Solar Energy and Solar Cells

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Abstract - Solar energy is the ultimate energy source for humans, as its characteristics are very appealing like being the renewable source and the most important is the cleanest of all sources of energy. These are not only reasons attributing to its advantages, but also the biggest available power source on earth. In the present situation, its cost is also decreasing rapidly. So

1 INTRODUCTION

The demand for energy in the 21st century is on the rise, and we are finding it difficult to fulfill this demand. Various techniques are being used around the world to produce electricity, some of these are thermal energy, hydroelectricity, nuclear energy, wind energy, solar energy, and few more. Each procedure has its merits and demerits, as some harm the environment and some are not that dependable for the need of energy. But solar energy is the best choice out of these as it has no adverse effect on the nature and its continuous availability to humans will never extinguish.

2 What are Solar Cells?

In simple terms solar cells are devices that covert light energy into electricity, they do so by following the principles of photoelectric effect. The photoelectric effect is the phenomenon of emission of electrons from metal under the effect of light. The phenomena were first showed by French physicist Alexandre Edmond Becquerel in 1839. According to Albert Einstein who explained photoelectric effect based on Planck's quantum theory (light is transmitted in form of photons). According to him light is transmitted in form of small bundles or packets of energy called photons these photons have their energy equal to h.ν where h is the Planck's constant and ν is the frequency of light when the photons strike a metal, they transit their energy to anyone electron present in or on the metal the transfer energy is used by electron in two ways one injecting from the metal a second using the remaining energy as kinetic energy and moving forward. Due to these electrons and other charge carriers in and on the metal a potential difference is created across the metal. A simple solar cell made using two different types of semiconductors, usually there are two layers of dopped semiconductors one being which has a greater number of positive charge carrier which is also called p-type semiconductor and another layer of semiconductor which has more negative charge carrier which is called n-type semiconductor.

3 A Brief History of Solar Cells

The first patent for solar cell was awarded for William Coblentz in 1913 but it was not until the 1950s that solar power started to become a real thing. In 1954, bell labs invented the first usable silicon photovoltaic device which had an efficiency around 6%. Solar cell efficiency is how much of the collected sunlight the cell can convert into electricity. In 1957 Hoffman electronics was able to increase that efficiency to 8% and then to 10% by 1959, in early 1960s solar cells had the achieved about a 14% efficiency. Today most solar panels are somewhere between 15 and 20% efficient with some of the higher efficiency models that you can buy being in the low 20% range.

4 Why Do We Need to Shift to Solar Energy?

4.1 How solar energy came into limelight?

The question that now arises is that why solar energy is useful for humans? Firstly, it is a source that will never run out as sun has only completed is half-life cycle and will not cool down for thousands of years to come. Secondly, add equator earth receives annually 4380 hours (about 6 months) of sunshine which if converted into electricity amounts to 2600 TW (Trillion watt). Humans have used the power of sun from past thousands of years but it was limited to drying clothes and even in the near past for cooking food. The invention of solar arrays or solar panels gave the ability to humans to harness sun’s energy and convert it into electricity. The popularity of solar arrays increased due to their use in the space programs by various nations. Solar Panels were first used in satellites by the United States of America in Vanguard 1 during 1950s. Solar panels soon became popular in the space programs because they can harness suns

energy and were compact and were light weight which is ideal for space exploration. Solar cells are simply p-n junction diodes which produces electricity when they are illuminated by light.

4.2 It's comparison to other types of energy sources

The current energy needed by humans in today world is 15TW and this number is estimated to rise in the coming years. So, let us look at the other resources that humans are using to fulfill this energy demand. 81% of our energy supplied by fossil fuels (which include coal, petroleum, natural gas, etcetera), 2.7% is supplied by nuclear energy and rest of the 12% is contributed by renewable resources. If we take deeper look at the share of these renewable sources, it is found out to be that 3.3% is produce with the help of hydroelectric, 0.5% by wind energy, 0.2% by both geothermal and solar energy. Below the table shows the available energy from the power sources discussed above: -

- Coal: 900TW yearly
- Petroleum: 240TW yearly
- Natural gas: 215TW yearly
- Uranium: 300TW yearly
- Wind energy: 75TW
- Hydro power: 4TW
- Direct Radiation (Solar Energy): **26000TW**

4.3 Challenges faced in generation of electricity from solar energy in present times

We can clearly see that solar energy is capable of fulfil our energy demand without any other supply of energy from other resource. If we want to set up a power plant to fulfill our energy supply an area cover with solar cell comparable to the country France is required to produce such kind of electricity. 26,000TW is fairly a substantial number but however energy production, from direct radiation is criticized for being variable and intermitted, as it is affected by day and night cycle, weather, and location of the solar plant. Another problem in the solar industry is that photovoltaic devices are expensive but it expected that with increasingly revolutionary technologies the prices will decrease in the future. The prices of Photovoltaic device have dropped due to development in solar infrastructure and the reduction of hardware costs over time. The cost has decreased from 106.05$/W in 1976 to 0.38$/W in 2019. In the same duration the efficiency has rapidly increased from 14% achieved by Hoffman electric in 1960 to 44.5% achieved by a prototype developed by U.S. scientists. The problem that is most concerning is that photovoltaic devices are only capable to produce electricity during day time so electricity shortages would also have to build alongside solar power plants to deliver electricity during the night time. If we want to switch to solar energy for our overall usage of electricity then to supply electricity at night storage houses can be built along with the solar plants which would store the energy that is produced in the daytime and could supply the same at night. These problems can be eliminated by technological advancements and with more development's solar energy will overcome these challenges in the future.

5 Conclusion

In conclusion, there is no doubt that solar energy is going to take over the electricity sector in the future. It overpowers its competitor in terms of availability and being a renewable source of electricity and it has truly little or no carbon footprint compare to other sources of renewable power sources. On the other hand, the drawback of solar energy can be resolved with development and innovations. So, I hope that your takeaway point from this text is that direct radiation is fully capable of delivering all the energy we can ever need. We need to deploy and develop renewable technology to optimally use the resources available to us and at the same time evolve our electrical grid and energy storage options.

References

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