OPTIMAL DESIGN OF LARGE SOLAR FIELDS: MAXIMUM ENERGY OUTPUT

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Economical design of large solar plants requires a careful analysis of the interrelated parameters involved. Parameters like shadow and masking effects, field slope and azimuth, collector's height and length, or efficiency, etc., have an effect on the results of the design. The use of many rows, in a limited piece of land, will increase the gross collectors' area but will also increase the shading and the masking effects. On the other hand, a small number of rows (i.e. large distance between rows) decreases the shadowing and the masking, but because the total collectors' area is smaller the energy output from the field may not increase. Another parameter that may effect the amount of collected energy is the use of step like structures, or sloped fields. In this case the shading and the masking effects are reduced, thus increasing the amount of collected energy by the field. ``Maximum Energy Output" of a field of collectors may be one of the objectives of a solar plant design. Other objectives may be ``Minimum Plant Cost" or ``Minimum Produced Energy Cost". The design of a large field of collectors is therefore a multivariable optimization problem with an objective function and constraints, and as such, optimization techniques must be applied.

The purpose of this article is to solve the problem of optimal deployment of an arbitrary oriented and sloped field made of stationary solar collectors using mathematical optimization techniques. The ``Maximum Energy Output" objective functions was considered for which the optimal number of rows, collector tilt angle and the distance between rows that maximizes the energy output from a given field were determined. A land with fixed dimensions and a yearly and worst months insolation criteria were investigated. The results apply to solar radiation data at Tel-Aviv (Israel) area.

Results of an optimal deployment of solar collectors for maximum energy output are given in Table 1 for a field of 12 times 7.5 m^2. The optimal design is: inclination angle $ß = 34.2°$, k=6 rows for yearly energy strategy and ß= 55.1° and k=8 rows for January (worst month insolation).

Table 1: Optimal deployment for maximum energy output.

	ß (°)	K	D (m)	Yearly Insolation Kwh - Year	January Insolation Kwh - Month
Yearly Energy Strategy	34.2	6	0.41	109,745	4,251
Worst monthly Energy strategy	55.1	6	0.40	107,849	4,374