A Glimpse at Just How Solar Energy Can Be Used in Industries

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ABSTRACT: Solar energy conversion is being commonly used to create heat and power. According to comparative research on global energy consumption published by the International Energy Agency (IEA), solar array installations will supply roughly 45 percent of global energy demand in 2050. Solar thermal has been discovered to be gaining a lot of traction in industrial applications. Solar thermal energy can be used to create power, process chemicals, or even heat your home. Food, non-metallic, textile, building, chemical, and even business-related industries can all benefit from it. Solar energy conversion is widely utilized to generate heat and electricity. Solar array installations will supply around 45 percent of worldwide energy demand in 2050, according to a comparative study on global energy use published by the International Energy Agency (IEA). Solar thermal has been reported to be growing popularity in industrial settings. Solar thermal energy can be utilized to generate electricity, produce chemicals, and heat your home. It can benefit the food, non-metallic, textile, building, chemical, and even business-related industries.

KEYWORDS: Industrial Application, Photovoltaic Systems, Solar Energy, Solar Thermal, Thermal.

1. INTRODUCTION

Because of the tremendous rise in energy demand in recent decades, energy use has become a major challenge. Furthermore, environmental challenges associated with conventional energy resources, such as climate change and global warming, are prompting us to seek out alternate energy sources. According to World Health Organization (WHO) estimates, direct and indirect effects of climate change cause the deaths of 160,000 people per year, with the rate expected to double by 2020. Natural calamities such as floods and droughts, as well as dramatic fluctuations in atmospheric temperature, are all caused by climate change. Conventional energy sources currently account for over 80% of worldwide energy use. The urgent need to replace energy sources was postponed in tandem with the discovery of nuclear energy in the mid-twentieth century, which would outperform fossil fuels by ten to twenty times. However, there are significant drawbacks to using nuclear power as a source of energy. Nuclear fusion, for example, exposes uranium and thorium ores, both of which are considered fossil fuels[1]. Furthermore, nuclear power facilities are now only available for large-scale electricity generation. . As a result, renewable energy remains the greatest option for cooking, heating, and small-scale applications. It is the source of energy that will allow humanity to continue to exist on the planet without relying on fossil fuels[2]. Because a large portion of energy is used in industrial processes, the role of energy in industrial development is critical. It now accounts for more than half of all global energy usage. The industrial sector's provided energy is used in four key areas: construction, agriculture, mining, and manufacturing. Energy use, savings, and emissions in the industrial sector Pattern of global industrial energy use by fuel between 2006 and 2030 (percentage) Electrical motors, compressed air, and boilers have all been studied, and it has been discovered that this sector consumes a significant amount of energy. Enterprises are no longer enticed to employ fossil fuels in the industrial sector due to significant increases in conventional fuel prices and environmental concerns. The utilization of renewable energy-based solutions in industry could reduce greenhouse gas emissions. Significantly reduced As a result, traditional energy sources should be considered to be transferred to renewable energy sources and new technologies to be created and implemented in industries. Solar power, out of all the renewable energy sources, has gotten the most attention as the most promising alternative for industrial use. Solar energy is abundant, free, and pure, and it produces no noise or pollution in the environment. Many attempts have been made thus far to extract solar energy using solar collectors, sun trackers, and massive mirrors in order to use it for industrial uses. In the industrial world, there are two types of solar energy applications: solar thermal and photovoltaic. Hot water, steam, drying and dehydration procedures, preheating, concentration, pasteurization, sterilization, and wafer drying are some of the most typical applications. The utilization of solar energy has received a lot of interest in the engineering sciences due to the worldwide energy constraint and the need to control detrimental environmental repercussions. As a result, there is a lot of research going on to find efficient and cost-effective ways to capture, store, and transform solar energy[3]. The conversion of energy into useable energy should not be overlooked. There is no comprehensive evaluation of solar uses in the literature. energy consumption in industrial facilities This review is expected to be lengthy industrial energy users, policymakers, research and development and environmental groups are two types of organizations. A block diagram of a typical industrial energy system is shown in Figure 1.

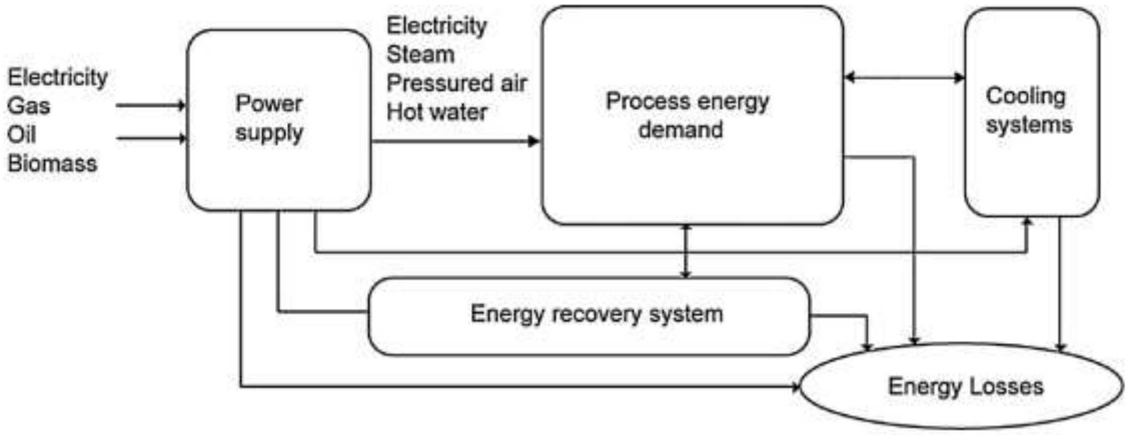

Figure 1: Block Diagram Of A Typical Industrial Energy System [4].

Power supply, production plant, energy recovery, and cooling systems are the four primary components of a typical industrial energy system. The energy required for the system to operate is provided by the power source, which is mostly made up of electrical energy, heat, gas, steam, or coal. The production plant is a component of the system that manages the production process. This portion uses energy to power subsystems, pressure/vacuum/temperature solenoids, valves, and switches. Solar energy systems can be used as a power source or directly to power a process.

2. LITERATURE REVIEW

Michael G et al. in their case study suggested that the use of organic and inorganic-based selective mirrors that allow sunlight in but reflect luminophore-emitted light, plasmonic structures to enhance emissions, novel photovoltaics, alignment of the luminophores to manipulate the path of the emitted light, and patterning of the dye layer to improve emission efficiency are all discussed as ways to limit surface and internal losses. Finally, several prospective 'future peeks' are presented, along with other research routes that could lead to a device that makes solar energy a pervasive element of the urban environment, with applications like sound barriers, bus-stop roofs, awnings, windows, paving, or siding tiles[5].

Martin A et al. in their case study suggested that Photovoltaics – the conversion of sunlight into electricity using solar cells — has advanced faster than even the most optimistic predictions in the last two years. In 2012, the sector is on track to achieve costs and output volumes that the International Energy Agency predicted would not be achieved before 2020, even in its 2009 plan. On a large scale, the results have been outstanding. Hundreds of thousands of mostly tiny, private solar systems supplied more than 20% of Germany's monthly peak electricity demand, as well as 8% of its monthly electricity usage1 in May 2011. This is only one example of how photovoltaics will play a bigger role in the future[6].

L. P. Gaucher et al. in their case study suggested that this long-range analysis, which is presented in detail, not only confirms the eventual need for nuclear power and a large "synthetic" fuels industry, but it also suggests that the United States may become increasingly reliant on electrical energy derived from central solar power stations in the not-too-distant future. Approximately 30% of all energy consumed in this country might be obtained this way in 200 years. The size and rate of growth of this vast solar-power business, as well as solar-energy collection, conversion, and transmission systems, are reviewed [7].

3. DISCUSSION

3.1. Thermal energy for industrial processes:

To create necessary thermal energy, nearly all industrial energy networks and systems are partially or completely reliant on the combustion of fossil fuels. According to the distribution of energy consumption, around 13% of thermal industrial applications require low temperatures thermal energy up to 100°C, 27% up to 200°C, and the remaining 27% require high temperatures thermal energy up to 200°C.In steel, glass, and other materials, high temperatures are required for the remaining uses industry of ceramics. Many industrial processes use heat at temperatures ranging from 80 to 240 degrees Celsius. Solar thermal energy has enormous uses in low (i.e., 20–200 C), medium (i.e., 80–240 C), and medium-high (i.e., 80–240 C) temperature levels, according to industrial energy analysis. Almost every industrial operation necessitates the use of heat in some form. Heating accounts for over 15% of the final energy consumption in the industrial sector in southern European nations. WHs, solar dryers, space heating and cooling systems, and water desalination are the most popular industrial applications for solar thermal energy. Many industrial applications employ solar as an input power source for heat engines. Sterling engines can operate with any type of external heat source. They are extremely dependable, have a basic design and construction, are simple to operate, and are cost effective. The efficiency of such mechanical devices, however, are extremely modest. When compared to external combustion engines, they are more efficient and emit fewer pollutants. Solar irradiation can be used to generate heat for Stirling engines, lowering their cost and complexity while boosting their efficiency. Solar-powered Stirling engines would be cost-effective if they were mass-produced in large quantities[8].

3.2. Applications:

On a Stirling cycle, compressed fluids such as air, hydrogen, helium, nitrogen, or steam are used. Stirling engines can be used in a variety of applications that require quiet operation Very good if required or in systems with multi-fueled features low speed, steady power output, and low rate of cooling adjusting the output power Solar energy is used to create thermal energy for industrial operations, which reduces reliance on fossil fuels while also lowering greenhouse gas emissions such as CO_2, SO_2, and NOx. Nonetheless, there are several obstacles to incorporating solar heat into a wide range of industrial processes, such as solar radiation's periodic, dilute, and changeable character. In both the home and industrial sectors, solar water heating accounts for the bulk of solar thermal applications. Among all the solar thermal systems currently available, they are thought to be the most cost-effective. SWH systems are currently commercialized and well-established in a number of nations throughout the world. The use of SWHs has expanded at a 30 percent yearly growth rate since 1980.Figure 2 discloses that the system of solar collectors.

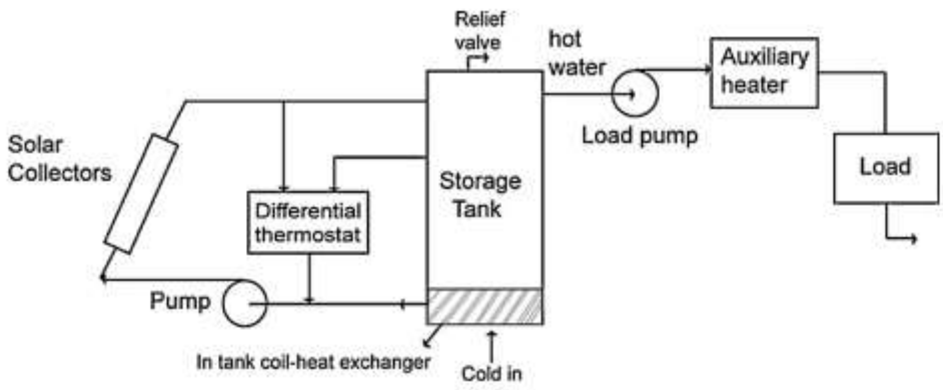

Figure 2. Block Diagram Of A SWH System[4]

3.3. Advantage:

Solar drying and dehydration systems employ solar irradiance to heat the air either as the sole source of energy or as a complement. Solar dryers use the sun's irradiation for drying and dehydration processes in industries including bricks, plants, fruits, coffee, wood, textiles, leather, green malt, and sewage sludge, whereas conventional drying systems need fossil fuels. They are divided into two groups: high temperature dryers and low temperature dryers. Almost all high-temperature dryers need fossil fuels or electricity to heat them, although low-temperature dryers can use either fossil fuels or solar energy. Photovoltaic systems are divided into two categories: stand-alone and grid-connected systems [43,44]. Systems that are not connected to the grid are known as stand-alone systems and the system's energy output is usually matched with the load necessitates a certain amount of energy. They are typically fueled by energy. When there is no sunshine, storage methods such as rechargeable batteries are used to provide electricity. Occasionally, wind or hydro systems are used. They are referred to as "photovoltaic hybrids" since they assist each other. systems". Grid connected systems, on the other hand, are those that are connected to the public grid. This kind of link is rare, by using a stand-alone system, it solves the problem. Solar thermal energy with a low temperature is appropriate for you. Passive dryers that are exposed to the sun are particularly popular since they have a low initial and ongoing cost and require little maintenance. However, because to insufficient drying, fungus and insect infestation, and bird and rat encroachment, open-to-sun drying produces significant waste and crop losses. Furthermore, weather and climate variations such as rain and even cloudiness have an impact on the effectiveness of such systems. Sun energy is used with electricity or fossil fuels to provide power for pumps and engines that circulate air in active solar drying systems. Solar energy is the only source of heat in this sort of solar dryer. This technology is employed in commercial drying applications on a huge scale. This type of device can cut energy use while also managing drying conditions[9].

3.4. Working:

For the direct drying procedure, high-temperature sun heaters are used. The fossil-fuel fired dehydrator, on the other hand, is used to raise the air flow temperature to the required level in medium and low temperature systems. The latter is referred to as a "hybrid solar dryer." It eliminates the effects of the solar collector's changing energy production at night or when the sun's irradiation is low. Solar active dryers are commonly utilized in high-temperature drying procedures that demand constant air flow. Hot air or gas with a temperature range of 140°C to 220°C is commonly used in industries that include drying processes. Solar thermal systems can be properly integrated with conventional energy sources to suit system needs. When a system is required to work in the cold, heat storage appears to be vital. Poverty, pollution, health, and environmental issues have all arisen as a result of the world's population growth rate, particularly in emerging countries. Currently, one-fourth of the world's habitats lack sufficient pure water.

The global population distribution since 1950, with projections through 2050. As can be seen, the world's population is more concentrated in Asia and Africa's developing countries. As a result, water desalination technology appears to be more important in these areas. There are times during the day when there is no irradiation. Solar dryers can be used widely in the food and agriculture industries to increase output quality and quantity while reducing waste and minimizing environmental issues. Despite the use of large-scale solar dryers in commercial food sectors, the greatest impediment to further improving the technology in poor nations is a lack of information. The initial purchase and installation fees for this type of dryer are both substantial. As a result, only large farms can afford the financial costs. Solar power systems are a reliable alternative for water desalination facilities as an innovative power source. For such systems, it is the most effective and practical solution. In addition, they are more ecologically friendly and cost-effective than traditional approaches. Small tubs implanted in lifeboats, known as "solar stills," can be used to desalinate sea water using solar energy. Solar stills are ideal for home use, especially in rural and remote places, small islands, and large ships without grid connectivity. In this case, solar energy is more cost-effective and technically superior than traditional reverse osmosis systems powered by diesel engines. This technology is relatively easy, but it requires a large initial investment, a large surface area, frequent maintenance, and weather sensitivity. As a result, its use in large-scale manufacturing operations is limited. Currently, however, the majority of the small to medium-sized companies. When these systems are used in isolated areas where there is no connection to a public grid, the economic future for these systems is more favourable. Initial investment, depreciation factor, economic incentives, PV module cost, and oil price should all be taken into account. Increased demand for air conditioning systems has been fueled by rising living and working standards, rapid urbanization, unpleasant outdoor pollution, and affordable air conditioning systems. The greater the need for air conditioning, the greater the demand for electricity. As a result, power plants satisfy peak load demand on hot summer days, resulting in blown-out situations. Statistics show a massive increase in the number of air conditioning systems in European countries over the last 20 years, with cooling capacity more than doubling[10].

4. CONCLUSION:

This report discussed the applications, advances, and forecasts of solar energy in industry. It was highlighted how utilizing solar energy can increase product quality and quantity while lowering greenhouse gas emissions. Both solar thermal and photovoltaic systems have been shown to be suitable for a variety of industrial process applications. The water desalination industry has grown to address water scarcity and the constraints of available water supplies. It may produce safe drinking water from brackish or seawater. However, traditional desalination processes, often known as supply-side approaches, have significant negative environmental consequences and disrupt natural ecosystems. Furthermore, their operation necessitates a large quantity of energy. The overall efficiency of the system, however, is dependent on correct system integration and solar collector design. Solar energy systems can be used as a source of power or directly applied to a process. Because stationary collectors are used, large-scale solar thermal systems with vast collector fields are economically possible. Furthermore, when compared to small plants, they require a lower initial investment. The feasibility of integrating solar energy systems into conventional applications is determined by the energy systems used by industries, as well as an analysis of heating and cooling demand and advantages over existing technologies. Solar PV systems are trustworthy alternatives that should be considered as a cutting-edge power source in construction, industrial industries, and water desalination systems. When these systems are used in rural areas where there is no connection to a public grid, they have a better economic future. Other technical and economic factors such as wear and tear, initial and operating expenses, economic incentives, PV module price declines, and oil price increases should not be overlooked. Solar energy systems must be considered by designers, engineers, architects, service engineers, and material providers as a sustainable energy development. Furthermore, government and community policies may play an important role in encouraging the home and industrial sectors to adopt new technologies.

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