Solar PV Water Pumping System Sizing

PV array size, daily hydraulic and electrical energy and average pumping rate for a solar water pump lifting a daily volume against a total head.

Method: Hydraulic energy and PV array sizing for direct pumping

Input parameters

Unit system: SI

Parameter	Value	Unit
Water volume per day	50.000	m³
Total dynamic head	40.000	m
Pump and motor (and controller) efficiency	45.000	%
Peak sun hours on the array (kWh/m² per day)	5.5000	
Array derate (temperature, soiling, wiring)	80.000	%
Water density	1,000.0	kg/m³

Calculated results

Parameter	Value	Unit
Hydraulic energy per day	5.4481	kWh
Electrical energy per day	12.107	kWh
PV array size (DC, at STC)	2.7516	kW
Average flow over the peak sun hours	9.0909	m³/h
Average hydraulic power	0.99057	kW

Notes for this case

• E_h = ρgHV; array kWp = E_h/(η_p·PSH·f). Size for the worst month's sun and the highest demand; storage in a tank (rather than batteries) covers cloudy days.

Formula and method

$$E_h = \rho g H V_d, \quad P_{PV} = \frac{E_h}{\eta_p \, PSH \, f}$$

Variables

V_d	Water volume per day	m³
H	Total dynamic head	m
η_p	Pump and motor (and controller) efficiency	-
PSH	Peak sun hours on the array (kWh/m² per day)	-
f	Array derate (temperature, soiling, wiring)	-
ρ	Water density	kg/m³
E_h	Hydraulic energy per day	J
E_e	Electrical energy per day	J
P_{PV}	PV array size (DC, at STC)	W
$\bar{Q}$	Average flow over the peak sun hours	m³/s
P_h	Average hydraulic power	W

Method and standards

Solar pumping energy balance.

Assumptions and limits

- Daily energy balance; pump efficiency constant over the day.

References

Hydraulic energy and PV array sizing for direct pumping

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-water-pumping-sizing

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.