EMS Annual Meeting Abstracts
Vol. 12, EMS2015-563, 2015
15th EMS / 12th ECAM

Solar energy lost in a Solar Thermal Energy plant, due to aerosol extinction between the heliostats and the optical receiver

Thierry ELIAS (1), Didier RAMON (1), Laurent DUBUS (2), Charles Bourdil (2), Rémi Perrin (3), Emilio Cuevas-Agulló (4), and Taoufik Zaidouni (5)

(1) HYGEOS, Lille, France (te@hygeos.com), (2) EDF R&D, CHATOU, France, (3) EDF-EN, (4) AEMET, Santa Cruz de Tenerife, Spain, (5) DMN/DTE, Casablanca, Morocco

Aerosols attenuate the solar radiation along two pathways: 1) the vertical pathway, between the top of the atmosphere and the heliostats, resulting in Direct Normal Irradiance (DNI) changes; 2) the horizontal pathway in the surface atmospheric layer, between the heliostats and the optical receiver. We present the second impact of the aerosols on the solar energy collected by a Solar Thermal Energy (STE) plant, as it becomes significant in solar tower plants of 100 MW or more. Indeed aerosols mostly lay within the surface atmospheric layer, called the boundary layer, and the attenuation increases with the distance covered by the solar radiation in the boundary layer. In such plants, the distance between the heliostats and the receiver becomes large enough to produce a significant attenuation by aerosols.

The aerosol attenuation at surface level in Ouarzazate (Morocco) was derived from the aerosol extinction coefficient (AEC). AEC was obtained by dividing the aerosol optical thickness (AOT) by the boundary layer height (BLH), assuming that all aerosols were uniformly distributed in the boundary layer. AOT, representing the extinction by aerosols distributed in the whole atmospheric column, was measured by the AERONET network at Ouarzazate airport. BLH was provided by the European Centre for Medium-range Weather Forecast operational analysis. The estimated attenuation at 550 nm caused by aerosols and molecules along a 1-km distance between a heliostat and the receiver in Ouarzazate was 4.8% in 2013 and 6.2% in 2014, and the transmission T1km was 95.2 and 93.8%, respectively. To estimate the amount of solar energy attenuated by aerosols between the heliostats and the optical receiver, we have to apply the estimated transmission on incident solar radiation at the heliostat level, as DNI . T1km.