmission systems are currently one of the most futuristic technologies for wirelessly transmitting power over the long distance in space i.e from a satellite in orbit to the surface of the Earth**(figure 6).[**8] (pg 2-5)The two methods differ in size, mode of operation, efficiency, and cost.

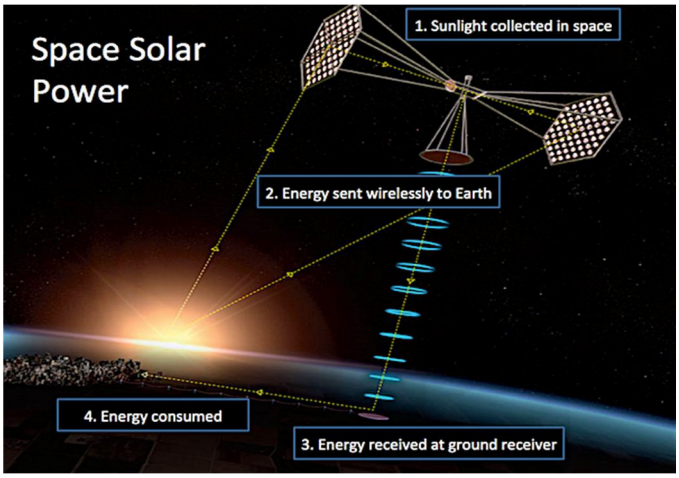


Figure 6: Depiction of a possible space solar power system.

C. Microwave Wireless Power Transmission

A microwave power transmission consists of the source of the RF energy, a transmit antenna, a transmission medium or channel, and a rectifying antenna usually mentioned as the rectenna.

D. Laser Beam Wireless Power Transmission

In this technique of wireless power transmission, a beam of photon sends concentrated light to a solar cell receiver through the vacuum of space and therefore the atmosphere.

IV. GROWTH OF SOLAR PV IN INDIA

A. Indian Renewable Energy Scenario

Over the years, the renewable energy sector in India has emerged as a big player within the grid-connected power generation capacity. It supports the govt. agenda of sustainable growth, while, emerging as an integral part of the answer to satisfy the nation's energy needs and an important player for energy access. It has been realized that renewable energy has got to play away from a deeper role in achieving energy security within the years ahead and be an integral part of the energy planning process. There has been a clear impact of renewable energy within the Indian energy scenario during the last five years. If we talk about India the Renewable energy sector landscape has, during a previous couple of years, witnessed tremendous changes within the policy framework with accelerated and impressive plans to extend the contribution of solar energy.

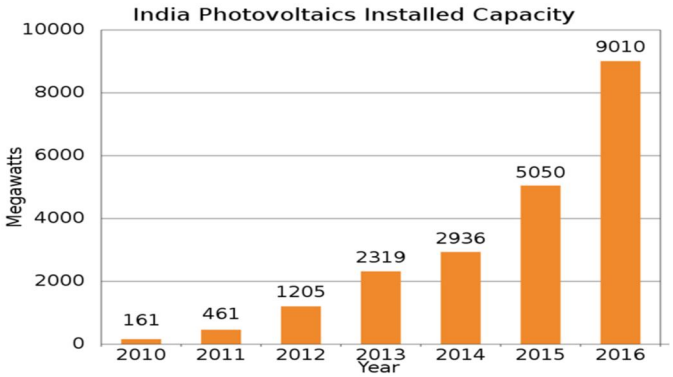


Figure 7: India PV installed capacity

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B. Renewable Energy Potential

India has an estimated renewable energy potential of about **900 GW** from the sources that are available commercially: Wind – 102 GW power; Small Hydro – 20 GW power; Bio-energy – 25 GW power; and **750 GW solar power**. India has developed extensive databases for renewable energy resources in the country.

The National Institute of Wind Energy (NIWE), also known as Centre for Wind Energy Technology, has done an assessment to create the Wind Atlas of India.

The institute also collects data from Solar Radiation Resource Assessment stations to assess and quantify solar radiation availability. National Institute of Solar Energy has done the assessment of the State-wise solar potential by taking 3% of the wasteland area where the solar PV modules could be installed.

C. Renewable Energy Target Scheme

The Government has set up the target of renewable energy capacity to 175 GW that is to be achieved by the year 2022 which includes 100 GW power from solar electricity, 60 GW power from wind electricity, 10 GW power from bioelectricity and 5 GW from small hydro-power. [6] (pg 5-10).

The capacity target of 100 GW set under the National Solar Mission (JNNSM).[2] (pg 17-19) will principally comprise of 40 GW Rooftop and 60 GW through Large and Medium Scale Grid Connected Solar Power Projects. With this huge target, India will become one of the largest sustainable and green producers in the world, defeating several developed countries. In setting up 100 GW power, the total cost will be around Rs.6,00,000 crore.

As Confident of the growth rate in the clean energy sector, the Government of India has done the submission to the United Nations Framework.

D. Recent Programs And Schemes

In continuation of the new initiatives that were launched last year, the Government has started the following new projects and schemes during the current financial year.

a) The scheme introduced by the government for Setting up over 2,000 MW of Grid-Connected Solar PV electricity Projects with Viability Gap Funding (VGF) of the National solar mission phase II. Projects are to be set up by Solar Power developers on their basis.

b) The Conversion of Solar Energy Corporation of India (SECI) under the Companies Act, 2013 (No. 18 Of 2013) and to change its name to Renewable Energy Corporation Of India (RECI).

c) There was a Creation of Intra State Transmission System in some States such as Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, and Rajasthan with Government of India contribution from NCEF of Rs.3419.47 crore.[2] (pg 17-19)

d) Scaling up of Budget from Rs.600 crore during 12th Five Year Plan to Rs.5000 crore for Grid Connected Rooftop and Small Solar Power Plants Program for Five Years up to 2019-20 under National Solar Mission (NSM).

e) The Government has also approved a Scheme, in December 2014, for setting up of 25 Solar Parks, each with the capacity of 500 MW and above and Ultra Mega Solar Power Projects to be launched and finished in next 5 years in various States and will require Central Government financial support of Rs.4050 crore. These parks are able to accommodate over 20,000 MW of alternative energy projects. As of date, 33 parks with a capacity of about 20,000 MW in 22 states are sanctioned.

E. Current Achievements

The gross installed capacity of grid-interactive renewable power in the country stood at about 33.8 GW as of 31st December 2015. As of December 2015, solar, wind, biomass and small hydropower contribute about 13.60 percent of the total installed capacity for electricity.

Renewable energy has been witnessing over 20 percent growth within the last five years. From the whole renewable power installed capacity of 14,400 MW at the start of 2009, it's reached a capacity of 38,822 MW at the top of December 2015.

India occupies the fifth position within the world with a wind generation installed capacity of 25.1 GW. During the year against a target of 2400 MW, 1,645 MW wind generation projects were commissioned.

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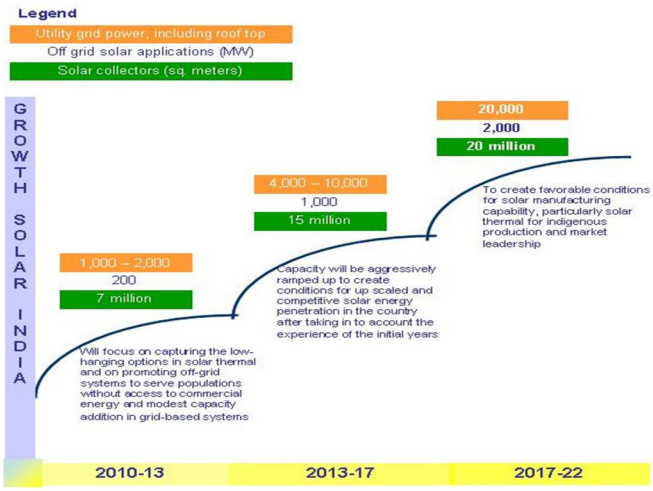


Figure 8: Growth of solar in India

F. National Solar Mission

26 nos. SPV projects of aggregate 330 MW capacities have been commissioned. A 5 MW SPV project by Delhi Mumbai Industrial Corridor Development Corporation Limited (DMICDC) has also been founded under the MNRE bundling scheme. Thus, 523 MW solar PV projects and 202.5 MW solar thermal power projects are commissioned under the bundling scheme. Under the 100 SPV power plants, 78 projects were selected to line up 98 MW capacity projects from 12 States. Against this, 71 projects of a total capacity of 90.80 MW have been connected to the grid.

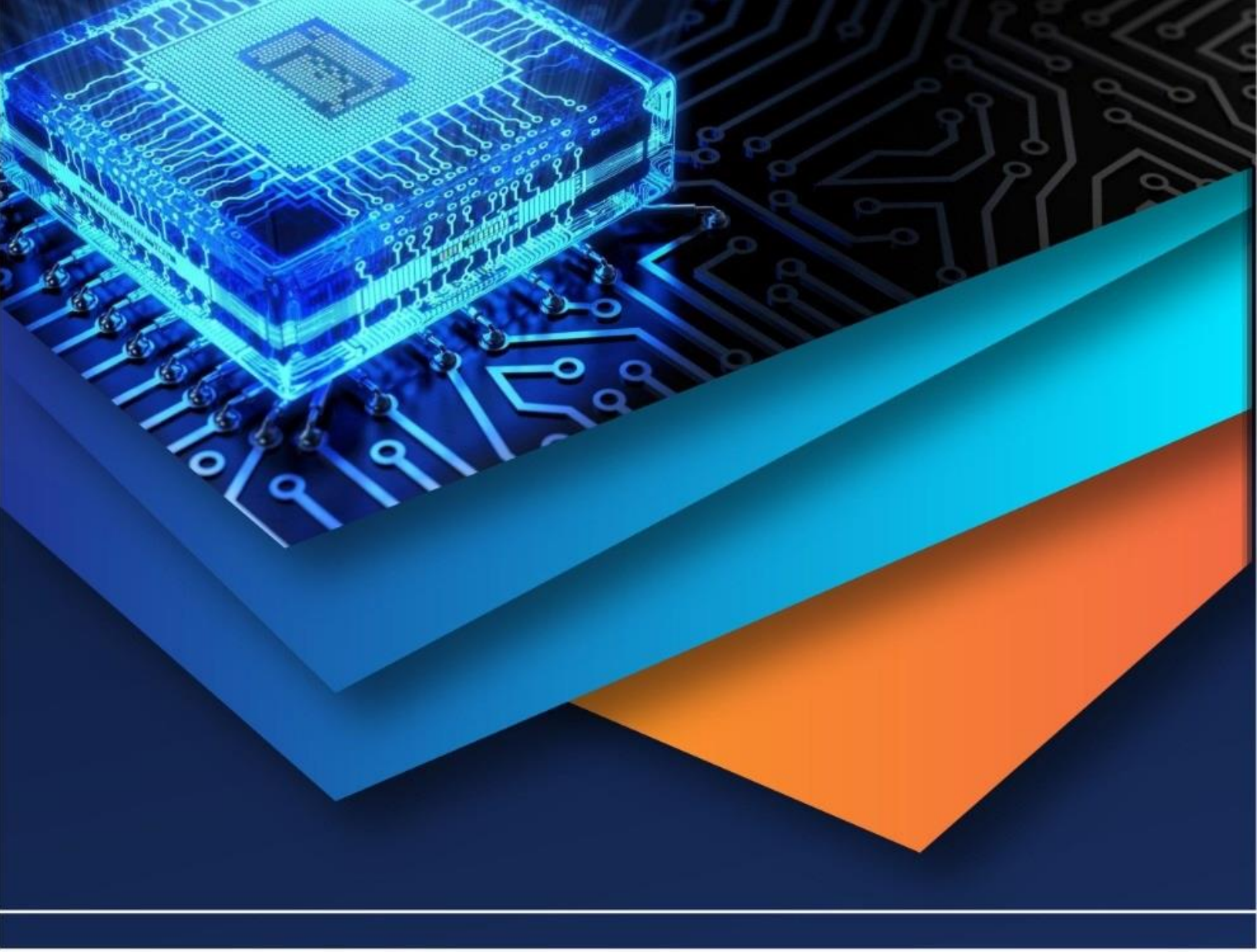
V. CONCLUSION

Most people are aware of non-renewable energy resources. Solar energy has become increasingly more popular thanks to its economic benefits. alternative energy is infirm power and efforts are required to be made it firm power by developing appropriate storage facilities. alternative energy may also make a viable source of energy by announcing suitable policy incentives. By on Battery Backup, solar power can even provide Electricity 24x7, even on cloudy days and in the dark. it's more benefits compared to other types of energy like fossil fuels and petroleum deposits. It is an alternative which is a promise and consistent to meet the high energy demand. Research on solar cells and solar energy is promising has a future worldwide.

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