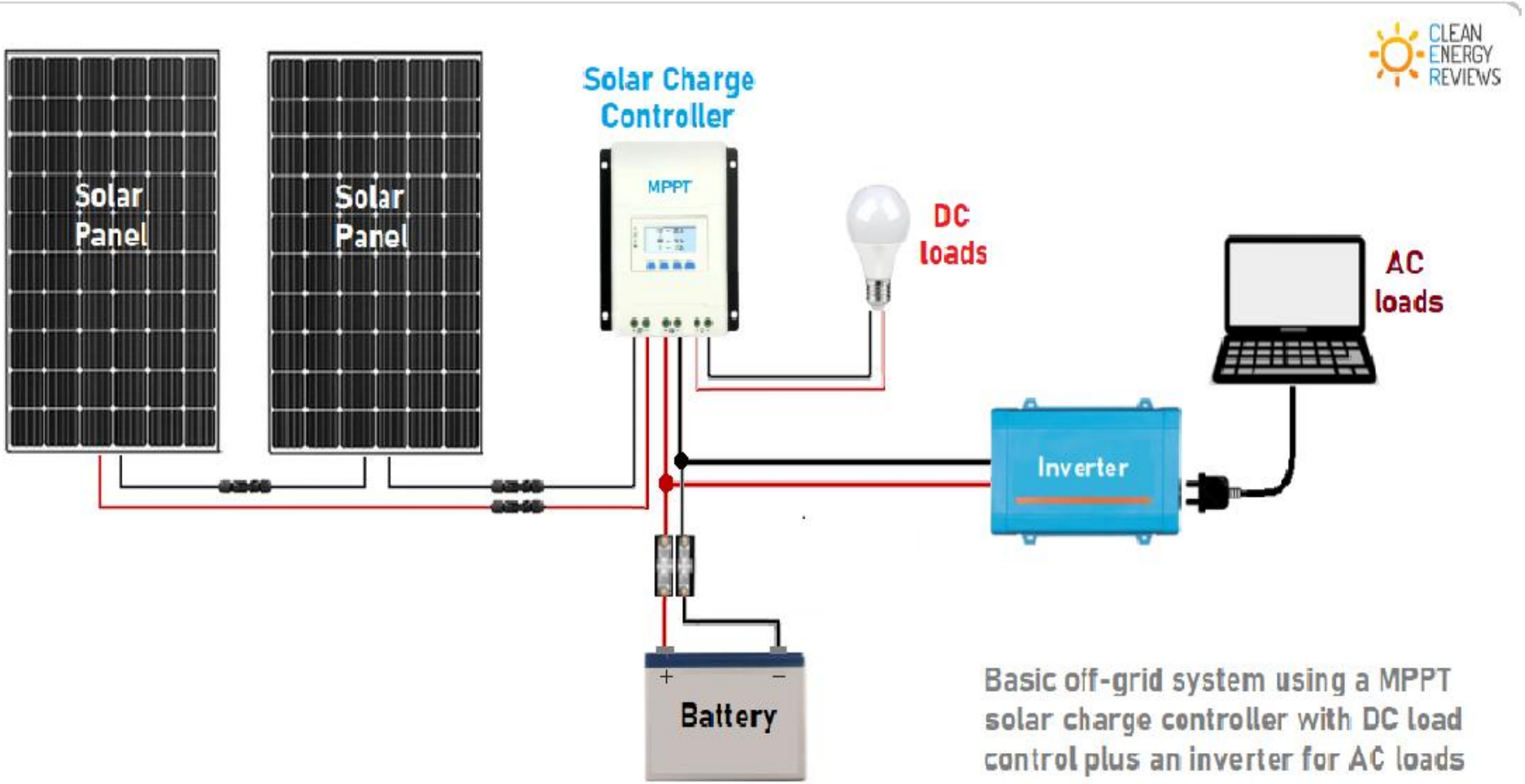
Emergency power options

Solar, battery, fuel hybrid combination

General electrical principals

- Watt = voltage x current
  - Voltage pressure
  - Current is flow of electrons, higher amp larger wire AWG
  - Wattage is work done
- Direct Current DC no change in polarity
  - Battery, solar panels
- Alternating current AC-- alternates + and -
  - House outlets 120 volts, 15 amps = 1800 watts
  - Sine wave at 60Hz. Microprocessor chips in appliances require clean since wave at 60Hz

Solar Battery Generator System



Integrated Solar Generators

- MPPT solar controller, battery, 120/240 V AC inverter, DC power output all in one unit
  - Advertised by AC inverter output in watts
  - Storage battery capacity in Watt hours—how many watts can the battery supply in one hour.
  - Mindful of varied options:
    - Number of solar input and voltage and amperage capacity , DC and USB output, expandability, battery chemistry.
  - Portable integrated adapted to emergency home vs home system adapted and made portable.
  - DC to AC Inverter is clean and safe for microchips

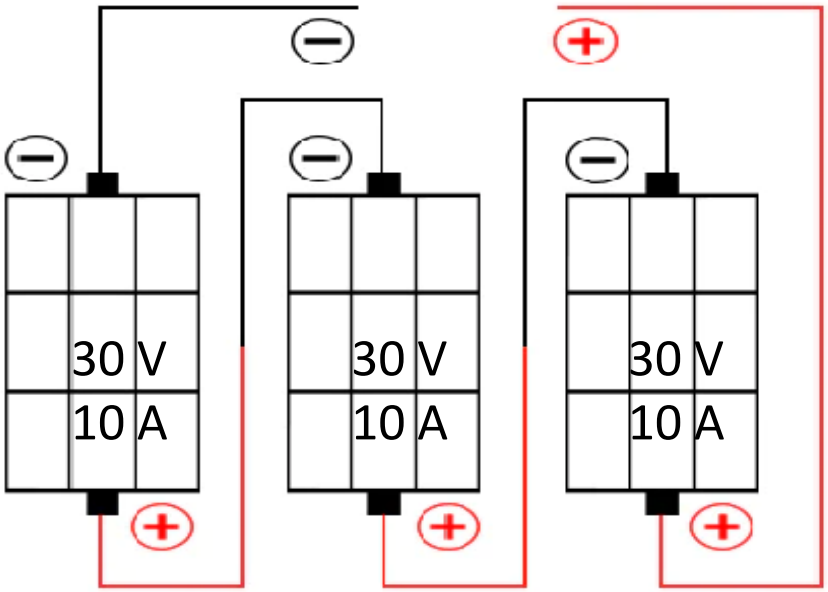
Solar Panel

- Watts advertised
  - Done in ideal lab posted STD
  - NMOT real world parameters, does not account for clouds, early morning and evening angle of the sun.
- Technological advancements
  - Newer more efficient, Mono/Ply cryst, N-type, P-type, PERC
  - Bifacial can use sun in more hours of the day, reflective sun.
- Sun orientation hours of power, face South
  - Our lat: 20-25 deg, 20 deg summer, 25deg winter
  - Max power generation 10am-3pm, bifacial help morn evening

Wiring solar panels DC

- Group panels with same voltage and amps
- Series: voltage is added, amps stay same
  - **SUV: series ups voltage**
- Parallel: amps are added, voltage stays same
  - Higher amps, larger gauge wire with longer distance.

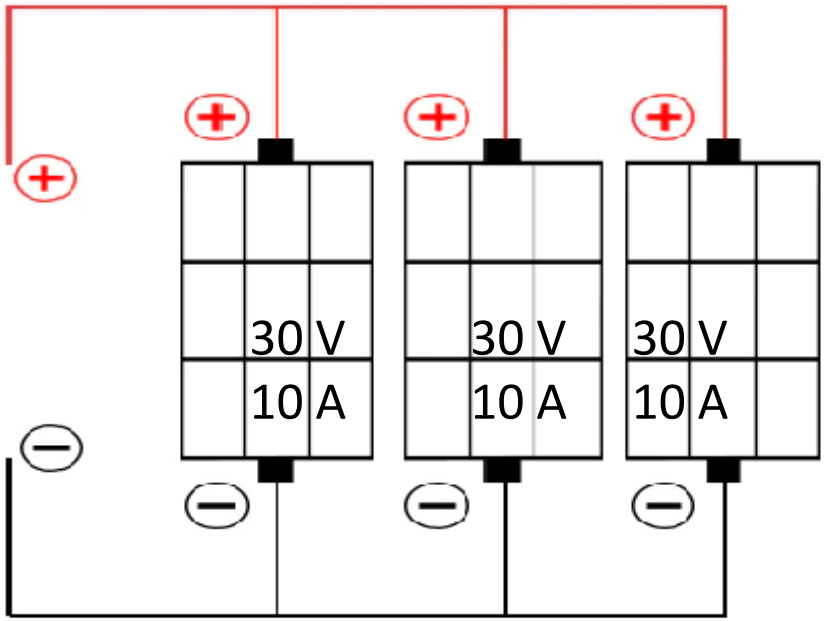
Voltage adds
Amps stay the same



Series

90V x 10A = 900W

Amperage adds
Volts stay the same



Parallel

30V, 30A = 900W

How many Watt hours and panels do you need

- Determine what appliances are needed in an emergency. See list of appliances and Watt/hr
  - Add total watts needed in 24 hrs + appliances used short term
    - Long term to 24 hr: Refrigerators/freezers, fan, propane fireplace fan, GMRS/ham radios LED lights.
    - Periodic: clothes washer, wheat grinder, instapot, rice cooker, microwave, dehydrator, garbage disposal, septic sewage pump.
  - Watt hour battery capacity meet watt needs.
  - Solar panels able to charge battery in day light--average
    - 50% stated watts on panel for 5 hours, 25% for 2 hours
    - 400 watt panel, deliver 200W for 5 hrs + 100w 2 hrs = 1200W
    - 6100 Wat/hr battery need minimum 5, 400 Watt panels.
    - Most likely need to supplement with fuel generator.

Solar/Fuel Generator hybrid

- Use a fuel generator to charge solar battery generator with 120V AC
  - Fuel generator add 1800-3600 watts per hour to the solar battery.
  - Use the fuel generator at night to top off battery or morning if low.
  - If fuel generator has enough watt output, use periotic items and charge battery at the same time.
    - Use instapot, food dehydrator, wheat mill, wash clothes while charging battery.
    - Do not over draw your fuel generator watt capacity.
    - Fuel usees 1/3 gallon per hour 4000 watt generator, 2-3 hours/day 5-7 G/week
    - Gas stores poorly, 6 months even with nonethanol and additives
    - Propane stores long term, but less energy dense than gas.
  - Power delivery--extension cords. Know the amps/watts and gauge of cord wire
    - Guage of cord limits watts and amps it can carry
      - See handout, 14 AWG 13-15 amp, 12 AWG 18-20 amp, 10 AWG 25-30 amp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