

Dimensioning of a solar/battery backup system

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May 2008

Agenda

- What is dimensioning?
- User requirements and input data
- Solar dimensioning
- Battery dimensioning

What is dimensioning?

- How much energy is available?
- What voltage/current do I want to obtain?
 - What is my load?
- How long do I need autonomy?
- What equipment do I need to cover my needs in terms of electricity?
 - How many solar panels and batteries?

How much energy is available?

- Radiant energy that hits a surface is measured in **Irradiance (G)**
- Measured in **W/m^2**
- Statistical data from weather stations
 - Solar history

Irradiation

- The amount of solar energy available
 - Depending on your location
 - Always plan for the worst!
- Sun peak hours/day
 - Normalized value of solar radiation of 1000 W/m^2 at 25 C
 - 5 peak sun hours corresponds to a daily solar radiation of 5000 W/m^2 .
 - Nigeria: 4 peak sun hours

User requirements

- Power consumption
 - Total consumption of all electrical devices
- Anatomy
 - How many days should the system work without power input?

Equipment specification

- Battery
 - Capacity (Ah)
 - Max discharge (%)
 - Voltage (V)
- Solar Panels
 - Nominal power (W)

Practical example

- Load: 120 W
- Autonomy: 5 days
- Battery
 - Voltage: 12V
 - Capacity: 100 Ah
 - Max discharge: 50%

How many batteries do we need?

How much current do we need?

$$\text{Power} = \text{Voltage} * \text{Current} = V * I$$

$$I = P/V = 120 / 12 = 10 \text{ A}$$

We need an output of **10A** from the batteries

How much energy do we need?

In 1 day:

$$10 \text{ A} * 24\text{h} = 240 \text{ Ah}$$

$$12 \text{ V} * 240 \text{ Ah} = 2880 \text{ Wh}$$

In 5 days:

$$5 * 240 \text{ Ah} = 1200 \text{ Ah}$$

How much energy do we need?

Assuming:

Max discharge level: 50%

Battery capacity: 100 Ah

Energy storage required: $1200 \text{ Ah} / 0,5 = 2400 \text{ Ah}$

No of batteries: $2400\text{Ah} / 100\text{Ah} = 24$

How many solar panels are needed?

Assuming:

4 sun peak hours 4000 W/m²

Panel peak current: 5 A

Energy needed/day: 240 Ah

Energy provided: 5 A * 4h = 20 Ah

No panels: 240/20 = 12

Conclusion

- Use radiation data for the worst month
- Measure your load carefully
 - Are there any possible energy savings?
- Be careful with the units!
 - W vs Wh = V · Ah
 - A vs Ah

Project Assignment

- Measure power consumption in your apartment
- Design a solar power backup system
- Provide a budget for the installation
- Assumptions:
 - 12 V installation
 - Batteries of 100 Ah, 50% discharge
 - 2 sun-peak hour worse month
 - 60 Wp, 5 A panel at sun-peak