# Balcony Solar Dimensioning

Determine the right size

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Design along the main points:

- Average output power as major design constraint
- Duration to bridge gaps during grid outage
- take wind and solar lull in January/ February into consideration
- Battery voltage, cabling and inverter's efficiency
- power a 24V circuit directly

A solary system can be designed to fulfill different aspects. With a lot of surface maximum power output will be the main goal as well as delivering to the grid. If budget is limited one cannot exceed a certain power. I want to power a fridge for 2-4 days. The model has a peak power consumption of 200W and standby power of about 10W. An entire day requires 0,25kWh. So 4 days means 1kWh.

Since the fridge runs on mains an inverter is necessary. It will have to provide twice the power and even a bit more. The fridge's compresser has a high inrush current. This means a peak power of about 1kW. Meanwhile the system must not trip any fuse or safety switch so it has to be designed for this. Taking the inverter's efficiency of 90% into consideration the batteries will have to supply 1,1kW. This means 93A for a 12V system requiring a cable cross section of 10mm² for a 0,5m cable. 16mm² or even 20mm² would be much safer.

Doubling the battery voltage cuts the current in half. But this also means the solar panels and charge controller must work with 24V. A safety margin of 2V is necessary to charge a 24V system. To sum it up a 24V battery stack is necessary, an inverter with 400W constant power and 1000W peak output power. Cabling must not be smaller than 10mm². Battery capacity has to provide 1kWh to fill a gap of 4 days 0,25kWh each.

The battery capacity can be derived by dividing the total power by the current. It will not exceed 50A. AGM (absorbend glass mat) batteries have a maximum power rating matching their capacity. Thus 50A for an hour means minimum 50Ah. This is also the minimum capacity in most of the datasheets for 400W inverters. Aging of the batteries must be taken into consideration, too.

I oversize the battery stack and will provide 90Ah. Four 20Ah batteries will be accompanied by two additional 50Ah blocks. Which compensates for aging sufficiently for about 10 years. The total of 90Ah and a maximum charging current of 0,1C yields the last paramter: charging current or panel size. They should not provide more than 10A as the batteries would heat up too much and age faster. Luckily the panels alignment matches only 1-2hours for 100% with solstice. And during summer

heat their efficiency drops, too. So I calculate with a charging current of 15A. This is above 0,1C but rarely the case. Now in a compact form until the module's size:

- Inverter power 400W continuous, 1000W peak
- bridge 4 days, 1kWh total (4x0,25kWh)
- 50A peak current from the batteries at 24V (2x12V)
- minimum battery capacity of 90Ah
- with 90Ah charging current of 10A average
- Solar panels 36V, standard size of 100-150W
- 10A charging current at >24V means at least 240W power from the panels
- 300W is the lower bound, 400W goal of installation

Nowadays I can pick from a range of panel voltages. I chose 36V modules which saves space and cabling of self stacked 12V smaller ones. This means 4 panels total. During winter time I expect a tenth of the power due to lower angle of the sun and shorter day period. During wind a solar lull in January or February there could be no power at all for 2-4 weeks in a row. The highest output will be in spring and fall. Lower temperatures increase efficiency. In summer time peak power cannot be reached since 50°C or more on the panels cuts efficiency dramatically. Finally there is a little trick with tolerance: I want to run the fridge wich requires less power when it is colder.

Non-goals:

- Heating is not worth the discussion, 20% panel efficiency, 90% inverter efficiency and only 60% of total power can be taken out of the battery
- three-phase operation, smallest inverters require 6-10kW input power, more likely 48V battery voltage for affordable cabling
- powering only the grid and get payed, not very much for such a small system (single phase difficult)
- personal use and excess power to the grid, cabling of the power outlet on the balcony limits use (connected to living room but not the kitchen)