Chapter 18
A Comparative Study on a Built Sun Tracker and Fixed Converter Panels

Farzin Shama
Razi University, Iran

Sobhan Roshani
Razi University, Iran

Gholam Hossein Roshani
Shahid Beheshti University, Iran

Arash Ahmadi
Razi University, Iran

Saber Karami
Amirkabir University of Technology, Iran

ABSTRACT

Producing non-polluting renewable energy in large scale is essential for sustainability of future developments in industry and human society. Among renewable energy resources, solar energy takes a special place because of its free accessibility and affordability. However, the optimization of its production and consumption processes poses important concerns, essentially in the affordability issue. This paper investigates several optimization and performance issues regarding solar panel converters using two-axis controlled solar tracer that has been practically implemented in comparison with fixed converter panels. Results shown in tables and graphs demonstrate clearly the advantages and disadvantages of the methods. Based on these results, large scale solar power plants are being suggested to be equipped with similar devices.

INTRODUCTION

Different energy resources that have been used during human history were based on knowledge and ability of man to produce; control and transfer the energy involved. Accordingly, human ability in energy production from these different sources has played an essential role in each period of history in which one or more sources have been more essential. Nowadays, rapid development of the global economy and population increase are accelerating the consumption of fossil energy; therefore governments, and human society in a broader sense, are facing energy crisis issues all over the world. In addition to political and economical issues, since fossil fuels are known as the most severe cause of the environmental pollution and ecological imbalance, they are in-

DOI: 10.4018/978-1-4666-4852-4.ch018

creasingly becoming undesirable resources. These are considered as essential constraints to social and economic development and even a serious threat to human society and national security of countries. As a result, application of new energy sources is becoming a global hot issue (Honglian & Ding, 2011).

Although fossil energy resources are playing a vital role in current civil and industry issues, economic analysis shows that continuous rise in their prices are inevitable in the first decades after the end of 2010, especially for oil (Azad & Panahandeh, 2000). Among all replacements for fossil energy resources, solar energy, as the oldest and the biggest energy source of the plant, has been one of the most important choices since early 1970 (Azad & Panahandeh, 2000). Unlike some non-fossil energy resources such as nuclear power, devices and technologies for power production from solar energy source are reliable and available all around the world (Hayashi et al., 2000; Nakamura, Sakurai, Suzuki, Hayashi, Enoeda, & Tobita, 2006; Yamanishi et al., 2008; Song, Huang, & Ni, 2010). Therefore, the general popularity of these technologies depends mainly on the economic feasibility and the proper sizing of the components in order to avoid outages and ensure quality and continuity of supply.

Photovoltaic (PV) technology has become one of several promising alternatives for energy technology (Winter, Sizman, & Vant-hull, 1989; Markvart, 1994; Sukamongkol, Chungpaibulpatana, & Ongsakul, 2002; Rajapakse, & Chungpaibulpatana, 1994). This endless source of energy, unlike fossil or nuclear resources which are associated with environmental risk and are not trustable in long term, is absolutely clean and free from any pollution. In a large area of our planet, the average density of solar radiation which reaches the earth is more than 2000 KWh/m^2. In these cases, the use of solar energy is not only necessary but inevitable. The geographical extent and circumstances, social context, frequency and extent of villages, often as a point in mountain and plain zones are located and also lack of advanced technology and independent production and distribution of today's conventional methods of energy and many other scientific and technical reasons should be taken into account to come to a conclusion whether solar energy can be a reliable and sustainable resource of energy for a country or not (Azad & Panahandeh, 2000).

A photovoltaic cell generates electricity from sunlight. Basically, the electricity is generated when photons of light are incident on semiconductors, leading to free electrons and holes, which have negative and positive charges respectively. A solar panel is capable to absorb solar radiation and convert them to electricity even for small energy values (Chow, Handb, & Strachan, 2003). The most popular semiconductor, photovoltaic cells is silicon based the silicon element is commonly found in sand. Photovoltaic cells have at least two layers of semiconductors. A positively charged layer of the cell and another negatively charged one. When the light reaches the semiconductor layers, electric field in the junction between these two layers causes direct current (DC) electricity to be produced. In general, more photons of light produce more electrical current. Photovoltaic cells can provide their maximum power output which can be used for air conditioning of buildings in hot summer days when electrical air conditioning systems require a lot of electrical energy, thus help to reduce average electricity consumption (Wong, Shimoda, Nonaka, Inoue, & Mizuno, 2008). In solar thermal power plants, large sun mirrors are arranged in a line or a point of focus, creating heat to produce hot vapor pressure to actuate a power turbine. In areas with long duration sunshine, higher efficiency of solar thermal power generation is guaranteed. According to a long term plan, by 2015 total installed thermal power capacity would have increased to 5000MW from current capacity of 354 MW. By 2020 installed capacity of power plants based on solar cells is predicted