The flow of electricity in a **solar + battery system** depends on whether it is **DC-coupled** or **AC-coupled**. Below is a step-by-step breakdown of how electricity moves through a solar system from **solar panels** to **inverters**, **batteries**, and **home appliances**. While this article uses home installations as an example, the processes are generally the same for commercial installations, such as parking lot canopy and other systems for businesses, churches, nonprofit organizations and HOAs.

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1. Basic Electricity Flow in a Solar & Battery System

Step 1: Solar Panels Generate Electricity (DC)

- Solar panels absorb sunlight and convert it into **Direct Current (DC) electricity**.
- Example: A **5 kW** solar panel array might generate **5000 watts (5 kW) of DC power** on a sunny day.

Step 2: Inversion & Power Distribution

There are two possible paths at this stage, depending on your system type:

- **DC-Coupled System:**
  - **DC electricity flows directly** to the battery for charging.
  - The **hybrid inverter** later converts the stored **DC power to AC** when needed.
- **AC-Coupled System:**
  - **Microinverters (like Enphase) convert DC to AC immediately** at the panel level.
  - The electricity flows to the home for immediate use.
  - Excess AC power is **converted back to DC** to charge the battery (requires a second inverter).

Step 3: Battery Charging (When Excess Power is Available)

- If home appliances don't use all the solar power, the extra electricity **charges the battery**.
- Batteries store power in **DC form**.

Step 4: Battery Discharges Power When Needed

- At night or during a power outage, the **battery discharges DC power**.
- A **battery inverter (or hybrid inverter)** converts **DC to AC** to power appliances.

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2. Two Types of Solar & Battery Setups

A. DC-Coupled System (More Efficient for Storage)

✓ **More efficient because power stays DC longer**
✓ **Fewer conversions = Less energy loss**
✓ **Common with Sol-Ark, SMA, or hybrid inverters**

- **Electricity Flow:**
  1. Solar panels generate **DC electricity**.
  2. The **DC electricity flows directly into the battery** for storage.
  3. When needed, the **hybrid inverter** converts **DC to AC** for home use.
  4. Any extra energy can be sent to the **grid**.

Example:
A **Tesla Powerwall** or **Sun Fusion battery** directly charges with **DC power**. At night, the stored DC energy is converted to AC for home use.

B. AC-Coupled System (Common with Enphase)

✓ **Best for adding batteries to existing solar systems**
✓ **Works with microinverters**
✓ **More conversions = Slightly less efficient**

- **Electricity Flow:**
  1. Solar panels generate **DC electricity**.
  2. **Microinverters (like Enphase IQ8) convert DC to AC immediately**.
  3. AC power is used in the home or sent to the battery.
  4. The battery inverter **converts AC back to DC** for storage.
  5. When needed, the battery discharges **DC power**, which is **converted back to AC** for home use.

Example:
An **Enphase system with IQ8 microinverters** sends **AC power** to an **Enphase IQ Battery**, which converts power between AC and DC as needed.

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3. What Happens During a Power Outage?

- If your system includes a **battery backup**, it automatically powers **essential loads** (lights, fridge, etc.).
- In a **DC-coupled system**, the **hybrid inverter** manages power seamlessly.
- In an **AC-coupled system**, the battery's inverter ensures continuous power supply.

Example:
If the grid goes down at night, a **Tesla Powerwall** or **Sol-Ark hybrid system** can provide hours of backup electricity.

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4. Summary Table

System Type	Electricity Flow	Best For
DC-Coupled	Solar (DC) → Battery (DC) → Inverter → Home (AC)	New solar + battery installs
AC-Coupled	Solar (DC) → Inverter → Home (AC) → Battery (AC) → Battery Inverter → Home (AC)	Adding a battery to an existing system