

BATTERY TECH



Energy storage

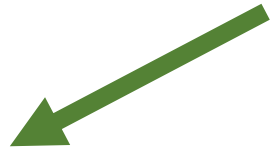
A device (or device assembly) that stores energy for later use.

Battery

Electrochemical energy storage.

Energy storage

Energy storage can be electrochemical, gravitational, or thermal.



Gravity-system image: [EDN](#)

Battery Management System (BMS)

Monitors and optimizes the battery's health.

Provides data to the inverter or charge controller.

Disconnects cells if there's a safety issue.



Energy Storage System (ESS)

An ESS includes:

- Battery

- BMS

- Enclosure

An ESS might include:

- DC-to-DC converter

- Charge controller

- Inverter

Battery-paired PV isn't new

In 1999, most PV systems had battery backup.



Year 1999



Year 2026

Thanks Bill Brooks for pointing this out

Lithium ion vs. lithium iron phosphate

Lithium ion has higher energy density.

Lithium iron phosphate (LFP) is safer.

No cobalt in LFP batteries. 🌈 🐎

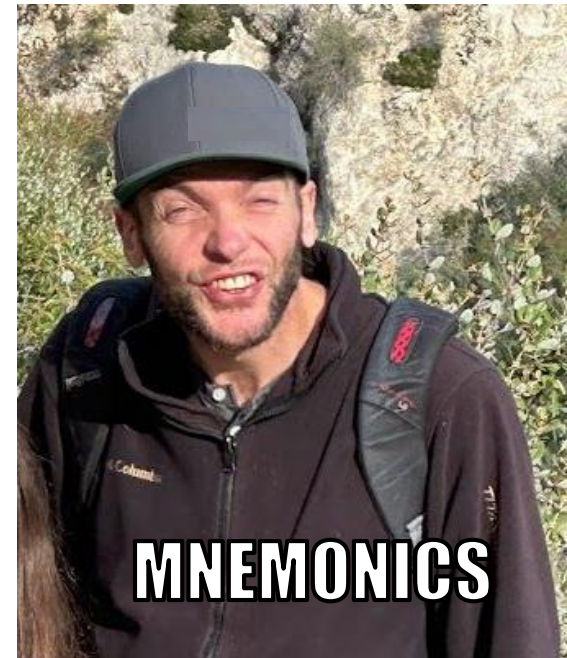
Li-ion vs. LFP (for lithium ferro-phosphate)

Anode vs. cathode

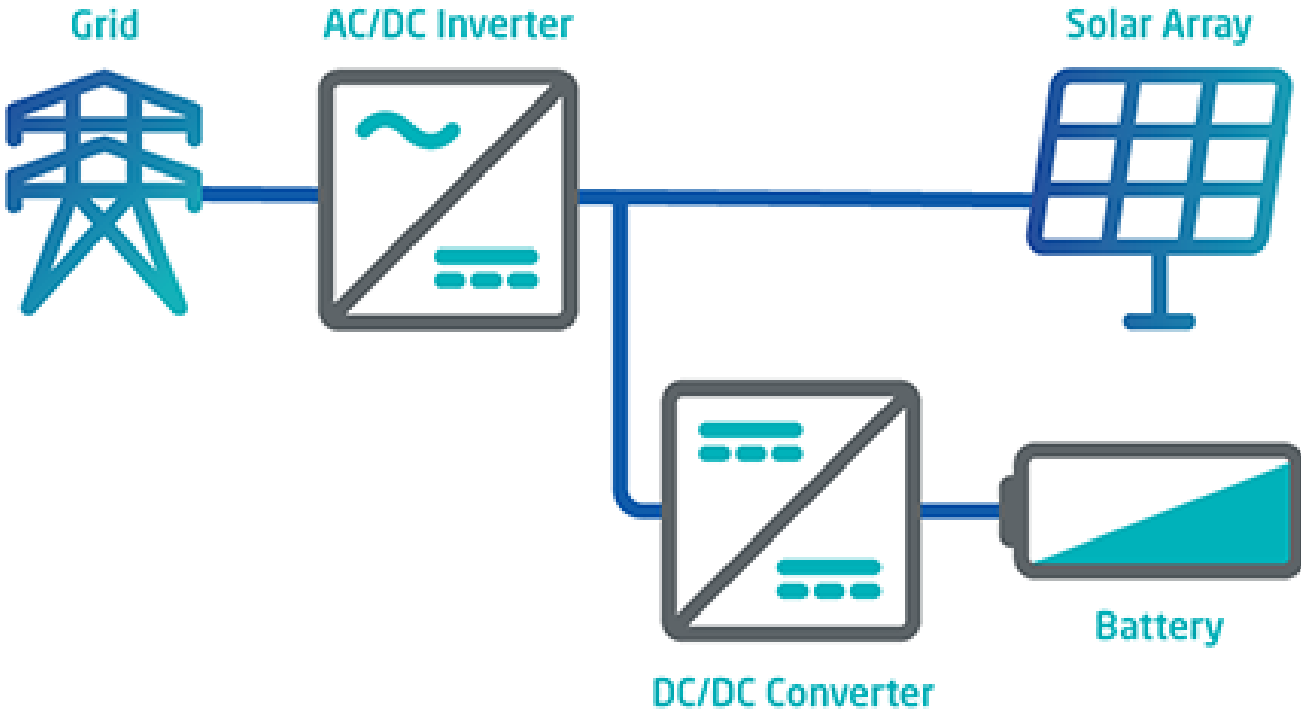
Anode: Where electrons leave a battery (discharge).

Cathode: Where electrons come into a battery (charge).

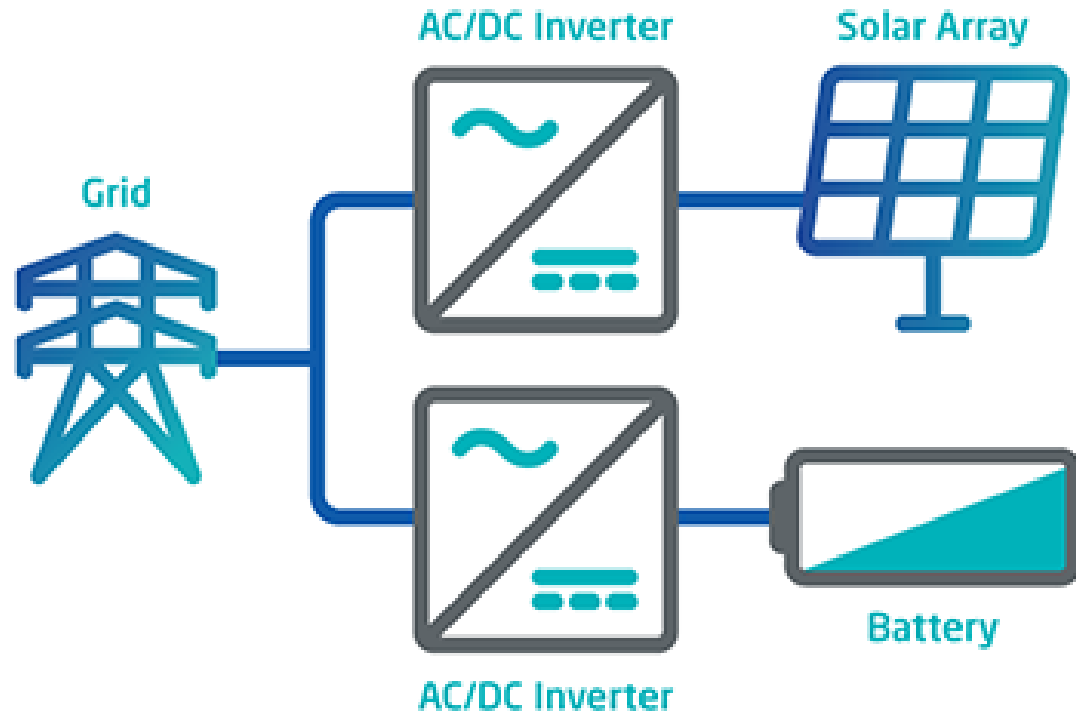
The **cathode** is the battery's electron **catcher**.



DC-coupled and AC-coupled storage



DC Coupled



AC Coupled

Diagrams: [Fluence](#)

Energy capacity

The total energy that a battery can store, in kilowatt-hours.

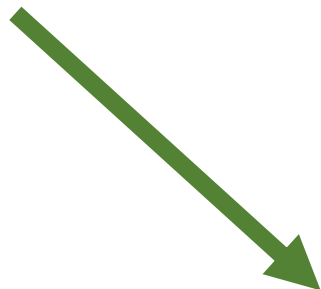


Battery size

Discharge rate

The rate that power can flow out of a battery, in kilowatts.

Continuous vs. peak



PERFORMANCE SPECIFICATIONS

AC Voltage (Nominal)	120/240 V
Feed-In Type	Split Phase
Grid Frequency	60 Hz
Total Energy	14 kWh
Usable Energy	13.5 kWh
Real Power, max continuous	5 kW (charge and discharge)
Real Power, peak (10s, off-grid/backup)	7 kW (charge and discharge)

Maximum depth of discharge (DoD)

The extent to which a battery can be regularly discharged.

...Without causing significant degradation.



lead acid:
~50% DoD



typical lithium options:
90%+ DoD

Roundtrip efficiency

The efficiency of storing energy in the battery and getting it back out again.

For example, Enphase 5P:

95% DC efficiency

90% AC efficiency



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