Solar Battery System Design

Power Assessment

What do you need to power?

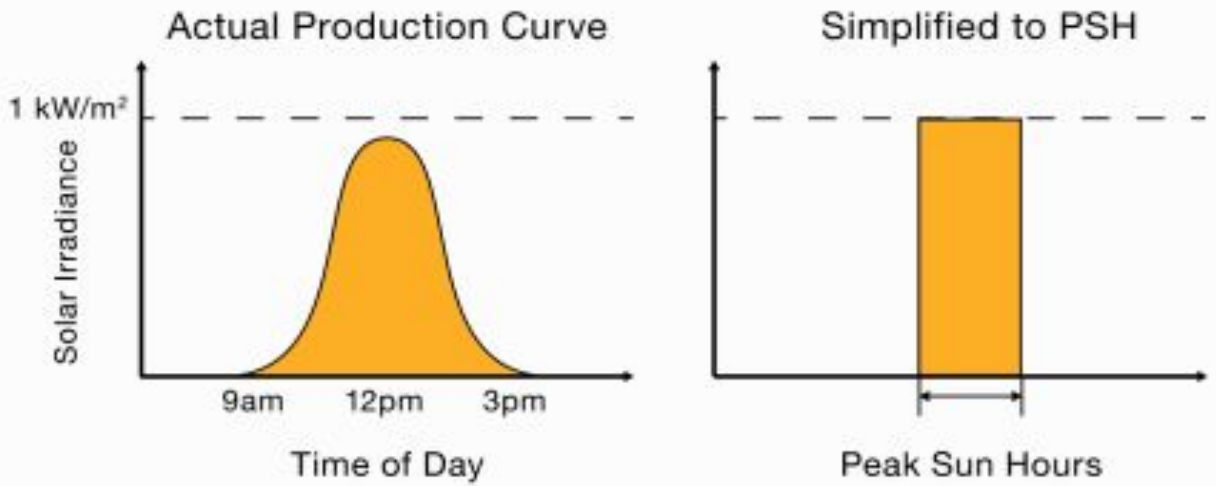
When, and for how long?

CRITICAL	PRIORITY	DESIRED
(Lighting, Comms, Cold Chain)	(WASH, HVAC, Office)	(Residential, Entertainment)

System Design Questions

- How many kWh of battery storage do you need to get through dark and cloudy times? Autonomy
- How much solar do you need to charge that battery bank, while keeping your daytime power on? Daily Draw
- Can you power everything you want to at a single moment? Peak Load

Location and Peak Sun Hours



PSH makes it possible to estimate the size requirements of the solar array and the available solar window

Calculating Minimum Solar Production

Find the minimum expected sun hours (winter, clouds) in order receive the needed number of watts to power your day-time energy needs.

Daily Energy Requirements (Wh) / Peak Sun Hours

= Minimum Solar Array (Watts)

How to size your solar battery system

WHAT IS THE POWER NEED (kW)? x HOW LONG DO YOU NEED IT GUARANTEED (hours)? = BATTERY BANK SIZE (Wh)

BATTERY SIZE (Ex. 40 kWh storage) / SOLAR POTENTIAL (Ex. 4 hours of direct sun) + CRITICAL LOADS (Ex. 10kW)

=

SOLAR SYSTEM SIZE (Ex. 20kW Solar Array)

Exercise: Energy Load Map

Make a spreadsheet listing each appliances running wattage, average daily usage, total energy Wh, and whether or not it is essential

Appliance	Running Wattage (W)	AVG Daily Usage (hours)	Total Energy Watt-hours (Wh)	Essen-tial?
4 LED lights	20w × 4 = 80	6	480	Y
Charging for 2 Cell phones	10w × 2 = 20	2	40	Y
Fan	100	4	400	Y
LCD TV	150	2	300	N
Essentials	80+20+100 = 200		480+40+400 = 920	
Nonessentials	150		300	

What happens when the sun doesn’t shine?

How big a battery bank do you need?

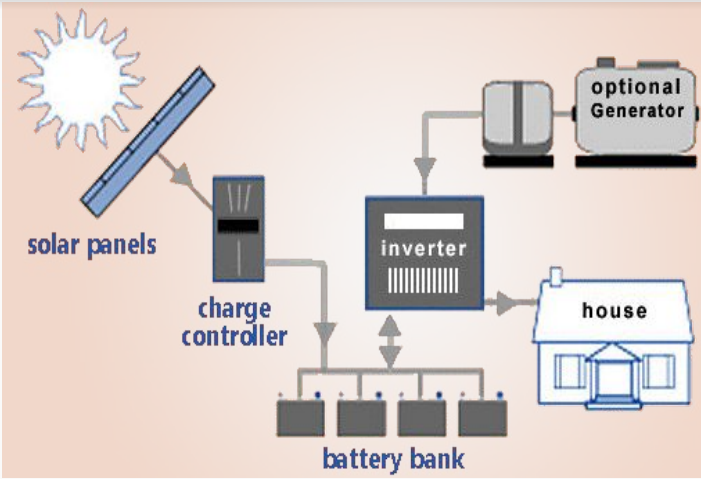
Do you need a secondary power source such as a generator, wind, or hydroelectric power?

Autonomy

- Number of days the fully charged batteries can meet the system load requirements without recharging
- If you have a secondary energy source, you might not need more than one or two days of autonomy
- If your system is off-grid with no secondary energy source, you might want up to three days of autonomy
    - This will prolong the life of your batteries but it is a high cost

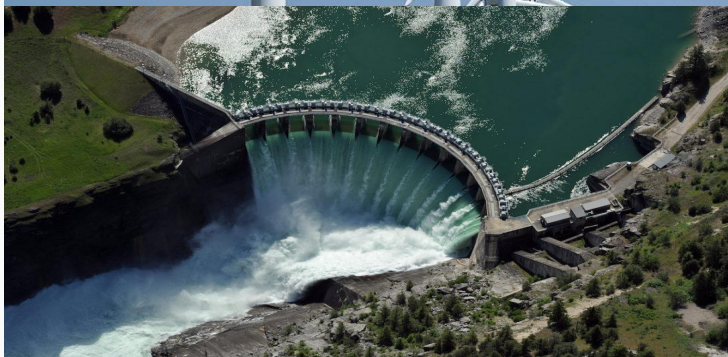
Secondary Power Source: Generators

- Generators can assist the PV array in charging the batteries during winter months or cloudy days
- Useful if you plan to operate high-power equipment (i.e. welding equipment, central heat or AC)



Secondary Power Source : Wind or Hydroelectric power

- Not as controllable as a generator but allows you to reduce the days of autonomy
- Allows for a smaller battery bank and PV array
- Wind can blow during night, when secondary power is most needed
- Water flow for hydropower peaks in winter months
- Make sure to research which charge controllers and inverters are compatible with wind and hydro power



Derate Factor

- No system operates perfectly!
- Derate factor takes into account that different equipment has different levels of inefficiency
  - shading on modules
  - temperature effects on PV cells
  - wire resistance
  - battery inefficiencies
- Important to overcompensate for the systems imperfections

System Design Questions

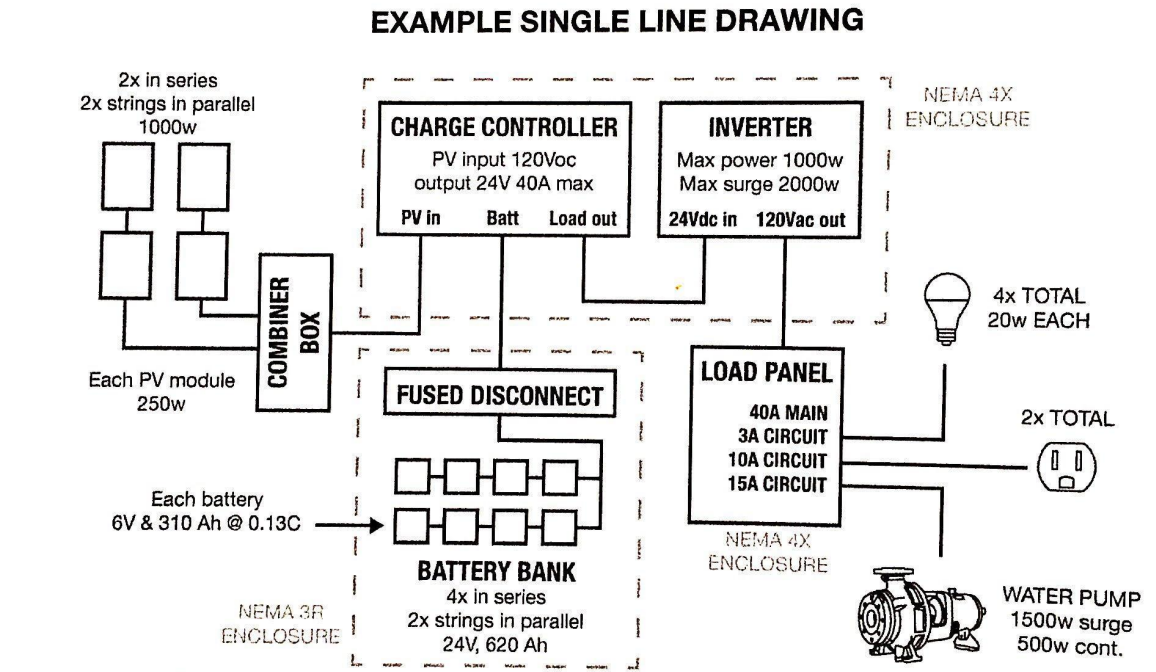
- Since the electrical appliance must operate with the type of current supplied to it, do you need a DC or an AC system?

- Are the solar panel power output the right size (amps and volts) so you don't fry your charge controller? Make sure amps and volts are in the rated range for the other components!

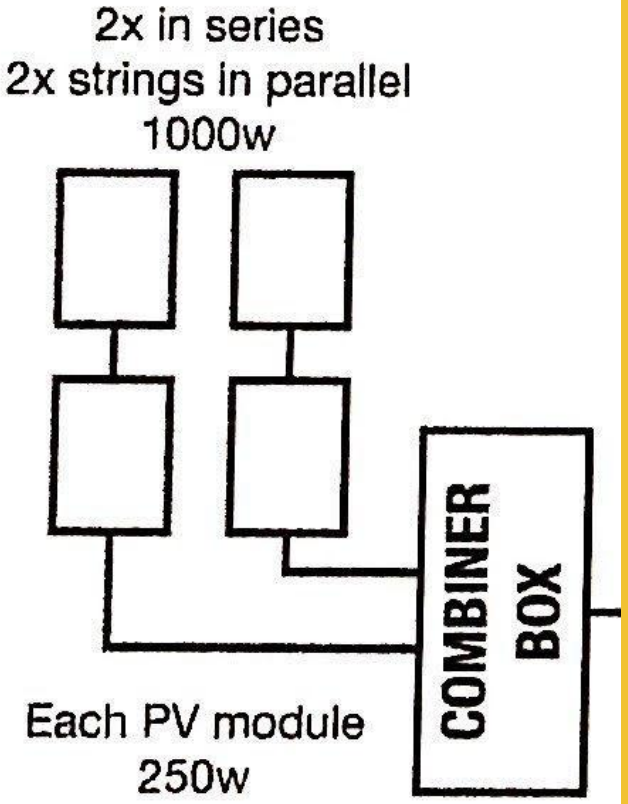
- Does your charge controller work with the voltage of the batteries?

Single Line Diagram

Helps to determine the series and parallel connection points



Single Line Diagram



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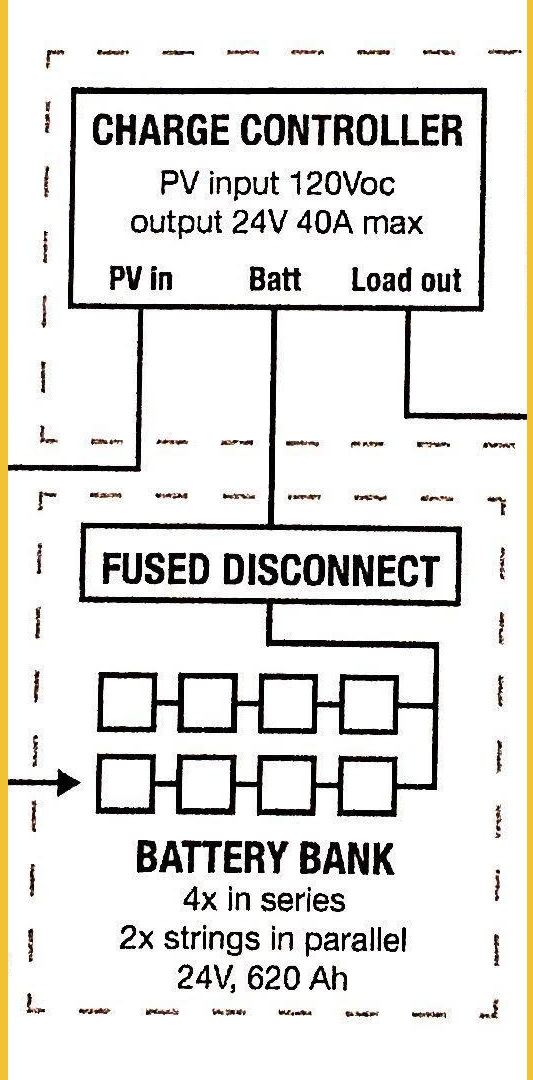

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