DIRECT DC POWER SUPPLY. REAL POSSIBILITY OR SCI-FI?

Examples of direct DC power supply in solar storage

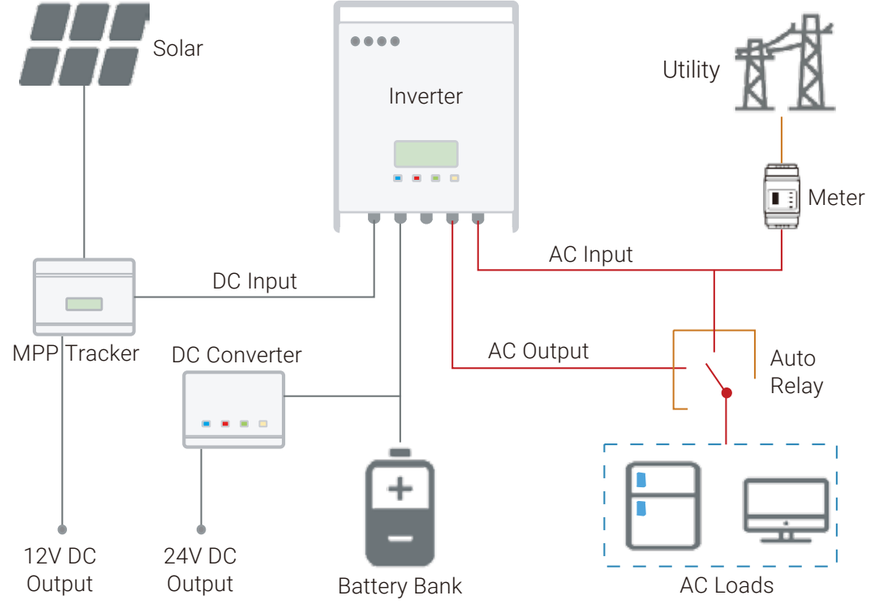
—— Jack.Song

AC power is convenient for high-voltage power transferring and countless other applications. On the other hand, direct DC power supply to loads allows simpler load circuit structure and higher power efficiency.

There are some cases where DC loads are used in renewable energy systems, such as solar street lights, DC-power air conditioner, 5G communication base station etc. In a solar storage system, power from the solar or battery side is taken to provide direct-current power to specific loads.

DC power supply in a storage system is usually realized by an external DC converter or MPP tracker to get power from solar, battery or from the grid through an AC/DC converter.

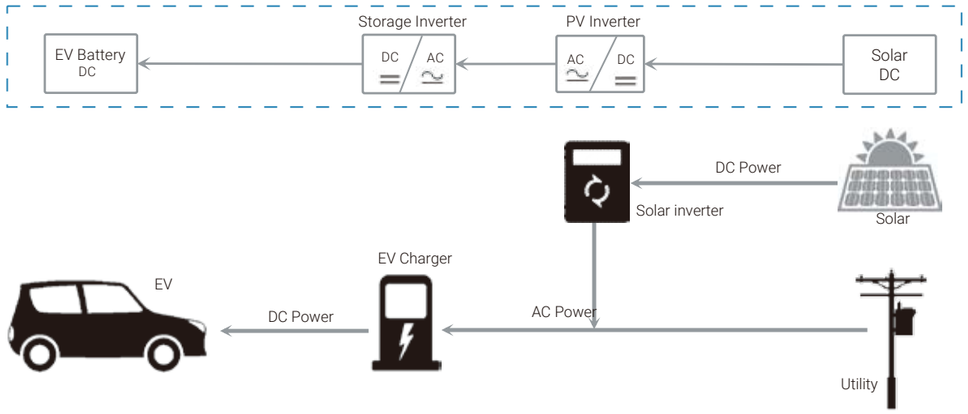
DC power supply systems tend to coexist with AC power supply systems.



General DC Power Supply System Example

The following are examples of DC power supply with specific devices. There is big potential of DC power supply in residential scenarios.

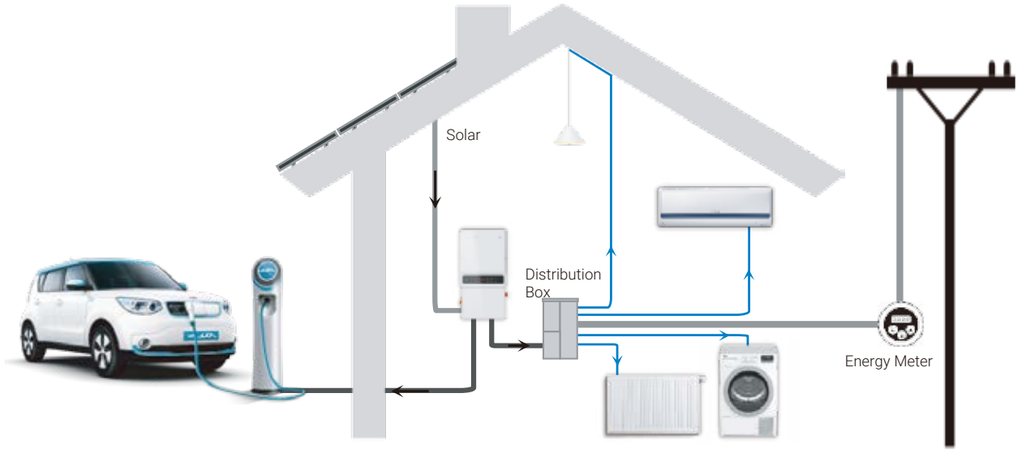
EV CHARGING SYSTEM



Sketch Diagram of AC Charger System

Electric vehicles are expected to become mainstream in the near future. In an EV charging scenario, solar or storage is usually adopted to shave the peak power consumption of a house. Home vehicle chargers mostly take power from AC for now.

But a direct DC charging could make the charging faster at a higher efficiency without DC/AC power conversion.



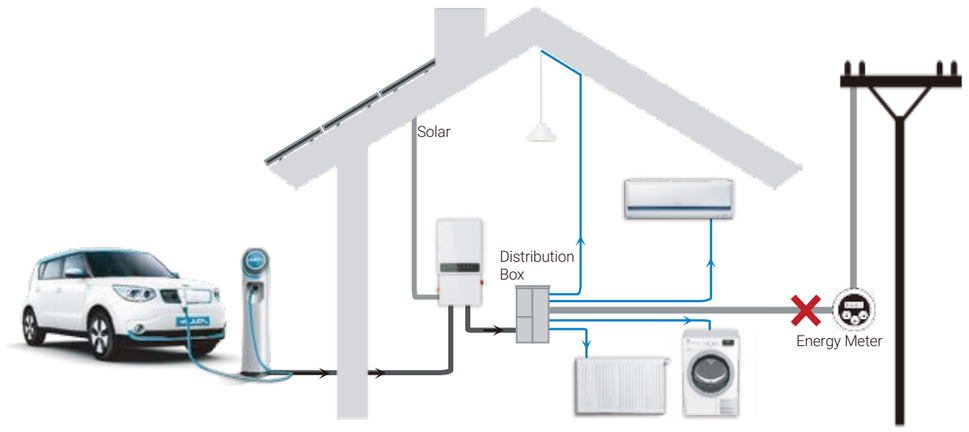
DC EV Charging Illustration Example

Solar power could be used to support house loads first and the excess power could charge the EV, directly through DC/DC circuit. The charge could be controlled based on time-of-use strategy or load priority configurations. Communication between the inverter and the EV charger would be required, which would ideally be wireless or PLC.

V2H (VEHICLE TO HOUSE) SYSTEM

EV batteries could also be used to support emergency power supply during occasional blackouts.

Solar storage systems are sometimes set up occasionally for backup power supply during blackouts. No additional battery bank is required if the EV battery is able to supply the house.



V2H System Illustration Example

This application requires a bi-directional solar inverter, which is able to stand alone during a grid outage. Also it requires a specific control function for charge and discharge. The vehicle battery must be able to discharge to external loads and the solar inverter should be equipped with backup output ability.

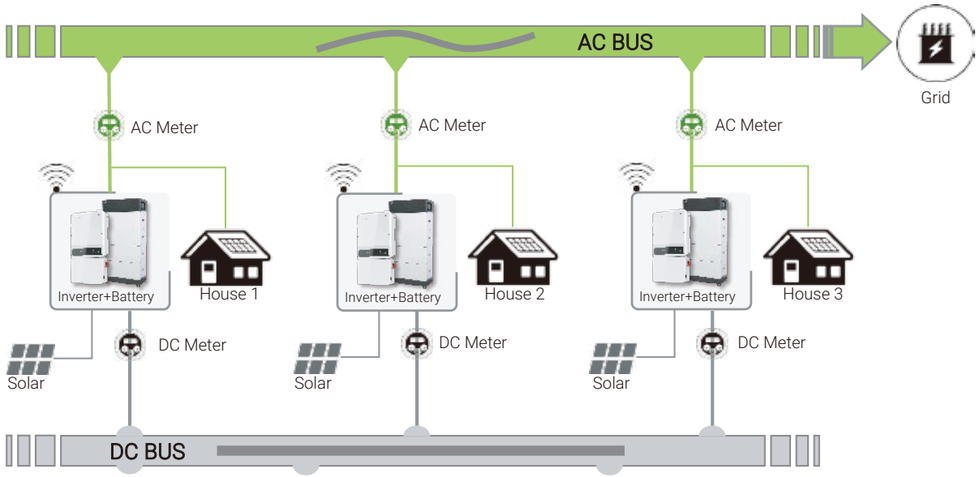
MULTIPLE INTEGRATED SYSTEMS

The examples above represent DC power supply in a single storage system. But what would it be like if we put multiple systems integrated? The following is an example. We can call it “DC BUS Power Sharing System”

DC BUS POWER SHARING SYSTEM

We all know that micro-grid systems or VPP systems usually create a combination and sharing of multi power sources across house meters on the AC side. But DC power sharing could, in some case, be more suited to balancing power supplement and consumption.

In some countries, power injection before house meter is not allowed (zero-injection), which makes it impossible to share power between multiple residential solar storage systems installed behind house energy meters. DC BUS system could solve this problem.



In a DC BUS sharing system, multiple residential solar storage systems are paralleled on the DC side and the excess solar or battery power can be traded between houses or offset the purchased energy from the DC BUS. Any power sharing in this system is controlled by a general command from a central management system with a communication set up for the whole system.

Also, the excess solar or battery power on the DC BUS could supply public loads such as DC street lights or community EV chargers in the neighborhood.

Such power sharing system could easily maximize solar self-consumption and balance power supplement and load consumption among households. It could also be a useful way to avoid peak demand in a TOU price strategy from the utility system.
If AI algorithms are adopted in the system to learn power requirements of each house prior to instructing battery charge or discharge, things could get even more interesting.

Currently, most residential EV chargers take power from the AC side and cannot support V2H application and most daily house loads also take power from the AC side. However, some of these applications might be possible in the future. We shall find out soon.

SMART GRID