Sizing Calculations: Solar-Powered EV Charging Station

This document contains the step-by-step calculations used to size the primary components of the off-grid EV charging station.

Table 1: Inputs & Assumptions

Parameter	Value	Unit	Notes
Load Inputs			
Target Vehicles	5	per day	Assumed daily traffic.
Energy per Vehicle	32	kWh	Assumes 80% charge of a 40 kWh battery.
Site Inputs			
Location	Mumbai, India		
Peak Sun Hours (PSH)	5.1	hours/day	Average for Mumbai.
System Parameters			
PV System Efficiency (η)	0.85	(85%)	Standard derate factor for losses (heat, dust, wiring, inverter).
Days of Autonomy	1	day	System can survive 1 day with no sun.
Battery Type	Li-ion		
Battery Depth of Discharge (DOD)	0.80	(80%)	Safe limit to protect battery longevity.

Battery Efficiency (η)	0.95	(95%)	Round-trip efficiency of storing & discharging.
Peak Load (Charger)	50	kW	Assumes one 50 kW fast charger.

Table 2: Load Calculation

Description	Calculation	Result
Daily Energy Demand (kWh)	(Target Vehicles) x (Energy per Vehicle)	
	5 x 32	**160 kWh/day**

Table 3: PV Array Sizing Calculation

Description	Calculation	Result
Effective Peak Sun Hours	(PSH) x (PV System Efficiency)	
	5.1 x 0.85	**4.335 h**
Required PV Array Size (kW)	(Daily Energy Demand) / (Effective PSH)	
	160 / 4.335	36.91 kW
Final Design Size		**~37 kW**

Table 4: Battery Storage (BESS) Sizing Calculation

Description	Calculation	Result
Usable Storage Required	(Daily Energy Demand) x (Days of Autonomy)	

	160 x 1	**160 kWh**
Battery Efficiency Factor	(DOD) x (Battery Efficiency)	
	0.80 x 0.95	**0.76**
Total Battery Capacity (kWh)	(Usable Storage) / (Battery Efficiency Factor)	
	160 / 0.76	210.52 kWh
Final Design Size		**~210 kWh**

Table 5: Power Electronics Sizing

Component	**Sizing Rationale**	**Result**
Inverter	Must meet the single highest peak load.	**50 kW**
Charge Controller	Must be rated to handle the power from the PV array.	**~37 kW**