Suspended Solar Farm

Efficiency of the dishes

Solar parabolic dish concentrator is one of the solar power technologies which reflect the direct normal radiation of the sun to a central receiver, located at the focal point of the dish. This energy can then be converted into mechanical energy and be used for irrigation (Saini, et al., 2013), or it can be converted into electricity using a thermoelectric generating unit (usually a Stirling engine) attached to the receiver (Nepveu, et al., 2009; Wu, et al., 2010). Attaching the generator unit to the dish receiver, reduces thermal loss. That is why this technology has one of the highest overall efficiencies between solar concentrating systems (Baharoon, et al., 2015: p1017). The other advantages of solar dishes are: having high power density, versatility, long lifetime, modularity, their durability for moisture effects, and possibility of hybrid operation. Also this technology has relatively low construction cost as many parts can be constructed by local manufacturers. These reasons, make solar dish system an economically reasonable source for electricity generation (Hafez, et al., 2017: p1020)

In this project, 75 solar dishes with diameters between 6 and 13 m, and surface areas between 40 and 188 m2 were used to shape a tent-shaped solar farm with total area of 17331 m2. To perform better, these dishes are tilted towards the sun in different angles. Surface area of different parts of the solar farm is demonstrated in table 1.

Tables

Table 1: surface area of various parts of the solar farm situated in different tilt angles

Tilt Angle (β)	8°	17°	20°	24°	27°	30°
Surface area (m^2)	1148.7	4913.3	1441.1	6898.5	1404.4	1525.3

Total incident solar radiation of the farm: 1263.1 MWh

Based on the literature review, the average solar–to–electric efficiency of dish/Stirling system was 30%. So total electricity generated in the farm would be as table 2.

Table 2: electricity generation from different parts of the solar farm, based on the average solar–to–electric efficiency of dish/Stirling system reported in the literature (30%)

Tilt angle	8°	17°	20°	24°	27°	30°
Jan.	1,616.7	7,624.5	2,295.1	11,320.6	2,349.2	2,593.5
Feb.	1,863.7	8,511.1	2,537.4	12,363.1	2,542.9	2,783.4
March	2,093.6	9,213.5	2,715.0	13,029.3	2,650.2	2,869.0
April	2,300.8	9,735.7	2,832.2	13,360.6	2,682.7	2,866.6
May	2,452.4	10,086.1	2,906.3	13,535.7	2,691.4	2,847.4
June	2,404.7	9,755.2	2,798.0	12,949.4	2,562.4	2,697.5
July	2,267.5	9,249.0	2,657.7	12,331.2	2,444.8	2,578.8
Aug.	2,248.6	9,388.7	2,719.1	12,751.1	2,548.7	2,710.9
Sep.	2,188.8	9,473.3	2,776.5	13,229.2	2,676.4	2,881.8
Oct.	2,014.2	9,074.6	2,694.0	13,055.3	2,674.7	2,916.4
Nov.	1,734.8	8,107.8	2,434.1	11,965.9	2,477.1	2,728.4
Dec.	1,577.4	7,507.5	2,266.0	11,214.5	2,332.7	2,581.2
Annual	24,763.2	107,727.0	31,631.4	151,105.9	30,633.1	33,054.9

Harvesting rainwater

The average precipitation reported in 'Airport' and 'Corniche' stations were 54.8 mm (equivalent to 54.8 litres of rainfall per square metre. As the total area of the parabolic mirrors are 15,202.9 m2, a total capacity of 832.4 thousand liters of water can be harvested per year.