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Solar radiation increase over a capturing surface considering R_b factor for Braşov urban area

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Abstract. The paper calculates the available solar potential for Braşov urban area and the possibility to increase this potential by using different tilt angles of the capturing surfaces (photovoltaic panels, solar collectors).

The paper also presents: the variation diagrams of the R_b coefficient considering an inclination angle during all year, respectively the values of the optimum tilt angle obtained for months March (47°), June (23°), September (44°), and December (69°); the daily means of the direct and global energy, depending on the tilt angle of the capturing surface; the annual variation of the direct and global energy depending on the tilt angle.

Key words

Direct irradiation, global irradiation, solar potential, tilt angle, R_b factor.

1. Braşov urban area – Geographic and Climatological description

Braşov city is located in eastern-central Romania at 25°36' East longitude and 45°39' North latitude. Placed in Braşov basin, in Carpathians internal curvature, Braşov urban area is about 790 m above the sea level.

This region exhibits some typical features with respect to the topology, the climatology and the environment. The build-up area is low in comparison with that of the neighbouring mountains, which circles the basin area.

The lowest atmospheric layers in the basin are – especially in winter – under the influence of temperature gradient inversions that restrict the atmospheric conversion and, therefore the vertical dispersion of air pollutants and dust. The slope winds that alternatively move up and down along the basin are too weak (the wind speed monthly mean is lower than 2 m/s) to carry the pollutants completely out of the basin. Consequently, crucial situations of atmospheric pollution are frequently observed in winter when cloudy air masses persistently stay in the bottom of the basin, stopping solar radiation and incidentally increasing temperature inversion [1].

In order to calculate the performance of an existing system or to estimate the energy generated from a system in the design stage, appropriate weather data must be required. In this regard, both an analysis of the influence of the measurement interval of solar radiation and wind speed, and a good fit for the data measured in a typical hybrid energy system are of paramount importance, not only with regard to technical reliability but also in the minimization of total system cost (kWh costs).

Most of the times, we record information concerning the solar radiation onto a horizontal surface. However, it is necessary to know the direct and diffuse components of the radiation onto the plane of a solar collector or a PV system. In all primary solar systems, solar radiation can be adsorbed by a flat collector, a PV panel or can be concentrated using mirrors and optical lenses. Optimal choice of technology (fix or tracked) depends on energy needs, area and location-specific weather conditions.

To provide the necessary information about the weather, meteorological instrumentation was used. The meteorological data measurements were carried out with a Delta-T local weather station, positioned on the roof of "Transilvania" University of Braşov. The data sets have been collected since October 2005 until now and they comprise: global solar radiation [W/m^2]; diffuse solar radiation [W/m^2]; air temperature [°C]; wind speed [m/s]; wind direction [degrees]; relative humidity [%]; rainfall [pluviometric mm]; sunshine duration [2].

2. Available solar potential

The amount of solar radiation that reaches the earth's surface is not constant; it depends on location, time of day, period of the year, and specific weather conditions.