



Solar power technologies for sustainable electricity generation – A review



Jibran Khan^{a,b,*}, Mudassar H. Arsalan^a

^a Department of Basic Sciences, Dawood University of Engineering & Technology, New M. A. Jinnah Road, Karachi 74800, Pakistan

^b Institute of Space and Planetary Astrophysics, University of Karachi, Main University Road, Karachi 75270, Pakistan

ARTICLE INFO

Article history:

Received 17 August 2014

Received in revised form

15 August 2015

Accepted 26 October 2015

Keywords:

Fossil fuels

Hazardous

Solar energy

Photovoltaic technology

Sustainable power generation

ABSTRACT

Most of the energy generated globally utilize fossil fuels involving the emission of environmentally hazardous carbon dioxide and depletion of fossil fuel resources. The continuous variation in fuel prices has added a major concern on its sustainable use for future energy requirements. In order to minimize the environmental degradation during energy production process due to emissions of hazardous gases, the utilization of renewable energy resources can make the energy use clean as well as sustainable. Due to an ever increasing demand of clean energy, a sharp rise in the utilization of naturally available solar energy has been observed. Currently, there are several possible routes for solar energy technological developments. In order to effectively utilize the solar power system, one needs to know the technology and its suitability according to the requirements and nature of usage. In this article, different solar power technologies have been reviewed which can be utilized for the global sustainable electric power generation. Major emphasize has been on solar photovoltaic (PV) and concentrated solar power (CSP) technologies. Their types, mechanism, efficiency and cost factors have been discussed. It has been observed that solar PV being more commercially developed and mature technology is suited for both small and large scale applications while CSP technology despite being expensive yield higher economic returns and is suited for large scale applications. Every solar power technology has its own advantage and disadvantage and their preferred usage is basically dependent on the specific case and given conditions. It has also been observed that solar energy, which is a fairly stable and consistently available source of clean energy has the significant potential to cater ever increasing world electricity requirements.

© 2015 Elsevier Ltd. All rights reserved.

Contents

1. Introduction	415
2. Materials and methods	415
2.1. Literature search	415
2.2. Identified studies	418
3. Results and discussion	418
3.1. Concentrated solar power (CSP)	418
3.2. Concentration technologies of CSP	419
3.3. Photovoltaic (PV) technology	419
3.4. Generations of photovoltaic technology	420
4. Comparison of CSP and PV technology	420
4.1. System efficiency	420
4.2. System sustainability	420
4.2.1. Environmental impacts	420
4.2.2. Economic concerns	422

* Corresponding author at: Department of Basic Sciences, Dawood University of Engineering & Technology, New M. A. Jinnah Road, Karachi 74800, Pakistan.

E-mail address: jibranliaquat@gmail.com (J. Khan).

4.2.3. Social acceptance..... 422
 5. Discussion and conclusion 423
 References 423

1. Introduction

Energy is the most important factor for economic development and prosperity of any country. It is directly related to the global key challenges that the world faces – poverty alleviation, global environmental change and food security [1]. The growing energy crisis is one of the major issues of 21st century [2]. Energy demand increases at a rate proportional to the population and economic growth of a country. In the International Energy Outlook (2009), a technical report issued by the US Department of Energy, the total world energy consumption has been projected to increase by 44% during the period of year 2006–2030 [3]. Fig. 1 shows the projected world energy consumption chart.

According to International Energy Agency [4], the current share of fossil fuels in the global energy mix, at 82%, is the same as it was 25 years ago, however due to sharp rise in the understanding of renewable energy sources, use of fossil fuels is anticipated to be declined up to 75% by the year 2035.

The present global energy situation, led by the fossil fuels, has some serious concerns such as the impacts on regional climatic conditions, environmental degradation, depletion of fuel resources and the energy security. Nuclear power plants also have major reservations such as the associated radioactive emissions. It is thus indispensable to adopt renewable sources of energy for the global development of a sustainable electricity generation system. In the recent times, renewable energy sources have gained a major importance due to their worldwide social acceptance and an ability to provide sustainable energy generation to cater world electricity requirements. Based on recent technological innovation and extensive research initiatives by researchers across the globe, naturally available solar energy has shown an immense potential to meet the future world's energy demands [5].

Sun is the most abundant source of energy for earth. Naturally available solar energy falls on the surface of the earth at the rate of 120 petawatts, which means that the amount of energy received from the sun in just one day can satisfy the whole world's energy demand for more than 20 years [5]. The development of an affordable, endless and clean solar power technological innovation

has huge long-term benefits as it enhances countries' power security through being an import-independent source, thereby resulting in an improved durability, minimal environmental hazards and reduced cost [2,6]. The potential of solar energy makes it beneficial, in a variety of ways such as:

- The areas in tropical and sub-tropical regions receive a higher amount of solar radiations throughout the whole year thus countries in these regions have a significant potential to harness solar energy for their electricity requirements.
- Most of the fossil fuels and energy resources lead towards the climate change and consequently, a social decline. Thus, solar energy in comparison to fossil fuel is a sustainable source of clean energy. Solar power is environmentally friendly and its social acceptance has been significantly increased due to its reliability and efficient performance.
- Solar power systems are relatively affordable and they are suitable for both urban and rural areas.

With this background, solar power technologies which can be utilized for the development of a sustainable electricity generation have been thoroughly reviewed in this research work. An extensive literature search has been conducted and major studies pertaining to the applications of solar power technologies have been identified. Cost analysis, performance and efficiencies of different solar power technologies in common practice around the world have been reviewed and addressed.

2. Materials and methods

To review the solar power technologies for sustainable power generation, a rigorous literature search has been performed to identify existing relevant studies. The identified studies have been analyzed on the basis of different types of solar power generation technologies and their diverse applications. A review of both types of solar power technologies i.e., PV and CSP has been conducted and different types of their concentration technologies have also been addressed. A comparison of both PV and CSP concentration technologies has been carried out on the basis of sustainability indicators. Cost effectiveness and environmental impacts of both technologies have also been discussed. Fig. 2 shows an overall workflow of the adopted methodology.

2.1. Literature search

A systematic literature search was performed at Google Scholar and Science Direct platforms to identify relevant studies involving review analysis of solar power technologies' applications produced in last 17 years.

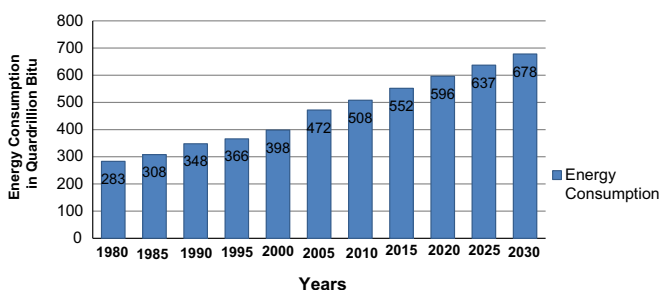


Fig. 1. Projected world energy consumption chart. Source: [3].

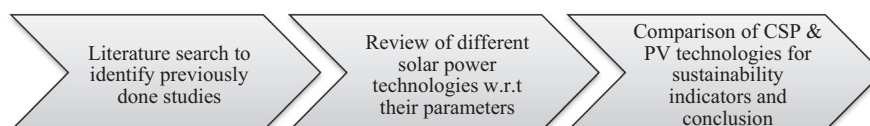


Fig. 2. An overall workflow of the adopted methodology.

Download English Version:

<https://daneshyari.com/en/article/8115244>

Download Persian Version:

<https://daneshyari.com/article/8115244>

[Daneshyari.com](https://daneshyari.com)