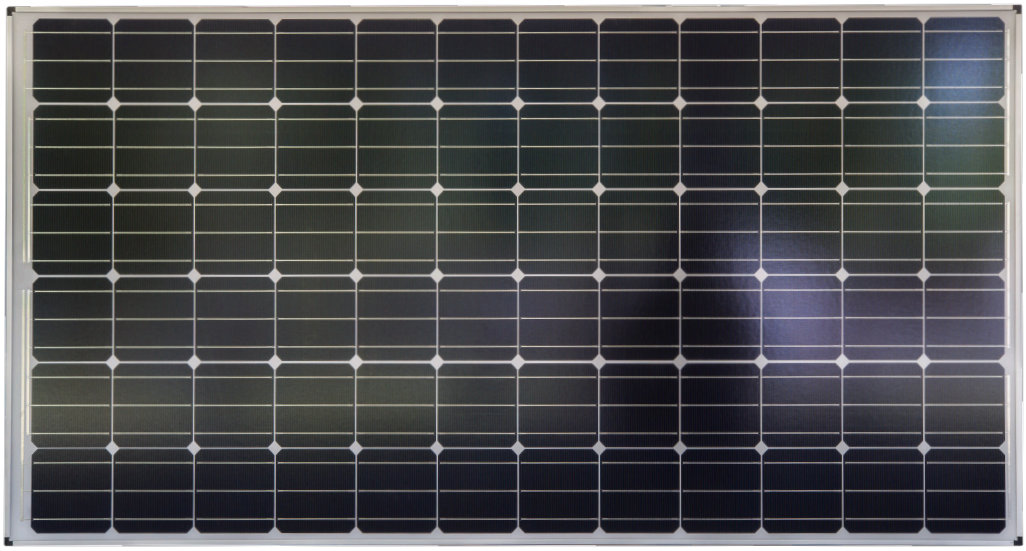
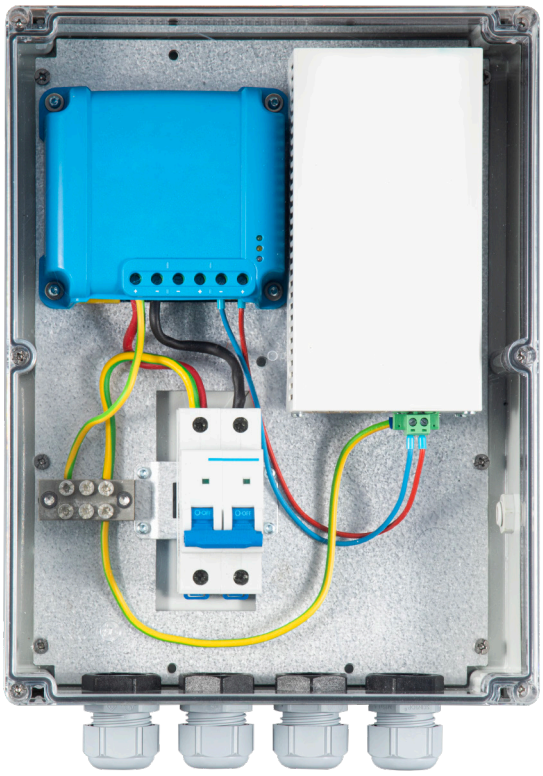




Aranet Solar PS Choosing solar panel and battery

aranet

This document will help you select the right battery and solar panel (SP) based for Aranet PRO Plus LTE base station powered by Aranet Solar PS.

Battery selection

General battery parameters are:
V – system voltage, here we consider 12 and 24 V, C – capacity (Ah), P – power (W)
For our case of solar panel setup, we need to define a few other parameters:
L – load power consumption (W/day), D – number of days battery needs to last without charging (-)
These variables are connected in a following way:

$$P = L \cdot D$$

$$C = P / V$$

The factors you must consider before the calculation of battery and solar panel parameters are:

- Load power consumption
- Environmental conditions – temperatures, lack of direct sun
- Usage needs – throughout the year or a limited period

Load power consumption

The Aranet PRO Plus LTE base station has a power consumption of 4.3 W/h. Assuming power supply system efficiency of 85 %: 4.3 / 0.85 = 5 W/h. Thus, the daily consumption (24 hrs) assuming non-stop operation is:

$$L = 5\ W/h \cdot 24 = 120\ W/day$$

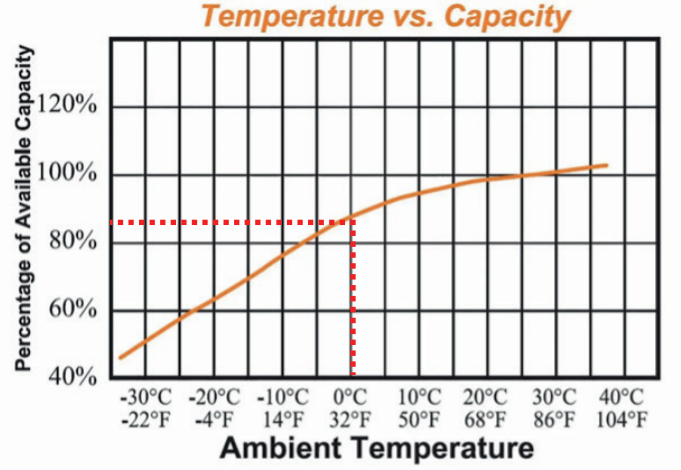
Environmental conditions

- Clouds / rain – considering the number of days in row without direct sun resulting in minimal charging, you can estimate the battery power reserve. Assuming D = 5 days of rain, the battery should be P = 120 · 5 = 600 W or more.
- Depending on the system voltage V, corresponding battery capacity C will be needed:

$$\text{If } V = 12\ V,\ C = 600 / 12 = 50\ Ah$$

$$\text{If } V = 24\ V,\ C = 600 / 24 = 25\ Ah$$

- Temperature – in cold environment battery effectiveness degrades – see the example graph of lead-acid battery below.



If lowest temperature is 0 °C, the battery capacitance will be 87 % of the nominal value. The power and capacity should thus be increased to:

$$P = 600\ W / 0.87 \sim \mathbf{690\ W}$$

$$C = 690\ W / 12 \sim \mathbf{60\ Ah}$$

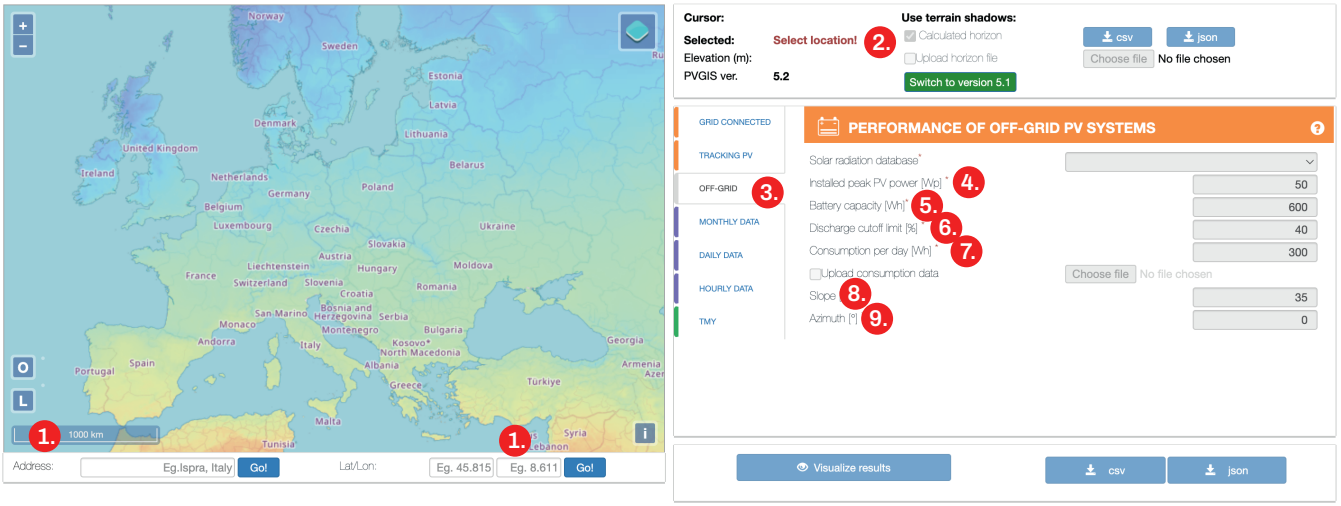
Solar panel selection

We stick to the conditions mentioned above for the following calculation example:

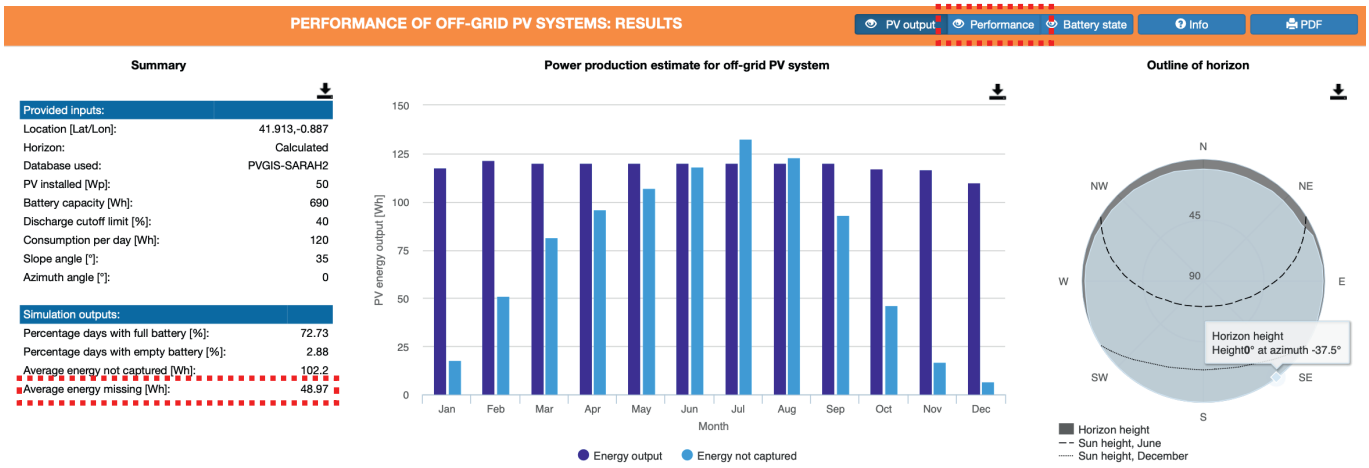
- Min temperature 0 °C throughout the year
- Non-stop operation of the system

The most important factor when deciding about solar panel size (power) is geographical location where the setup will be installed. You can find multiple calculators on the web, but we will stick to Photovoltaic Geographical Information System site of European commission. Please consult the detailed manual to this calculator for any questions regarding its usage.

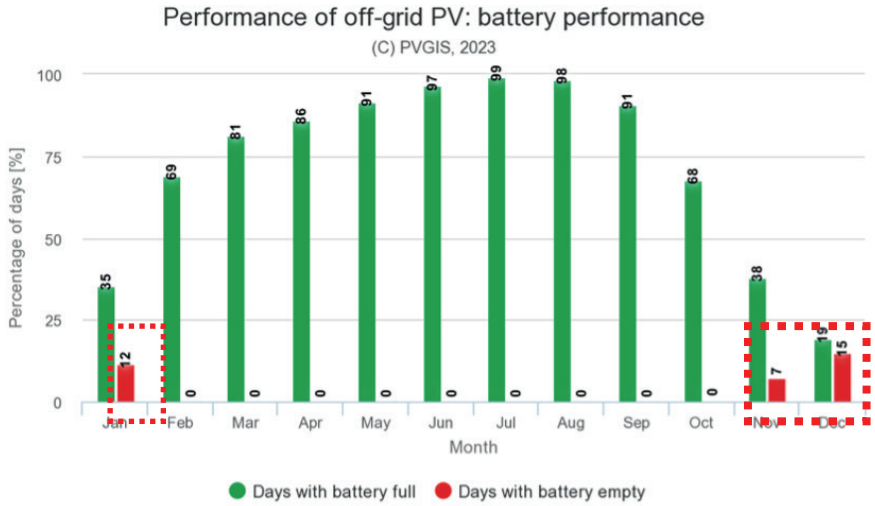
The calculation is typically an iterative process, where you will need to adjust the parameters and recalculate several times before you arrive at desired result. The process is following:



1. Enter the address, GPS coordinates (41.913, -0.887 for our example), or point out the installation site on the map.
2. It is recommended to tick the ‘Caclulated horizon’ tickbox.
3. Go to OFF-GRID tab.
4. Adjust the SP power to 50 W based on the example used above. This setting is **Installed peak PV power (Wp)** in the PVGIS calculator. This is the main feature of the solar panel and usually is shown in its model number.
5. Previously we calculated that **Battery capacity** should be 690 W.
6. **Discharge cutoff limit** depends on the battery type, for most common lead-acid batteries it is 40 %.
7. **Consumption per day** was calculated previously too and is equal to 120 W.
8. In our example is assumed the panel **Slope** is at 35° angle and aimed south – **Azimuth** is 0°. Adjust these settings based on your site location.
9. Now you can **Visualize results**.

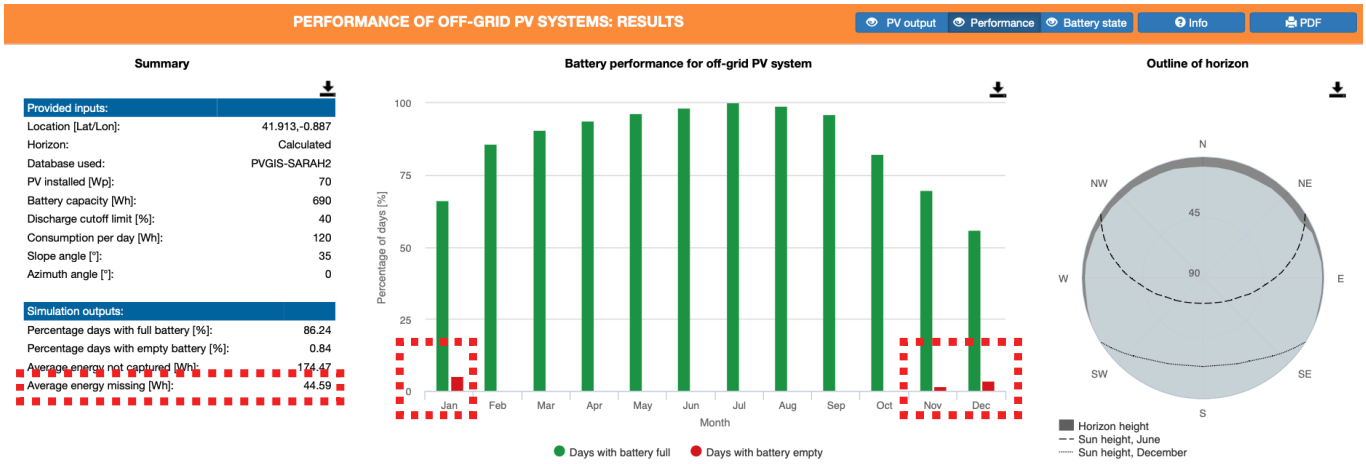


10. Note that **Average energy missing** is not equal to zero indicating there are days in the year that the system may not be working. Go to **Performance** to see details.



11. The red bars in the chart indicate that months when the chosen solar panel does not have enough power to ensure non-stop system operation – bigger sized panel should be selected.
12. Return to the step 4 and try larger power SP, say 70 W. Leave other fields unchanged, press **Visualize results** again.

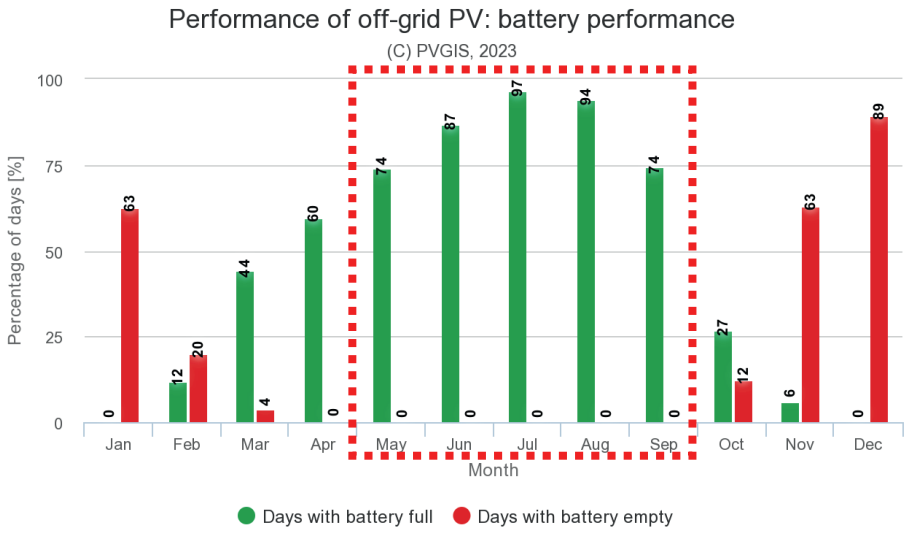
13. Still a few red bars indicate insufficient SP size. Repeat the step 4 again with higher SP power until there are no red bars.



After a few iterations, we arrived at the result – at least 141 W power SP is needed to ensure non-stop operation of the Aranet setup at the chosen geographical place.

Summer months operation

If Aranet setup is required to operate only a few months during summer (May – September), and temperatures are not dropping below 10° C, the battery capacitance can be lowered to 600 / 95 % ~ 630 W. With these input conditions the solar panel of 35 W will be enough:



For any additional questions about the Aranet PS solution, please contact us at **info@aranet.com**