Sizing a solar kit

The rise of renewable energy is making solar kits increasingly popular. This course will teach you how to properly size your solar installation to optimize its efficiency and cost-effectiveness.

By Eric Chimeshula

Course objectives

1

Calculate the power required

Determine the precise energy requirements for your installation.

2

Select the right equipment

Choose components for optimal and reliable operation.

3

Optimize yield

Maximize efficiency by considering operating conditions.

Skills acquired

1

Needs analysis

Accurately assess the energy needs of a site.

2

Technical calculations

Determine power and energy needed for reliable power.

3

Component selection

Choose the right equipment according to technical criteria.

4

Optimized design

To size a high-performance and durable system.

Key steps

1

Needs assessment

Quantify the consumption in kWh and identify the appliances to be powered.

2

Component sizing

Choose panels, batteries, regulator and inverter as needed.

3

Optimization

Explore the factors influencing production and improve yield.

Energy needs assessment

Consumption

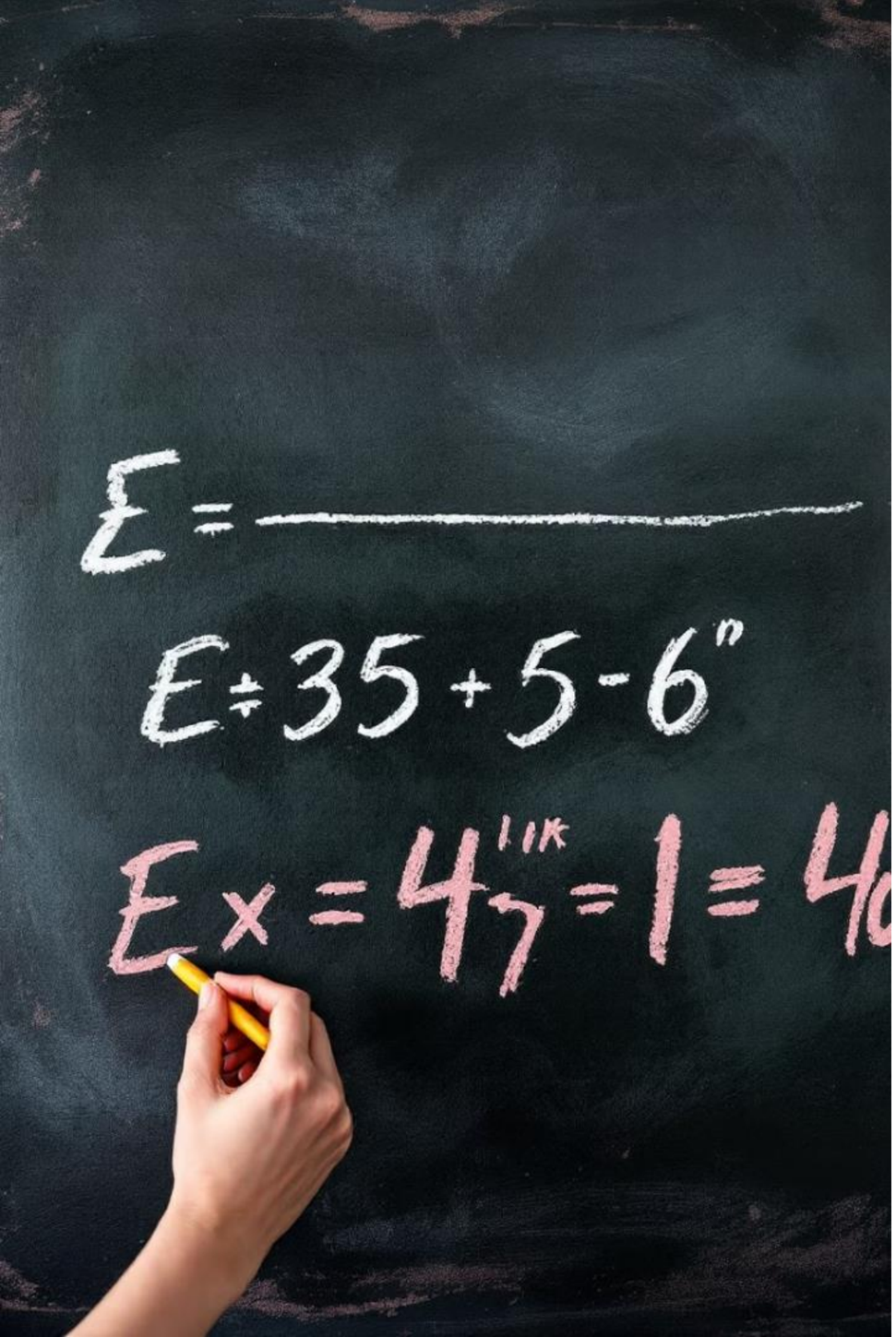
Calculate the total consumption in kWh of all appliances.

Power

Determine the maximum power needed at any given time.

Usage Profile

Analyze when and how energy will be consumed.



Energy calculation formula

The formula

E = P × t, where E is the energy in kWh, P is the power in watts, and t is the time in hours.

Application

This formula applies to all your electrical appliances.

Importance

A precise calculation ensures that your solar system is properly dimensioned.

Examples of calculation

Refrigerator

150 W × 10 hours = 1.5 kWh per day

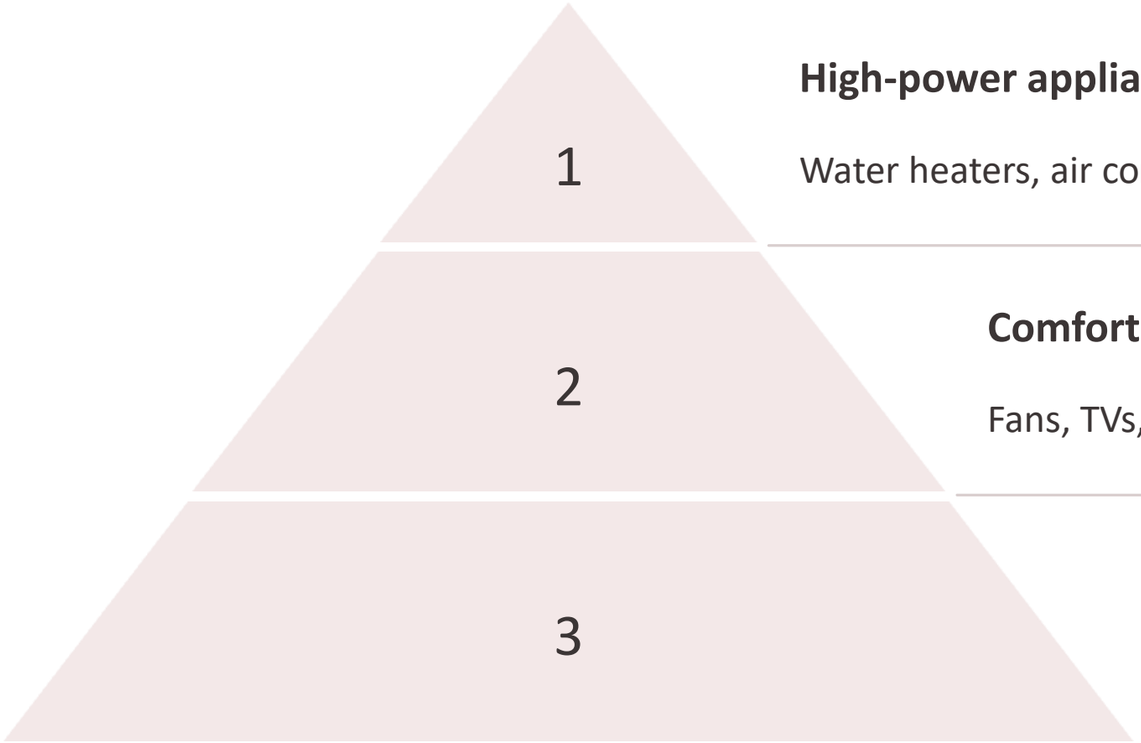
LED Lamp

10 W × 5 hours = 0.05 kWh per day

Computer

50 W × 4 hours = 0.2 kWh per day

Device classification



High-power appliances

Water heaters, air conditioners, electric hobs

Comfort Devices

Fans, TVs, small appliances

Essential Devices

Lighting, refrigerator, chargers, computers

Summary table of consumption

Device	Power (W)	Usage (hrs/day)	Consumption (kWh/day)
Refrigerator	150	10	1,5
LED Lamp	10	5	0,05
Computer	50	4	0,2
Fan	75	6	0,45
Television set	100	3	0,3

Selection of components

Solar panels

Select according to the required power and available space.

Batteries

Choose according to the desired autonomy and the type of use.

Regulator

Adapt to the voltage of the system and the power of the panels.

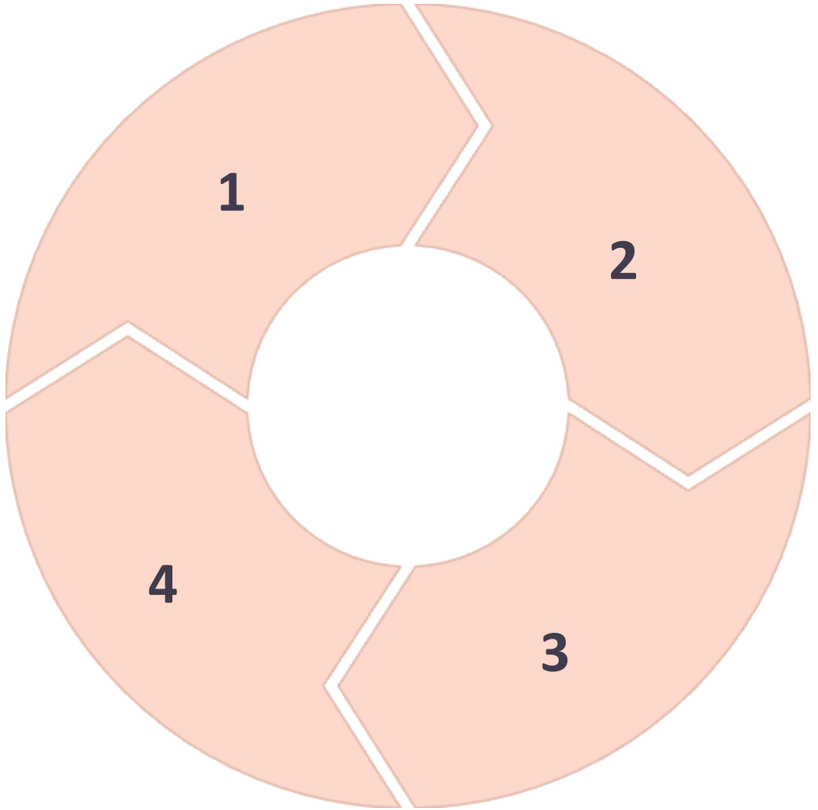
Inverter

Size according to the power of the devices to be powered.

Optimization factors

Sunshine

Consider local weather data.



Orientation

Optimize the angle and direction of the panels.

Losses

Minimize losses in cables and components.

Maintenance

Provide regular maintenance to maintain performance.

Use of the GAISMA software

This software makes it possible to obtain meteorological data (annual sunshine for example) from the site where the solar field is installed.

To access the software, use the following link: www.gaisma.com

Kigali, Rwanda - Sunrise, sunset, dawn and dusk times, table

Future | Past

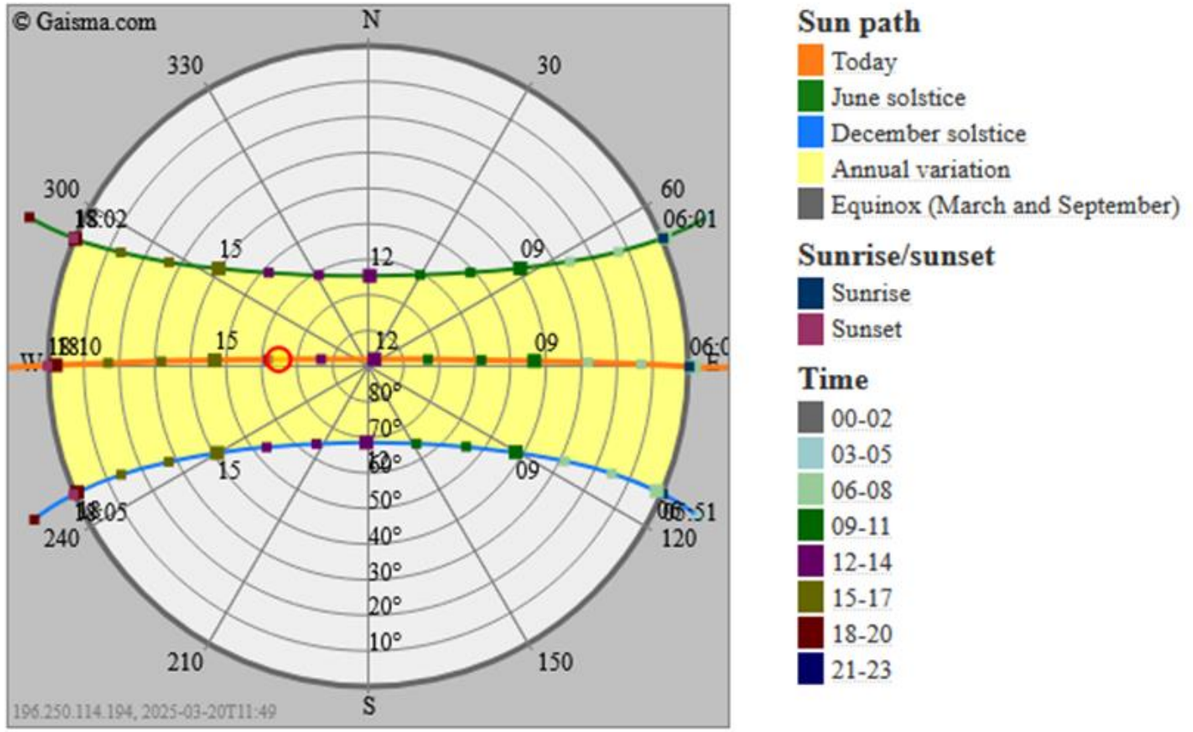
Date	Sunrise	Sunset	Length	Change	Dawn	Dusk	Length	Change
Today	06:04	18:10	12:06		05:43	18:31	12:48	
+1 day	06:04	18:10	12:06	00:00 equal length	05:43	18:31	12:48	00:00 equal length
+1 week	06:02	18:08	12:06	00:00 equal length	05:41	18:29	12:48	00:00 equal length
+2 weeks	06:00	18:05	12:05	00:01 shorter	05:40	18:26	12:46	00:02 shorter
+1 month	05:57	18:01	12:04	00:02 shorter	05:36	18:22	12:46	00:02 shorter
+2 months	05:56	17:57	12:01	00:05 shorter	05:34	18:19	12:45	00:03 shorter
+3 months	06:01	18:01	12:00	00:06 shorter	05:38	18:24	12:46	00:02 shorter
+6 months	05:51	17:57	12:06	00:00 equal length	05:30	18:18	12:48	00:00 equal length

Kigali, Rwanda - Solar energy and surface meteorology

Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Insolation, kWh/m²/day	4.63	4.87	4.65	4.48	4.48	4.63	4.95	4.85	4.82	4.39	4.26	4.36
Clearness, 0 - 1	0.45	0.47	0.44	0.44	0.47	0.51	0.54	0.50	0.47	0.42	0.42	0.43
Temperature, °C	19.84	20.67	20.23	19.72	20.69	21.19	21.25	22.03	21.69	19.95	19.19	19.26
Wind speed, m/s	2.87	2.97	2.75	2.77	3.31	3.89	3.60	3.44	2.99	2.65	2.50	2.37
Precipitation, mm	75	102	118	186	107	23	9	35	90	109	140	101
Wet days, d	16.9	16.6	20.3	23.2	16.8	5.8	5.0	7.2	12.7	18.8	23.3	19.8

Use of the GAISMA software

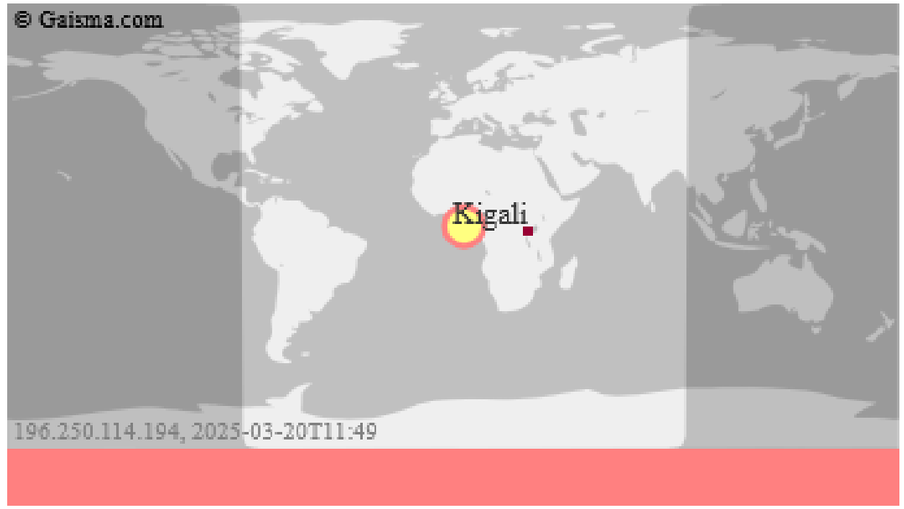
Kigali, Rwanda - Sun path diagram



Sun path
- Today
- June solstice
- December solstice
- Annual variation
- Equinox (March and September)

Sunrise/sunset
- Sunrise
- Sunset

Time
- 00-02
- 03-05
- 06-08
- 09-11
- 12-14
- 15-17
- 18-20
- 21-23

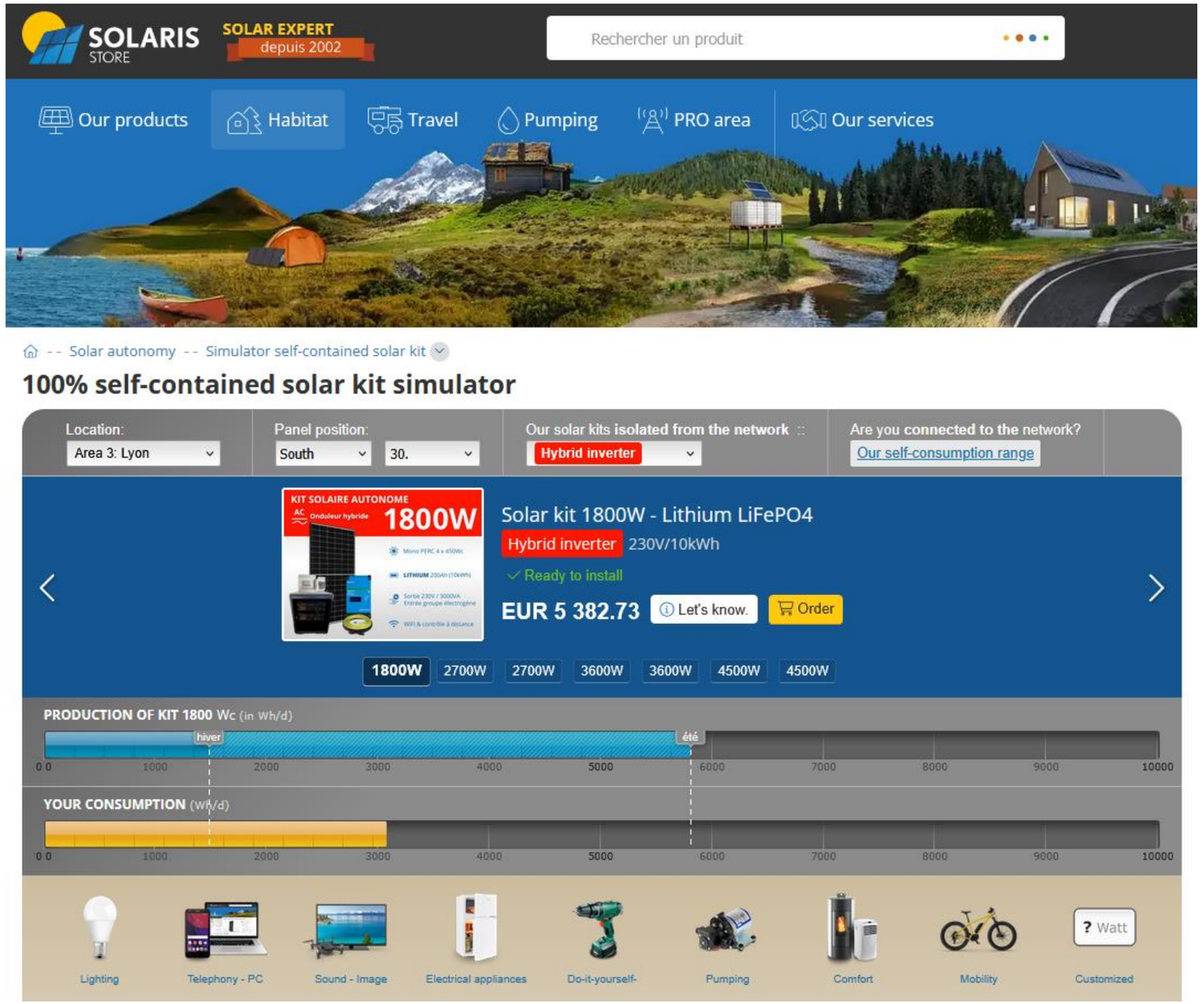


▶ Real-time solar terminator on a larger map

Using the SOLARIS STORE Simulator

The SOLARIS STORE simulator allows you to calculate your electricity consumption and compare it with the production of different solar kits.

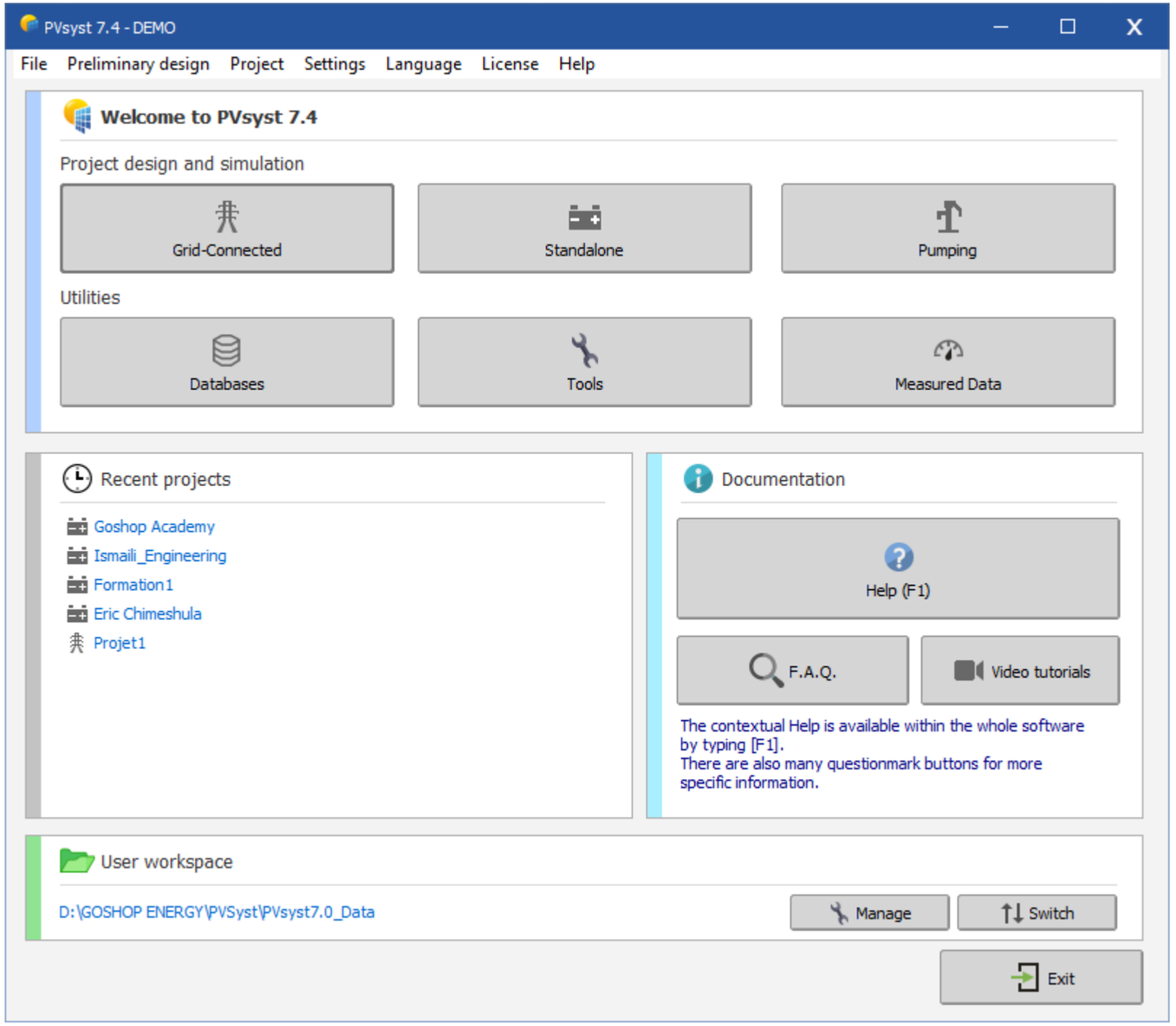
The application can be accessed online at www.solaris-store.com



Using the PVSyst software

PVsyst is the photovoltaic sizing software of reference for financiers. A powerful program that allows the PV production of any sunny surface on earth to be evaluated, taking into account possible shades.

To access the software, use the following link:
www.pvsyst.com



Calculation of solar panel capacity

1 Basic Formula

$$P_{Panneaux} = \frac{E_{Quotidienne}}{H_{Solaire} \times \eta_{Système}}$$

The power required depends on the daily consumption, the hours of sunshine and the overall output.

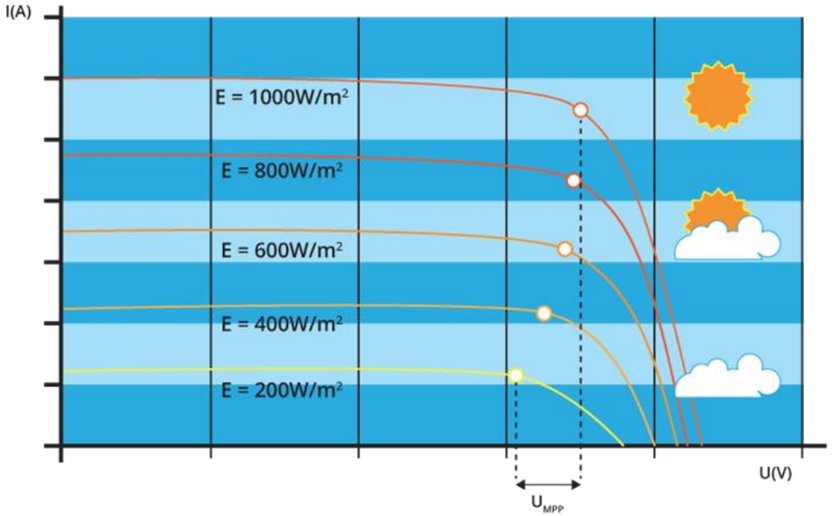
2 Key Factors

Sunshine and temperature vary depending on the location. The yield is usually between 70% and 80%.

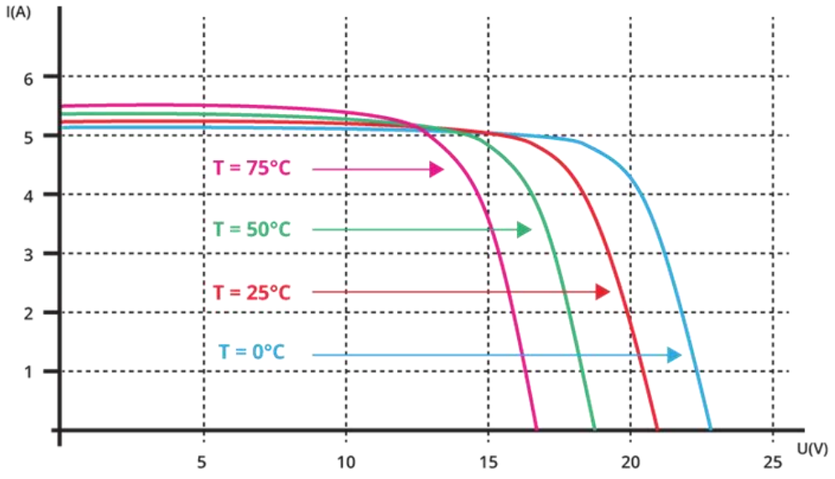
3 Practical example

For 5 kWh/day with 5 hours of sunshine and 75% efficiency, 1.33 kWp of panels are needed.

COURBES DE PUISSANCE D'UN PANNEAU SOLAIRE
EN FONCTION DE L'ENSOLEILLEMENT



INFLUENCE DE LA TEMPÉRATURE SUR LES PERFORMANCES
D'UN PANNEAU SOLAIRE PHOTOVOLTAÏQUE



Battery sizing

Capacity Requirements

$$C_{Batterie} = \frac{E_{Autonomie} \times 1000}{V_{Batterie} \times DoD \times \eta_{Batterie}}$$

Depends on the energy to be stored, voltage, depth of discharge (DoD) and efficiency.

Types of batteries

Lead-acid/AGM/Gel: 50% DoD.

Lithium: DoD up to 90%.

Example

For 5 kWh/day, 2 days of autonomy, 24V, DoD 50%, efficiency 90%: need 925 Ah in 24V.

Go shop ACADEMY

Charge controller

System voltage

The regulator must be compatible with the voltage of the batteries (12V, 24V, 48V).

PV Input Voltage

Must match the panels. MPPT regulators accept higher voltages.

Ampacity

For 1.33 kWp in 24V, a regulator of at least 60A is required.

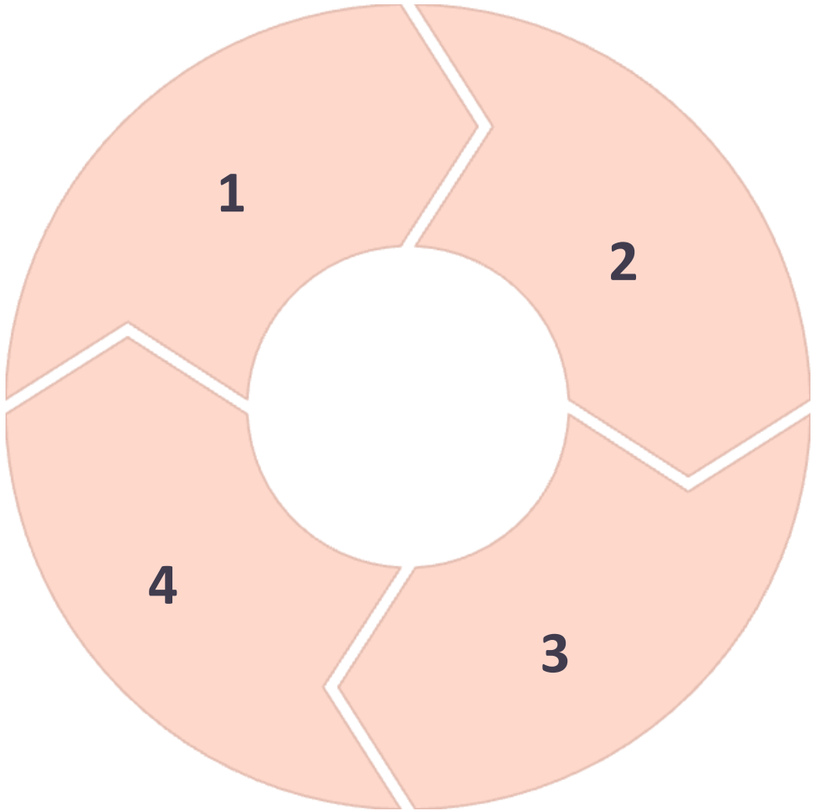
Choice of inverter

Power

Exceeds the maximum power of connected devices.

Example

For 2000W of consumption, choose an inverter with a minimum of 2500W.

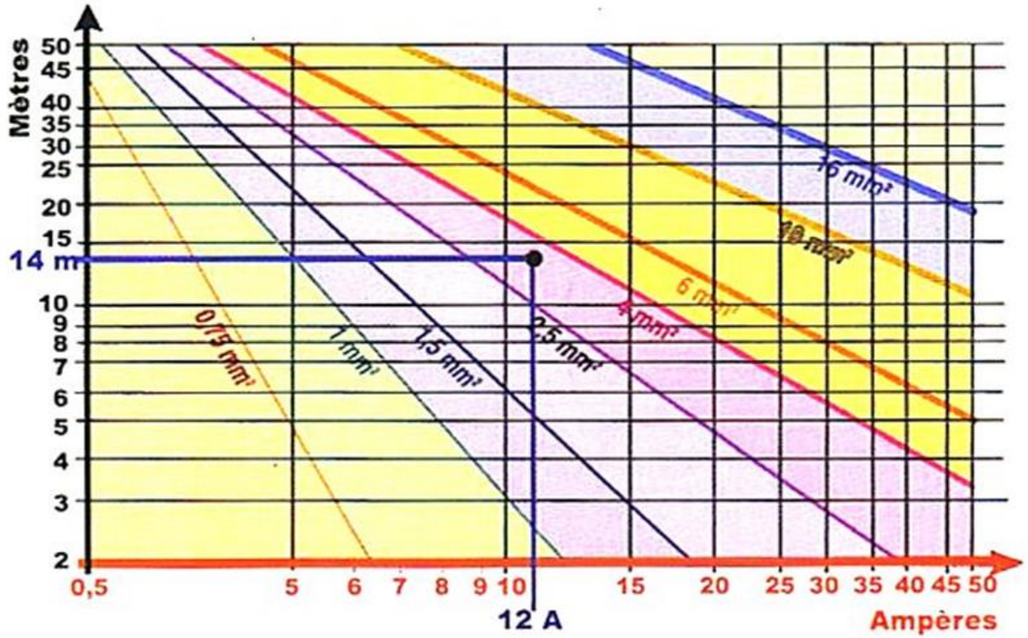


Type

Pure sine wave for sensitive equipment.

Alternative

Modified wave, cheaper but less compatible.



Sizing cables

1

Formula

$$S = \frac{\rho \times 2 \times L \times I}{\triangle V}$$

The cross-section depends on the length, current, conductivity and acceptable voltage drop.

2

Importance

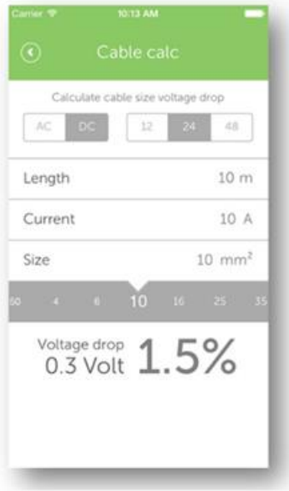
Undersized cables cause overheating and energy loss.

3

Materials

Copper offers a conductivity of 56 m/Ωmm². The voltage drop should not exceed 3%.

Calculs de chute de tension AC et DC faciles et rapides avec **Victron Toolkit**



Téléchargeable gratuitement

GET IT ON Google Play

Download on the App Store

Protective equipment

Circuit breakers

Protect against overloads and short circuits by automatically shutting off the circuit.

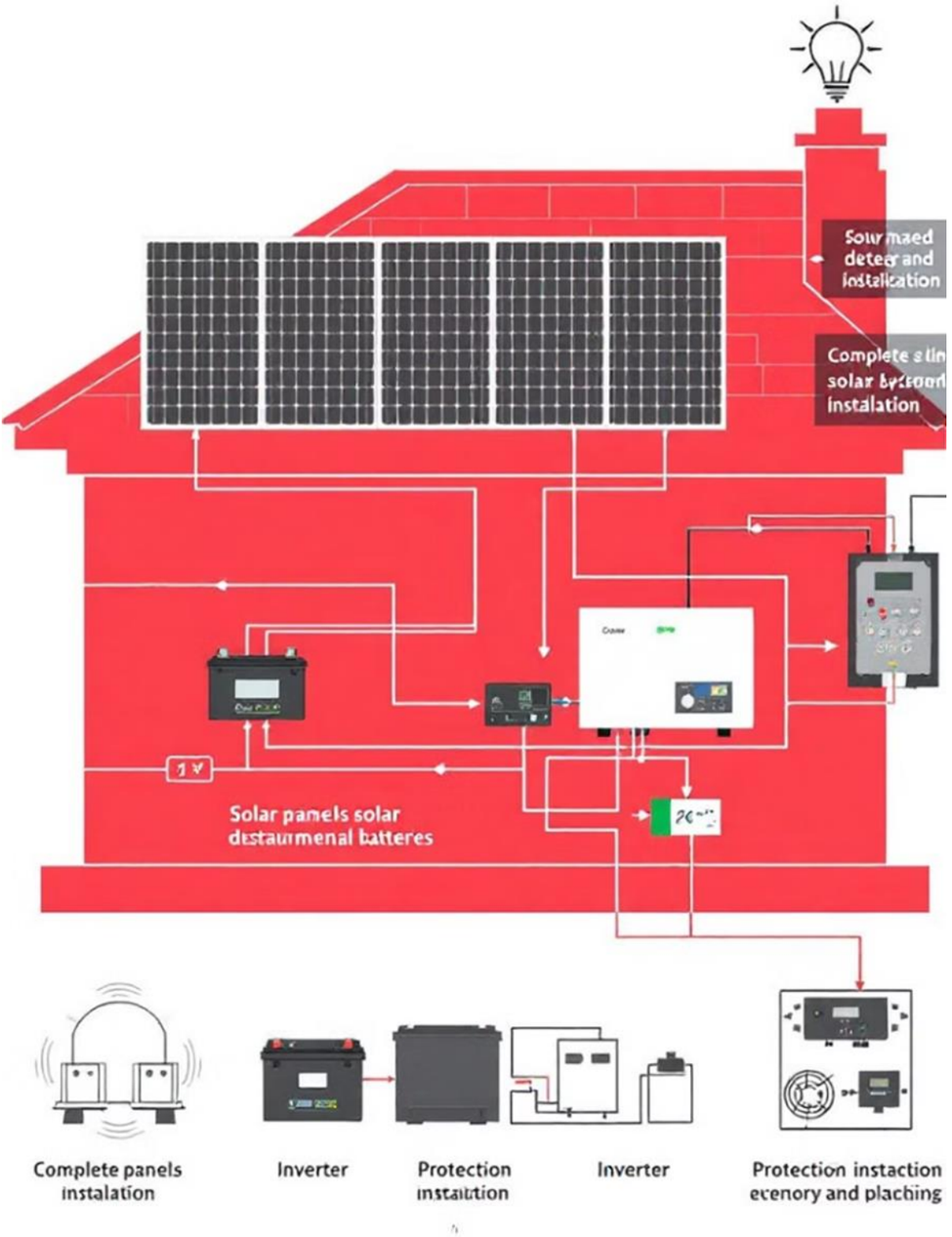
Fuses

Protects DC batteries and circuits from overcurrent.

Surge arresters and lightning rods

Protect against power surges caused by thunderstorms.

Full sizing example



1

Needs

Consumption: 5 kWh/day. Battery life: 2 days. Voltage: 24V.

2

Panels

1.33 kWp of solar panels with 5 hours of sunshine and 75% efficiency.

3

Batteries

925 Ah in 24V with 50% DoD and 90% efficiency.

4

Equipment

MPPT 60A regulator. 2500W pure wave inverter. Suitable cables and protections.

Summary and tips

1. **Initial assessment**

   Calculate your daily energy consumption precisely.

2. **Classification**

   Identify your devices by priority and consumption.

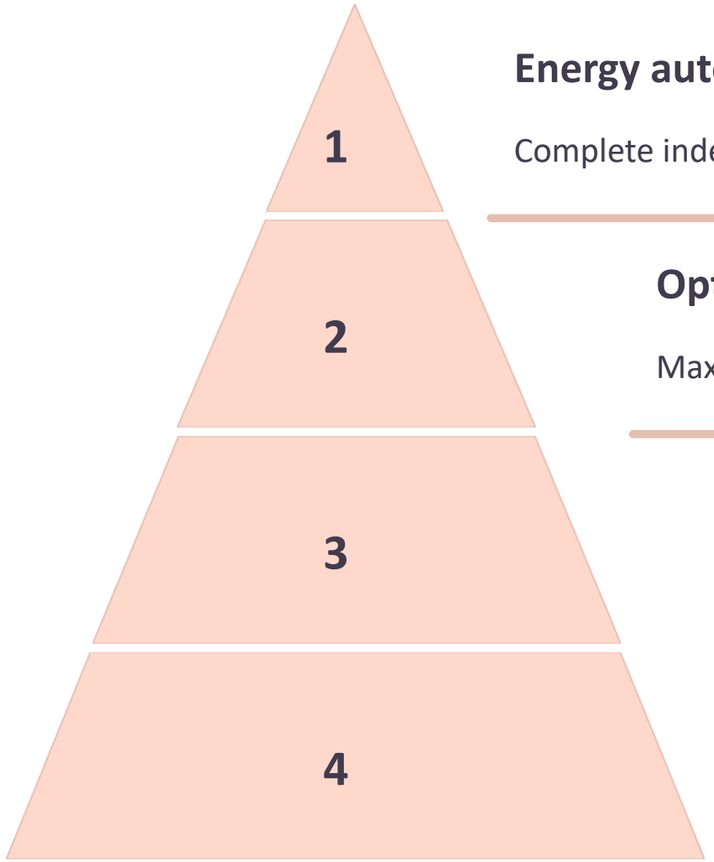
3. **Sizing**

   Use this data to choose the right components.

4. **Installation**

   Call on a professional to guarantee safety and efficiency.

Conclusion



Energy autonomy

Complete independence

Optimized installation

Maximum performance

Precise sizing

Adaptation to needs

Structured methodology

Systematic approach

Thanks to this methodical approach, you will design a high-performance and sustainable solar system, meeting the specific needs of your project.