

EXERCISE 3

Concentrating Solar Power (CSP), Tower Plant



Technical characteristics

The PS20 plant located near Seville, Spain, went into operation in April 2009. It has 20 MWe of power generating capacity. It consists of a solar field of 1255 mirrored heliostats of 120 m² area each. Each heliostat reflects solar radiation onto the receiver on the 162 m high tower. The receiver converts 92% of received sunlight into steam, generating electricity through a steam turbine. The receiver in the solar tower is designed to deliver 55 MW_{therm}. The plant is designed to generate 50 GWh_{el} / yr.

Questions:

- With a latitude of 37°, and an atmosphere albedo of 30%, estimate the annual direct irradiance at the plant site.
- Calculate the efficiencies: (a) of the thermal cycle; (b) of the heliostats field; (c) global (plant).
- Compute the X-Y extension in the figure, assuming that the 1255 heliostats are roughly regularly distributed in a circle ($\Rightarrow X \approx Y$) tangent to the receiver tower. The land use for each heliostat equals 5 times its mirror area.