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An Assessment of Solar Energy for The Future World

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ABSTRACT: The world's energy consumption is rapidly increasing as a result of population growth and technological advancements. For future energy demand, it is thus critical to choose a dependable, cost-effective, and eternal renewable energy source. Solar energy, like other renewable energy sources, is a cost-effective and readily accessible energy source for dealing with long-term problems in the energy crisis. Because of the increasing need for energy, the solar business is rapidly growing all over the globe, despite the fact that the main energy source, fossil fuel, is finite and alternative sources are costly. It has become an instrument for improving developing nations' economic position and sustaining the lives of many disadvantaged people since it is now cost efficient as a result of years of active research to speed up its growth. In comparison to other renewable energy sources, the solar sector would undoubtedly be the greatest choice for future energy demand since it is better in terms of availability, cost effectiveness, accessibility, capacity, and efficiency. As a result, this paper discusses the importance of the solar industry, as well as its fundamental concepts, the global energy scenario, highlights of research done to upgrade the solar industry, its potential applications, and barriers to a better solar industry in the future in order to resolve the energy crisis.

KEYWORDS: Energy Crisis, Fossil Fuel, Fuel Consumption, Renewable Energy, Solar Energy.

INTRODUCTION

The world's energy consumption is rising rapidly as a result of population increase and industrialization. It's worth noting that the world's population has grown by 2 billion in only one generation, with emerging countries playing a significant role[1]. One of the most inconsequential problems of the twenty-first century is preventing an energy crisis. As a result, energy consumption is rapidly rising to satisfy the needs of the world's expanding population. To establish themselves in the globe, many nations have their own tactics, plans, programs, and control methods. The world's resources are being drained as a result of population expansion and development efforts. Since a result, considering energy sources is critical, as they play a critical part in meeting the world's and living population's needs[2]. Accessible energy is insufficient for people for a variety of reasons, including a country's developmental profile, people's economic position, and the nature of the country's technical advances. The environment is severely contaminated as a result of the emissions of different gases produced by the burning of fossil fuels, which are easily accessible and widely utilized to meet the world's energy needs. Developing nations are under increasing pressure to find new energy sources as their populations increase and they seek economic development in order to become environmentally viable[3].

Energy consumption rises in tandem with economic development since it is proportionate to economic growth. Despite the fact that numerous methods for expanding energy production capacity have been suggested, many people still live in non-electrified regions of developing nations. Nonrenewable energy sources would not be able to satisfy energy demand indefinitely since they are a finite and exhaustible resource. All nations should be able to utilize their resources to recover energy in order to create an environment that is favorable to long-term human existence. Carrying, on the other hand, is not adequately performed at the present. Many nations rely on finite energy sources rather than renewable energy sources, making this a difficult job[4]. It is a well-known truth that many contentious problems arise between nations, many of which result in major disasters, because powerful parties want to gain access to areas rich in fossil fuel deposits. Furthermore, continued usage of nonrenewable energy sources may contribute to climate change, which may result in severe natural catastrophes that harm the planet's ecosystems[5].

For the sake of the future of the planet, it is thus critical to use environmentally acceptable energy sources. Renewable energy sources, such as solar, wind, hydropower, and geo-thermal, are important in this regard since they are environmentally benign. Solar energy, on the other hand, may be the greatest choice for the future world for many reasons: First, solar energy is the most plentiful renewable energy source[6]. The sun produces 3.8 1023 kW of solar energy, of which about 1.8 1014 kW is intercepted by the earth. Solar energy arrives on Earth in a variety of ways, including heat and light. The bulk of this energy is lost as it travels due to dispersion, reflection, and absorption by clouds. According to studies, solar energy can meet world energy demand adequately since it is plentiful in nature and is a cost-free source of energy. Second, it is a potential source of energy in the globe since it is non-exhaustible and has higher production efficiencies than other energy sources. The dispersion of solar radiation and its intensity are two important variables that influence the efficiency of the solar PV sector. These two variables are extremely varied between nations[7].

In comparison to other temperate nations, Asian countries have the greatest potential for receiving solar radiation since their sunlight duration is longer throughout the year. It's essential to remember that a lot of solar energy is lost since it's not utilized. Solar radiation is abundant in many nations, especially in developing countries, and therefore has a beneficial use. Take, for example, the average solar power in Sri Lanka. Third, the use and monitoring of solar energy has no negative effects on ecosystems in which natural equilibrium is maintained for the benefit of living things. Exploitation of fossil fuels harms ecosystems, which disrupts natural equilibrium. Finally, since solar systems are readily cheap and adaptable, they may be successfully utilized in village systems, industrial operations, and residences. Furthermore, the globe is currently in a frenzy to find solar energy due to the growing reliance of the global population on fossil fuels for energy recovery in order to carry out different tasks[8].

The correct use of this technology would be the greatest choice for the future world to prevent the negative effects of an energy crisis. Many studies are now being conducted in order to improve the efficiency of the solar business in order to make the future world more productive in terms of energy consumption. According to reports, such reserves would be depleted by 2300 as a result of rising energy consumption. However, because to growing energy demand, its usage has already resulted in significant CO_2 emissions, with a rising trend from 1980 to 2010[9].

Fuel energy is advancing at a rapid pace. As a result, renewable energy sources are required to satisfy rising demand. Solar power has made a significant advancement. Because of its potential for energy recovery. Solar PV and concentrating solar panels, as well as solar heaters, had the greatest yearly growth rate in 2013 when compared to other renewable energy sources, according to. Solar PV had the greatest growth rate among solar technologies in 2013. Since significant advancements in solar cell production have been documented. As a result, the goal of this article is to provide an overarching basic perspective of solar energy for the future world

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that is supported by logic. Photovoltaic technology, the global energy situation, notable research highlights in the solar PV business, solar energy applications, and obstacles to such an industry have all been thoroughly addressed. Readers of this article will get a comprehensive understanding of the solar business and its significance for a future world that is energy efficient, sustainable, and emits few pollutants[10].

DISCUSSION

This is a technology that converts sunlight directly into electricity without the need for a conversion interface. As a result, these gadgets are designed to be simple and easy to use. Furthermore, they are capable of producing greater outputs from smaller inputs. As a result, they're utilized in a variety of applications all around the globe. However, it still has to enhance its system in order to provide better results. To generate energy, photovoltaic devices typically utilize semiconductor materials, the most common of which being silicon. The idea behind this gadget is to energize electrons by providing them with more energy. The electrons in this device are triggered from a lower energy state to a higher energy state as a result of the energy addition from sunlight. This activation produces a large number of holes and free electrons in the semi-conductor, resulting in the generation of electricity. In photovoltaic systems, semiconductors such as monocrystalline silicon, polycrystalline silicon, microcrystalline silicon, copper indium diselenide, and cadmium telluride are frequently utilized.

A variety of variables influence the selection of these materials. For producing electricity, a PV system comprises of numerous components such as cells, modules, and arrays. In addition, for improved operational efficiency, different methods of regulating and controlling structures, electronic devices, electrical connections, and mechanical devices are employed. Peak Kilowatts (kWp) refers to the amount of electrical power produced by a PV system when the sun is directly above on a clear day. PV devices have been the subject of many studies to improve their efficiency for many years, and it is essential to highlight that it is currently considered a fast-growing sector, with output doubling every two years and an average growth of 48 percent since 2002. To convert solar energy into electricity, concentrating solar thermal power (CSP) and concentrating photovoltaic technology (CVT) are employed in addition to PV technology. In photovoltaic systems, semiconductors such as monocrystalline silicon, polycrystalline silicon, microcrystalline silicon, copper indium diselenide, and cadmium telluride are frequently utilized.

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To convert solar energy into electricity, concentrating solar thermal power (CSP) and concentrating photovoltaic technology (CVT) are employed in addition to PV technology. CSP has been represented in a typical manner. Photovoltaic current, on the other hand, is supplied into grid systems for greater efficiency. Grid field electrical systems provide for about 90% of present photovoltaic producing capacity. To improve the efficiency of light capacity by PV systems, grid field insulation is either ground mounted or installed on the roof of the structure. PV systems must be appropriately labeled to show their capability. Multiple components, such as solar cell arrays and modules, as well as methods of controlling or regulating systems for both electrical and mechanical connections, make up a photovoltaic power production plant. This system is built in such a manner that it has the potential to increase conversion efficiency. In many cases, a grid linked system is utilized to provide power to the public electrical grid; as a result, this technology provides a means of decentralized energy production. The study presented in the following short notes aims to enhance solar power production for a more sustainable energy future.

A new technique of modeling an energy structure that might be used to match the power output of a wind turbine and a solar PV array to a changing electrical demand, and they tested it against time-stepping. It demonstrated good agreement across a wide range of store power ratings, store efficiencies, wind turbine capacities, and solar PV capacities investigated hybrid power generation plant, integrated by wind turbine and PV panels, systematically to be used in remote areas where electricity is in high demand. They investigated wind-alone and solar-alone power production in isolation and compared it to a hybrid power generating panel. Design and assessment of hybrid renewable energy system components. They also demonstrated that hybrid PV/wind energy systems are gaining popularity due to their capacity to provide electricity without interruption. It is currently being integrated into different power networks in order to enhance their performance.

Using monthly average daily global solar radiation and sun shine duration data examined the distribution of solar radiation and sunlight duration across Saudi Arabia. They also conducted a scientific analysis of a 5 MW photovoltaic-based grid-connected power plant for electricity generation in terms of renewable energy output and cost assessment. In Kuwait, a grid-connected PV system was used to improve the electrical demand pattern. They discovered that peak load matches maximum incoming solar radiation during performance assessment, thus using photovoltaic stations in Kuwait may be the greatest choice for reducing electrical load demand, and peak load can be lowered significantly using grid-connected PV systems. Over the past six years, the effect of PV systems installed by an energy project in homes, schools, and public buildings. They demonstrated that their effort has provided rural populations with the chance to obtain power by replacing conventional energy sources. Solar chimney power plant to conduct an economic study of its power production utilizing cash flows throughout the course of a 100 MW power plant's operational life.

The long-term prospects of large-scale PV production and transmission in arid and semi-arid regions across the globe utilizing hydrogen as the energy vector. At the new Munich Trade Fair Center, the big MW PV plant technology in terms of system technology, components used for operation, control, and cost issues. They used net present value analysis to evaluate renewable and non-renewable generators by calculating their life cycle costs. They demonstrated that PV energy has a lower life cycle cost than energy generated by generators powered by gasoline or diesel, making it economically viable in such locations. A hybrid power generating plant's solar array, electrolyze, metal hydride tanks, and proton exchange membrane cells were studied. Proton exchange membrane cells store solar energy efficiently by converting it to hydrogen, which is used to power the fuel cell. Nelson and colleagues studied the size and economics of a hybrid wind/photovoltaic or fuel cell power generating system. They compared the cost of a system like this to the cost of a wind/PV/battery system for a typical house in the Pacific Northwest of the United States.

They also said that conventional wind/PV/battery systems are more economically feasible than wind/PV/fuel cell/electrolyze systems after evaluating current cost figures and break even line distance comparisons. An energy system that uses Fuzzy logic control to provide energy at the highest efficiency possible, with maximum power tracking of the PV and wind energy sources used. They created a system in which PV, wind, and fuel cells were integrated in a methodical manner to provide the most power to a fixed direct current (DC) voltage bus. By analyzing long-term solar radiation data from Dhahran, an effort was made to evaluate the techno-economic feasibility of a hybrid PV-diesel-battery system. It was to satisfy the demand of a residential building, and they discovered that increasing PV capacity reduces diesel generator operating hours, which is further lowered by adding battery storage. Economic feasibility of a diesel-assisted PV-reverse osmosis (RO) plant, a solar-driven PV reverse osmosis plant, and a completely diesel-assisted reverse osmosis plant were investigated, with each system being costed separately to determine its cost effectiveness. By shutting off the generators during the day, the energy generated from diesel generators linked to PV systems with battery storage may be obtained at the lowest possible cost. An experiment to assess a hybrid photovoltaic/thermal (PV/T) system utilizing two distinct shaped materials as absorber collectors: sheet and tube. They planned on using this technology to generate both power and hot water. They did, however, come to the conclusion that this technique is not suitable for such a location due to the high ambient temperature during the summer season. In the year 2025, six main cities in India would use solar PV power to satisfy energy demand, as a solution to future energy problems. For the development of current solar cells, a variety of photovoltaic technologies spanning from silicon to thin film, multi junction, and solar concentrator systems are being used.

An effort to investigate the present viability of a cellular phone base station power production solution combining wind and PV power generation with an energy storage system. Prasad et al. optimized a wind-photovoltaic system with battery backup for increased efficiency, demonstrating that hybrid power production systems may be effectively integrated to increase generation capacity. A hybrid solar fuel cell generating system with an electrolyze for hydrogen production was developed experimentally. They also utilized a fuzzy regression model for maximum power point tracking to get the most available solar power from a PV array with changing insulation. In both stand-alone and grid paralleled configurations, a model of a solar hydrogen power home is shown. They utilized Mat-lab to evaluate the feasibility of using a regenerative fuel cell as an energy storage device in such a system. They also looked at regenerative fuel cell size, battery sizing, charging and discharging rates, and system limitations in order to improve hybrid power production systems. For improved selection and efficiency, a computer simulation of the behaviors of a photovoltaic gas turbine hybrid system was created. All of the aforementioned studies are aimed at improving the capacity of solar systems to meet rising energy demand. The goal of a hybrid system is to provide continuous power supply and minimize the impact of stand-alone power plants by using fossil fuel resources for energy recovery. PV technology may readily meet industrial and domestic requirements, since it causes little or no environmental damage when compared to other sources. As a result, if this system is favorably linked with other renewable sources such as hydropower plants and wind turbines, its commercialization will be stable and allow for acceptable growth. PV/T collectors are used to improve the efficiency of solar energy recovery.

PV cells are intended to generate electricity from solar radiation, while thermal collectors recover heat from radiation not collected by such cells as well as waste energy from PV cells. The following is a synopsis of solar-related research in PV/T systems that is commercially viable.

An investigation of the performance of photovoltaic/thermal (PV/T) systems by comparing traditional solar water heaters with photovoltaic/thermal systems, also known as integrated PV/T systems. They created this PV/T system by combining a polycrystalline PV module with a thermal collector composed of corrugated polycarbonate panels with copper collectors. It has been determined that a PV/T collector with high thermal efficiency may be produced, with additional improvements possible with appropriate insulating. They recovered a thermal efficiency of 32.5 percent at the beginning of the experiments with the water output temperature of 30.2 °C and it was around 52 °C at the end with 18.6 percent efficiency using amorphous-silicon (a-Si) thin film solar cell modules incorporated with hybrid flat plate PV/T module using copper pipes with tube and sheet concept. An experimental PV/T collector concept that combines a polymer absorber collector with a single crystal silicon PV cell to create a hybrid energy producing device. The absorber collector was made from a polymer square tube of polyphenol oxide plastic material with black surfaces. They compared the findings to simulation results and found that they were almost identical. They investigated the effect of channel depth, channel length, and mass flow rate on electrical and thermal efficiencies of both water and air in an experiment to develop combined water and air type PV/T collectors to produce hot air and hot water simultaneously with a specified design configuration. Under steady state circumstances, the performance of a photovoltaic solar air heater with a double pass configuration and vertical fins in the bottom channel. First, solar photovoltaic technology is complicated and costly, requiring advanced production and installation technologies. Second, a variety of environmental variables, including sunlight intensity, cloudiness, and wind speed, have a significant impact on solar panel performance. Third, due to their poor literacy levels, rural people all over the globe still need to be educated about the potential benefits of the solar business. Fourth, other markets' potential influence and rivalry are influencing solar energy projects and preventing them from progressing quickly. Fifth, solar cells are often composed of different chemicals that are harmful to the environment, making it difficult for manufacturers and consumers to dispose of them in the environment, despite the fact that solar businesses have no direct effect on the environment. Sixth, solar power production is not always reliable. As a result, additional energy sources must be integrated into this grid network in order to provide a constant supply. Seventh, the large-scale PV business has certain indirect environmental impacts. Birds and insects, for example, may be killed by solar collectors when they fly into a focused beam of sunlight. Eighth, there are some hazardous fluids in the heat exchangers in the collectors. It's also difficult to keep track of them once they've been used. Furthermore, a significant quantity of water is needed to clean and cool turbine generators in order to improve efficiency. This results in water waste and wastewater discharge, resulting in water contamination. Ninth, the energy produced by solar energy systems is direct current (DC), which is incompatible with household appliances, which operate on alternating current (AC). However, for higher efficiencies, it requires complicated circuits and storage systems, which are difficult to manage. Despite the fact that the solar sector faces such obstacles in its development, numerous studies are being conducted to reduce the impact of such obstacles to an acceptable level for improved production efficiencies.

CONCLUSION

A review of solar energy for the future world, including the foundations of photovoltaic technology, the world's energy scenario, driving forces and development trends, highlights of notable research work in solar power generation, PV/T collectors, solar heaters, design improvements and sizing, materials for efficient light absorption to upgrade the solar industry, and its potential applications. This concise depiction will be extremely helpful for solar system producers, scholars, researchers, and decision-makers who want to make a significant contribution to this sector in order to make the world a more energy-efficient place in the future.

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