



Optimum Tilt Angle of Solar PV Arrays and Collectors for Different Time Periods Used in Iran

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Abstract

One of the most important parameters in the solar energy received by the solar panels is the tilt angle of the panels. Precise determination of the optimum tilt angle of the panels, especially in high-capacity solar arrays, leads to saving considerable energy and cost. Determining the optimal tilt angle of the panels depends on the panels' geographic location in terms of latitude and the clearness index at different times of the year. In this paper, the optimal monthly, seasonal, semi-annual, and annual (fixed) tilt angles of the solar panels are calculated using the maximum solar energy received per unit area in different cities of Iran. Also, the energy received by panels for each angle is evaluated at different time periods. The results show that the optimum tilt angle for each city is approximately 4 to 8 degrees lower than the latitude of that city.

Key words: solar energy, tilt angle, optimum tilt angle, solar panel

1. Introduction

The fast increasing of the global energy demand, especially in recent years, has raised concerns about environmental impacts of the fossil fuel consumption and the reduction of the fossil fuel reserves [1]. Hence, the development of renewable energies mainly based on solar and wind energy has increased in last few years [2]. Iran approximately has 300 clear sunny days in a year and an average 2200 kWh solar radiation per square meter. In other words, 9 MWh of energy can be obtained in a day using 10% efficient energy-conversion systems in the 1% of the total area which is a considerable potential for clean energy production [3]. This considerable potential of solar energy clears the increasing efficiency necessity in solar energy systems in Iran. The efficiency of solar panels or collectors depends on several factors, one of which is the tilt angle of the panel [4]. The best way to receive the most solar radiation by panels is the use of Maximum Power Point Tracking (MPPT) systems, which mechanically and automatically tracks the sun and changes the angle of the panels. However, the use of this technology is costly and requires energy, and sometimes it is impractical. Therefore, it is possible to increase the incident solar energy received by the panels by changing the tilt angle of the panels at different time intervals [5]. M. Ahmad and G.N. Tiwari examined the theoretical aspects of choosing a tilt angle of solar