Battery Storage: Peak/Off-Peak Arbitrage Saving

Daily and annual saving of a battery charged off-peak and discharged at peak, from capacity, depth of discharge, round-trip efficiency, cycles and the two tariffs.

Method: Saving per cycle = E_b DoD (η c_p − c_o)

Input parameters

Unit system: SI

Parameter	Value	Unit
Battery capacity (kWh)	1,000.0	
Usable depth of discharge	90.000	%
Round-trip efficiency	88.000	%
Cycles per day	1.0000	
Operating days per year	300.00	
Peak tariff per kWh	11.000	
Off-peak tariff per kWh	6.0000	
Installed cost per kWh of capacity	18,000	

Calculated results

Parameter	Value	Unit
Energy delivered per cycle (kWh)	792.00	
Saving per cycle	3,312.0	
Saving per year	993,600	
Simple payback (years)	18.116	

Notes for this case

- Ignores degradation and replacement; cycle life limits the years of service.

Formula and method

$$S_d = E_b \, DoD(\eta_{rt} c_p - c_o)$$

Variables

E_b	Battery capacity (kWh)	-
DoD	Usable depth of discharge	-
η_{rt}	Round-trip efficiency	-
n_c	Cycles per day	-
N_d	Operating days per year	-
c_p	Peak tariff per kWh	-
c_o	Off-peak tariff per kWh	-
C	Installed cost per kWh of capacity	-
E_d	Energy delivered per cycle (kWh)	-
S_d	Saving per cycle	-
S_y	Saving per year	-
t_{pb}	Simple payback (years)	-

Method and standards

Energy balance.

Assumptions and limits

- One full cycle a day by default.
- Simple payback only: no discounting, degradation, replacement or auxiliary (cooling, inverter standby) consumption. With no saving the payback is never, and none is shown.

References

- Saving per cycle = E_b DoD (η c_p − c_o)

Report details

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Release checks	2 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/environmental/carbon-energy/battery-arbitrage

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.