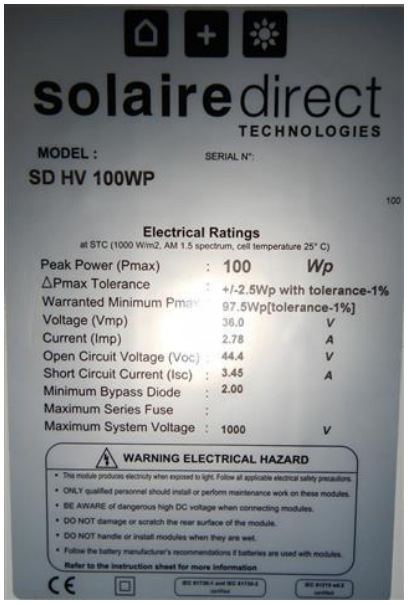
PV systems and system voltage.

First two photos to start the explanation:

SERIES – in this photo 4 pv panels are connected SERIES. Each panel is rated at 44,4Voc (Open Circuit Voltage), and 36Vmp (the actual working voltage). And these are 100W panels.



In SERIES the panel connection looks like this, see above :
This setup delivers : 400W with a voltage of 144V, thus only 2,78A.
This setup is used to drive a Grunfoss pool pump. There are no regulators or batteries in this system.
The Grundfoss pump incorporates the electronics to accept either DC (pv panels), or AC (eskom).

The benefit of this setup is high power while keeping the current flow low.

PARALLEL – in this system 8 pv panels are connected in parallel. . Each panel is rated at 112Voc (Open Circuit Voltage), and 87,5Vmp (the actual working voltage). And these are 170W panels.

By connecting it in PARALLEL the system voltage remains at 87,5V, while the power still adds up to the total of 1,02 kW. This means a maximum current of 11,7A.

This system powers a dual element for a geyser.

Note how it IS possible to choose panels with different voltages and power ratings to make up the total system power, AND keep the current draw to acceptable values. Remember that higher currents mean higher losses, and potentially higher heat losses in bad connections.

So what do these basics mean in real life ?

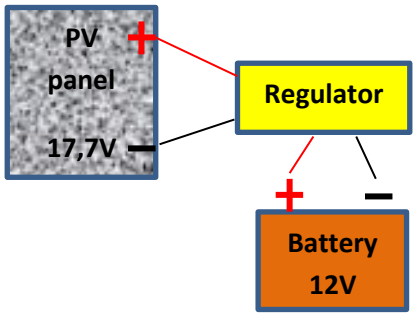
BASIC 12V system:

We know this system from our 4x4 systems. But to quickly recap.

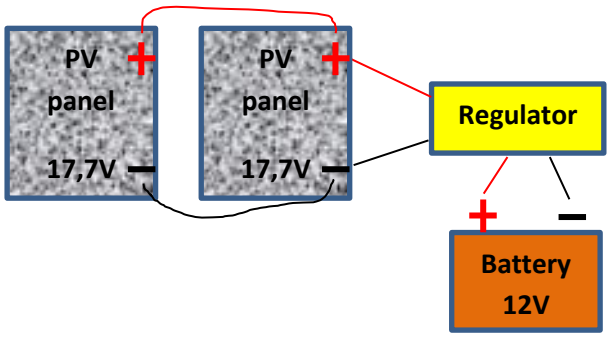
A standard 22Voc, 17Vmp, pv panel is used. From a 50 to a 200W depending on your needs.

A standard solar regulator ensures that the battery “sees” from 12 to 14,5V to fully charge the battery. A decent regulator would even go into idle mode when the battery is fully charged.

You can now power any 12V device from the battery.

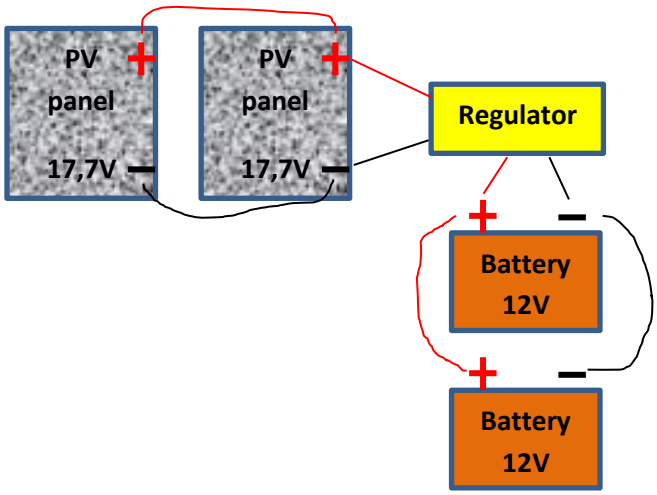


The first change to this happens when you want TWO panels, but still have a 12V system. The solution is to connect the two panels in PARALLEL :

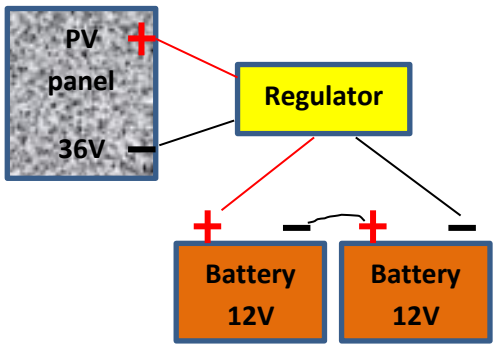


This way the system voltage stays the SAME, but you get more power, and also a higher current flow.

The next evolution is the need to store more energy, now you connect two batteries in PARALLEL :

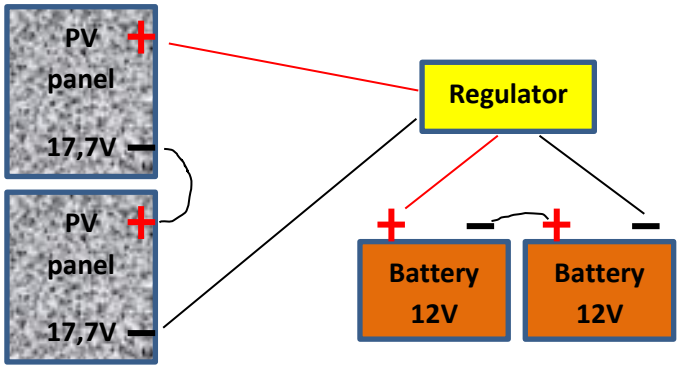


This works fine, as long as your maximum power draw remains below 200W. For larger power draw systems the voltage of the battery bank must be increased to reduce the current draw. Thus for the typical inverter systems, ie computers and tv's, you want a 24V system. Starting from scratch you may use components with the following values :



NOTE – see how you connect two batteries in SERIES to obtain a 24V power pack.

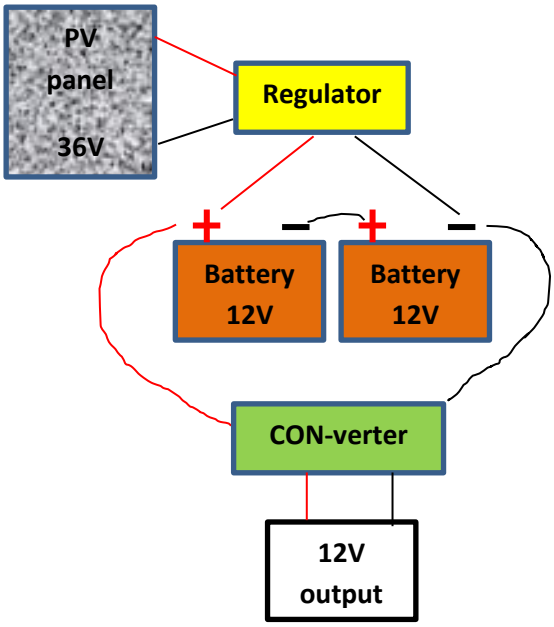
If you already have some "12V" system components (pv panels), then you can connect the panels in SERIES to obtain the required system voltage to charge your 24V battery bank :



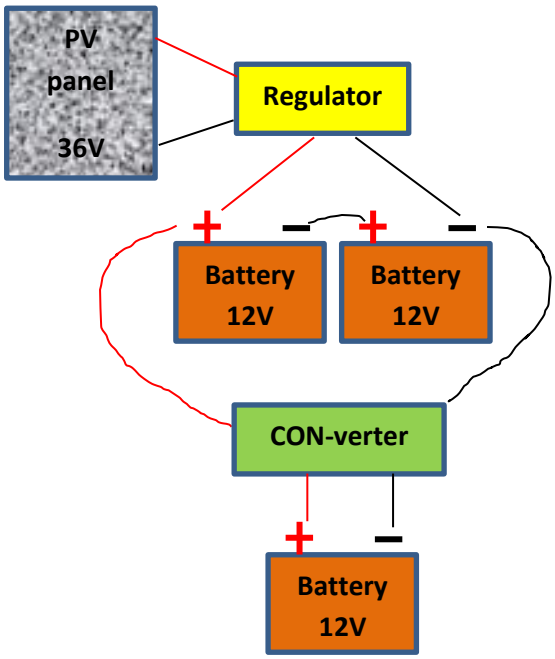
NOTE : many of the pv regulators can be used on 12 and 24V systems. Thus you may be able to re-use most of your components.

Another permutation is where you need 24V for the inverter, but still need 12V for some other components.

There are two options for this :



With the use of a “Converter” you can have 12V as an extra output, directly from the 24V battery bank.



With this layout you charge a 12V battery from a converter. The benefit of this option is that you can exceed the current capacity of the converter during operational cycles, provided there is enough time between cycles to charge the battery.