International Journal of Advanced Academic Studies 2020; 2(4): 18-20

E-ISSN: 2706-8927
P-ISSN: 2706-8919
www.allstudyjournal.com
IJAAS 2020; 2(4): 18-20
Received: 17-08-2020
Accepted: 18-09-2020

Vidya Sagar
Research Scholar, Department of Physics, L.N.M.U., Darbhanga, Bihar, India

Corresponding Author:
Vidya Sagar
Research Scholar, Department of Physics, L.N.M.U., Darbhanga, Bihar, India

Studies of future prospects of solar energy and its potential

Vidya Sagar

Abstract
Rapid growth within the field of solar technologies is nonetheless facing various technical barriers, such as low solar cell efficiencies, low performing balance-of systems (BOS), economic hindrances (e.g., high upfront costs and a lack of financing mechanisms), and institutional obstacles (e.g., inadequate infrastructure and a shortage of skilled manpower). The merits and demerits of solar energy technologies are both discussed in this paper.

Keywords: Solar Energy and Economic Hindrances

Introductions

With regard to solar research is associated with the current drive toward reducing global carbon emissions, which has been a major global environmental, social, and economic issue in recent years [1-4]. For example, 696,544 metric tons of CO2 emissions have been reduced or avoided via the installation of 113,533 household solar systems in California, USA [5]. Therefore, the adoption of solar technologies would significantly mitigate and alleviate issues associated with energy security, climate change, unemployment, etc. It is also anticipated that its use will play an important role within the transportation sector in the future as it does not require any fuel transportation. Policies, investment, and supports (such as research funding) from various governmental and non-governmental organizations for solar technologies have helped build up a solid foundation for the exploitation of this renewable energy system. While incentives and rebates can be effective motives for the development of these markets, there are also growing efforts to reduce the fiscal burden of these policy incentives. However, solar power subsidies have already faced sharp cuts in many countries, which may retard growth within the industry.

To revert this potential decline, policies are changing to support the deployment of solar power systems for large-scale power generation. Furthermore, greater subsidies should be provided for residential solar generators over utility-scale generators. In this article, we provide a global scenario with regard to solar energy technologies in terms of their potential, present capacity, prospects, limitations, and policies. This will help us expand our understanding on how much further we can count on solar energy to meet the future energy demand.

Only three renewable energy sources (i.e., biomass, geothermal, and solar) can be utilized to yield sufficient heat energy for power generation. Of these three, solar energy exhibits the highest global potential since geothermal sources are limited to a few locations and the supply of biomass is not ubiquitous in nature [6, 7]. A number of factors (e.g., latitude, diurnal variation, climate, and geographic variation) are largely responsible for determining the intensity of the solar influx that passes through Earth's atmosphere [8]. The average amount of solar energy received at Earth's atmosphere is around 342 W m^{-2}, of which ca. 30% is scattered or reflected back to space, leaving ca. 70% (239 W m^{-2}) available for harvesting and capture [9]. The annual effective solar irradiance varies from 60 to 250 W m^{-2} worldwide [10]. Fig. 2 depicts the annual average intensity of solar radiation over the surface of the earth. Research has shown that “black dot” areas could provide more than the entire world's total primary energy demand, assuming that a conversion efficiency as low as 8% is achieved [11].

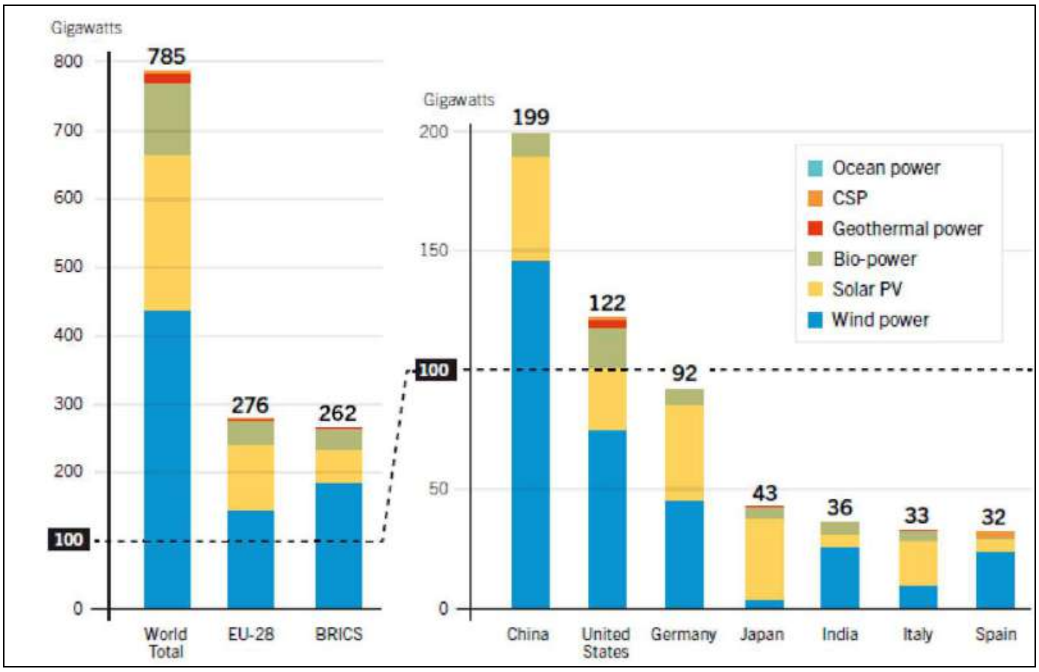

Fig 1: Comparison of non-hydro renewable energy capacities between countries

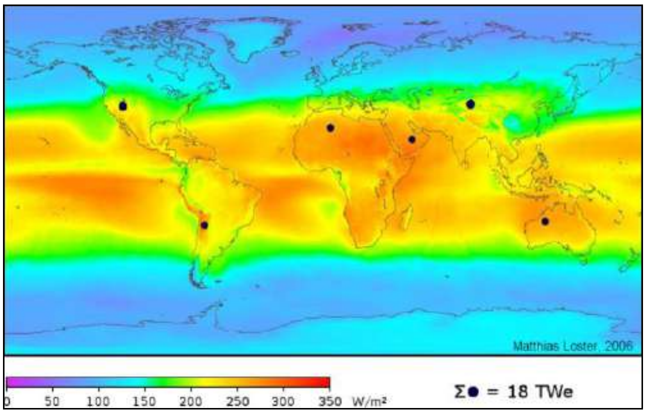

Fig 2: Annual average solar irradiance distribution over the surface of the Earth

In solar thermal technology, solar energy is harnessed into thermal energy for domestic and/or commercial applications such as drying, heating, cooling, cooking, etc. However, on the industrial scale, concentrated solar thermal (CST) technologies are being used to fulfill such heating requirements while concentrated solar power (CSP) technologies are being employed to generate electricity. The latter involves the use of high-magnification mirrors to concentrate solar energy prior to converting it into heat energy to power a steam turbine. Four types of CSP technologies are currently available on the open market: (i) parabolic troughs (these concentrate sunlight onto a receiver tube containing a working liquid); (ii) Fresnel mirrors (use multiple flat mirrors to concentrate solar sunlight onto a receiver tube); (iii) power towers (an array of thousands of sun-tracking reflecting mirrors positioned in a field to concentrate solar radiation to a single point), and (iv) solar dish collectors (concentrate power by focusing ST energy onto a single point situated above a reflector dish).

Current global status for solar energy

The availability of most renewable energy sources (i.e., wind, solar, tidal wave, hydro, etc.) tends to vary widely throughout the course of a day, season, year, even from one geographical location to another. A comparison of the global power capacities between different renewable energy sectors is listed in Table 1. In many countries, the use of renewable energy has been pursued competitively along with conventional energy sources, thereby making a significant contribution to the national generation of power.

Table 1: Comparison of the global power capacity between different renewable energy sectors (Unit: GW)

Order	Power	Year		
		2014	2015	2016
1.	Total Renewable power	1578	1712	1849
2.	Hydropower	1018	1055	1064
3.	Bio-power	88	93	106
4.	Geothermal	12.1	12.8	13.2
5.	Solar PV	138	177	227
6.	Concentrating solar thermal	3.4	4.4	4.8
7.	Wind power capacity	319	370	433

According to the American Solar Energy Industries Association, the total solar PV capacity of the USA could reach 45 GW by 2017. In Australia, solar power has become the foremost source of new power, producing 913 MW against 774 MW derived from wind power in 2015. Interestingly, 1300 MW of coal power was decommissioned in Australia at the same year. This was applauded as a huge drive towards replacing conventional coal-based power generation and achieving a greener earth.

In India, the installed solar power grid reached a capacity of 3743 (March 2015), 6762 (March 2016), and 8062 MW (July 2016). With such developments, India is currently planning to increase its solar power capacity to a staggering 100,000 MW by 2022. Similarly on the European front, France plans to construct a 1,000-kilometer-long solar roadway, with each kilometer capable of providing enough clean energy to power 5000 homes. To recap, Table 2 lists the present solar power generation capacities and world rankings at the end of 2015 [12-13].

Table 2: The 2015 global ranking for solar power generation capacity

World Ranking	Country Name	Total Capacity (MW) at 2015	Installed (MW) in 2015
1.	China	13,1800	15,130
2.	Germany	39,553	1418
3.	Japan	33,300	10,000
4.	USA	27,400	7260
5.	Italy	19,160	700
6.	UK	8437	3109
7.	Spain	6967	6946
8.	France	6680	1020
9.	Australia	5049	913
10.	India	4680	2048

Limitations and benefits of solar energy technologies

Solar energy is a constant power source that could provide energy security and energy independence to all. Such a propensity is hugely important not only for individuals but also for the socio-economic prosperity of companies, societies, states, and nations. Nevertheless, solar power is now being adopted as a natural and substantial part of electricity generation in many developed and developing countries to fulfill energy needs. However, there are a number of limitations as well as benefits associated with its use.

Future prospects of solar technology

Solar energy is one of the best options to meet future energy demand since it is superior in terms of availability, cost effectiveness, accessibility, capacity, and efficiency compared to other renewable energy sources. For the first time, researchers have successfully measured in detail the flow of solar energy, in and between different parts of a photosynthetic organis. The result is a first step in research that could ultimately contribute to the development of technologies that use solar energy far more efficiently than what is currently possible. Researchers from the Graphene Flagship showed that the lifetime of perovskite solar cells can significantly enhanced by using few-layer MoS_2 flakes as an active buffer interface layer. Furthermore, scientists in Hong Kong reported that they have successfully developed perovskite-silicon tandem solar cells with the world's highest power conversion efficiency of 25.5%. It is worth mentioning here that the efficiency of perovskite solar cells was only 3.8% when first appeared in 2009. Hence, semi-transparent perovskite solar cells have been created that demonstrate high-power conversion efficiency and transmit visible light while blocking infrared light, making them great candidates for solar windows. It was demonstrated that the polymer poly (3,4-ethylenedioxythiophene) should have great potential for cost-effective and highly efficient perovskite solar cells as a hole transporting material [14-15].

Conclusions

Hopefully, more research efforts will be dedicated toward PV technologies in the near future to enhance their efficiency, stability, manufacturability, and availability, to reduce balance-of-system (BOS) costs and reduce the costs of modules. In this review, we investigated the global potential of solar energy technologies, their limitations and benefits, and their future prospects. Accordingly, we concluded that despite a few drawbacks solar energy technology is one of the most promising renewable energy sources to meet the future global energy demand.

References

1. Renewable Energy Policy Network for the 21st Century (Ren21). Renewables Global Status Report 2016. ⟨http://www.ren21.net/status-of-renewables/global-statusreport/⟩ [Accessed August 2016].
2. Blaschke T, Biberacher M, Gadocha S, Schardinger I. Energy landscapes: meeting energy demands and human aspirations. Biomass- Bioenergy 2013;55:3-16.
3. World Energy Outlook, International Energy Agency 2012. ⟨http://www. worldenergyoutlook.org/weo2012/⟩ [Accessed March 2016].
4. International Energy Agency. 2DS-hiRen Scenario, Energy Technology Perspectives 2012.
5. Arif MS. Residential solar panels and their impact on the reduction of carbon emissions. Reduction of carbon emissions using residential solar panels. ⟨https:// www.nature.berkeley.edu/classes/es196/projects/2013final/ArifM_2013.pdf⟩ [Accessed August 2016] 2013.
6. Holm-Nielsen J, Ehimen EA. Biomass supply chains for bioenergy and biorefining. Woodhead Publishing 2016.
7. Sampaio PGV, González MOA. Photovoltaic solar energy: conceptual framework. Renew Sustain Energy Rev 2017;2017(74):590-601.
8. Al-Tameemi MA, Chukin VV. Global water cycle and solar activity variations. J Atmos Sol Terr Phys 2016;142:55-9.
9. Hart M. Hubris: the troubling science, economics, and politics of climate change. Compleat Desktops Publisher 2015. [ISBN 9780994903808].
10. Luqman M, Ahmad SR, Khan S, Ahmad U, Raza A, Akmal F. Estimation of solar energy potential from rooftop of Punjab government servants cooperative housing society Lahore using GIS. [article ID:56795]. Smart Grid and Renewable Energy 2015;6(05). http://dx.doi.org/10.4236/sgre.2015.65012.
11. National Aeronautics and Space Administration. Plotted from satellite data supplied by NASA Clouds and the Earth's Radiant Energy System (CERES) 2014.
12. Ministry of New and Renewable Energy,.State wise installed solar power capacity. Govt. of India 2016. [Accessed August 2016].
13. Macdonald F. France will install 1,000 km of solar-panelled roads in the next 5 years. ⟨http://www.sciencealert.com/france-is-planning-to-install-1-000-km-ofsolar-panelled-roads-in-the-next-5-years⟩ [Accessed March 2016].
14. Kim H, Kim HS, Ha J, Park NG, Yoo S. Empowering semi-transparent solar cells with thermal-mirror functionality. Adv Energy Mater 2016;6(14):1502466. http://dx. doi.org/10.1002/aenm.201502466.
15. Jiang X, Yu Z, Zhang Y, Lai J, Li J, *et al.* High-performance regular perovskite solar cells employing low-cost poly(ethylenedioxythiophene) as a hole-transporting material. Sci Rep 2017;7. http://dx.doi.org/10.1038/srep42564.