Solar PV Array Size for a Daily Energy Need

kWp, number of modules and roof or ground area needed for a daily energy requirement, from peak sun hours, performance ratio and module rating.

Method: IEC 61724-1 (performance ratio definition)

Input parameters

Unit system: SI

Parameter	Value	Unit
Energy needed per day	400.00	kWh
Irradiation on the modules (kWh/m² per day = peak sun hours)	5.0000	
Performance ratio	78.000	%
Module rating (Wp)	550.00	W
Module area	2.5800	m²
Ground (roof) coverage ratio Module area ÷ land or roof area, to leave room for row spacing and access; about 0.4–0.6 for tilted rows, near 0.9 for flush roof mounting.	50.000	%

Calculated results

Parameter	Value	Unit
Array rating needed (DC)	102.56	kW
Number of modules (whole)	187.00	
Array rating with whole modules	102.85	kW
Module area in total	482.46	m²
Roof or land area	964.92	m²

Notes for this case

- Sized on the yearly mean irradiation: an off-grid system must be sized on the worst month and needs battery storage.
- E_d is energy at the meter (AC) only if the performance ratio includes inverter and transformer losses; otherwise it is DC energy at the array.

Formula and method

$$P_{pk} = \frac{E_d}{H\,PR} \qquad N = \left\lceil \frac{P_{pk}}{P_m} \right\rceil \qquad P_{act} = NP_m \qquad A_l = \frac{NA_m}{GCR}$$

Variables

E_d	energy needed per day (AC at the meter if PR includes inverter and transformer losses)	J
H	peak sun hours	h/day
PR	performance ratio	–
P_m	module rating	W
A_m	module area	m²
GCR	ground coverage ratio	–
P_{pk}	array rating needed	W
N	number of modules	–
P_{act}	rating with whole modules	W
$A_m N$	module area in total	m²
A_l	roof or land area	m²

Method and standards

Inverse of the reference-yield relation of IEC 61724-1, rounded up to whole modules.

Assumptions and limits

- Yearly mean irradiation; string and inverter design separate.
- E_d is AC energy only when the performance ratio includes inverter and transformer losses.
- Module rating and area are independent inputs; the page warns when they imply an efficiency outside 5–30 % at 1000 W/m².

References

- IEC 61724-1 (performance ratio definition)

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/electrical/solar-pv/solar-pv-array-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.