

# PRACTICAL OPERATION AND MAINTENANCE MANUAL FOR SOLAR PV SYSTEMS

A Comprehensive Guide to Efficient Solar  
Energy Management and Maintenance



*Cover Image. OpenAi (2025), ChatGPT (May 27 Version)*

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## Disclaimer

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The information provided in this guide is for general informational purposes only and **should not replace professional advice**. Always consult and hire qualified professionals to ensure your solar PV system is installed and maintained safely and in compliance with local regulations.

## Introduction

This capacity-building manual was developed as part of the SESA project – Smart Energy Solution for Africa, funded by Research & Innovation funds of the European Union. It is designed for technicians, small and medium-sized enterprises (SMEs) proprietors, and ordinary consumers. The following are the fundamental **aims** of the manual:

- To provide owners of small and medium-sized enterprises (SMEs) with valuable insights regarding the operational efficiency of solar photovoltaic (PV) systems. This entails possessing the requisite knowledge and abilities to optimize energy efficiency, regulate costs, and ensure the longevity of the system.
- To offer extensive guidance on performing routine maintenance tasks, resolving frequent problems, and determining when expert assistance is required.
- To provide general users, including householders and small business proprietors, with a deeper comprehension of their solar PV systems, thereby empowering them. This includes gaining an understanding of the system's fundamental operation, monitoring its performance, and recognizing its energy and environmental benefits.
- To highlight the safety protocols necessary to ensure the well-being of individuals who interact with the systems and to prevent incidents.

Additionally, the manual offers several **advantages**:

- It allows to save costs and eliminate superfluous expenditures (e.g. repairs, energy wastage) by educating users on optimal strategies for operating and maintaining Solar PV systems on their own. It supports the overarching objectives of promoting sustainable energy practices. This, in turn, aids in the mitigation of carbon footprints and the advancement of green energy solutions.
- It assists users in adhering to both domestic and international benchmarks.
- It serves as an indispensable resource for those involved in the operation of solar PV systems, offering practical, efficient, and security-focused guidance.

## 1. Overview of solar PV system

### 1.1. The Scope of Solar PV Systems Covered / What are the fundamentals of PV Systems

Photovoltaic (PV) solar energy conversion is a process that utilizes semiconductor materials, which are predominantly composed of silicon, to transform sunlight into electrical energy. The fundamental principle behind solar PV technology is the **photovoltaic effect**. Electrons within the semiconductor material of the solar cells are energized when sunlight strikes the material, generating an electrical current.

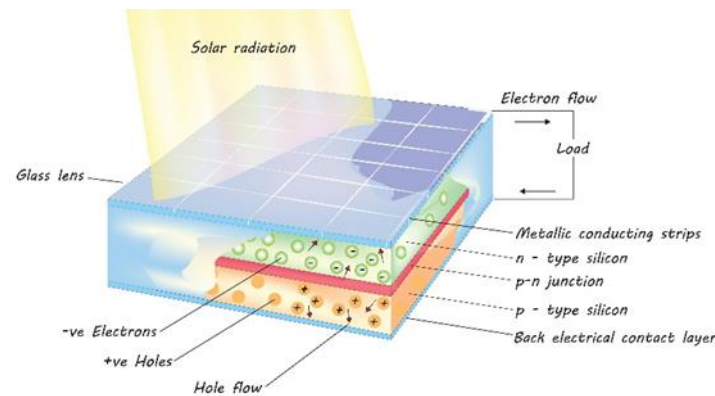


Figure 1: Photovoltaic Effect © KKT Madhusanka | Dreamstime

Solar panels are constructed from solar cells as their fundamental components. In most cases, these cells are constructed from silicon, a readily available material with advantageous semiconductor characteristics. Solar cells can be monocrystalline, polycrystalline, or thin film, each with different efficiencies and costs.

- **Monocrystalline Solar Cells**  
Made from a single crystal of silicon, these cells are highly efficient and recognizable by their uniform black color and rounded edges. They are ideal for spaces with high energy demands and limited area.
- **Polycrystalline Solar Cells**  
Constructed from multiple silicon fragments melted together, these cells have a distinct blue, speckled appearance. They are less efficient than monocrystalline cells but more cost-effective.
- **Thin-Film Solar Cells**  
Composed of photovoltaic material layers on a substrate, these are lightweight and flexible. They are less efficient but excellent for large-scale or portable applications.



Solar cells are assembled into larger units known as solar panels or modules. These panels are typically what you see on rooftops or in solar farms.

Figure 2: Types of solar cells – monocrystalline at the bottom, polycrystalline at the top. ©Mona Makela | Dreamstime



## 1.2. Components of Solar PV Systems

Regardless of the size and location of an installation, the basic components needed to guarantee a correct and safely functioning Solar PV system are the same. Additional components can be included to increase the performance and efficiency of the overall system.

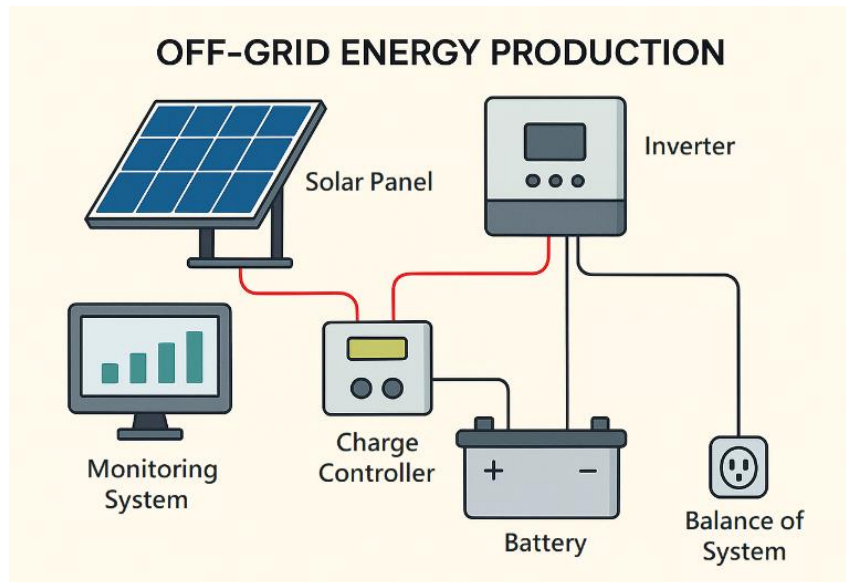


Figure 3: Off-grid solar power system with battery storage. OpenAi (2025). ChatGPT (May 27 Version)



Figure 4: Actual solar system installation in health facility in Tanzania, photo by Elico Foundation.

Table 1: Components of Solar PV Systems

Fundamental components	Description
Solar Panels (PV Modules)	<p><b>Function:</b> Capture sunlight and convert it into direct current (DC) electricity.</p> <p><b>Types:</b> Monocrystalline, polycrystalline, and thin-film solar panels, each with different efficiencies and cost.</p> <p>Typically installed on rooftops, ground mounts, or solar farms.</p>
Inverters	<p><b>Function:</b> Convert DC electricity generated by the solar panels into alternating current (AC) electricity.</p> <p><u>Essential</u> for the usability of solar energy in standard electrical systems and for feeding electricity into the grid.</p> <p><b>Types:</b> String inverters, microinverters, and hybrid inverters.</p>
Mounting Systems	<p><b>Function:</b> Securely hold solar panels in place.</p> <p>It needs to be robust and weather-resistant and may need to be angled for optimal sun exposure.</p> <p><b>Types:</b> Fixed mounts, tracking mounts, and ground-mounted systems.</p>
Electrical Components	<p>Include wiring, fuses, circuit breakers, and disconnect switches.</p> <p><b>Function:</b> Ensure safe operation and connectivity of the solar PV system and protect against electrical surges and faults.</p>
Balance of System	<p>All other components that are required to ensure the proper functioning of the solar PV system, such as grounding equipment, conduits, junction boxes, etc.</p>
Additional components	Description
Batteries	<p><b>Function:</b> Store excess electricity produced by solar panels for use when there is no sunlight (e.g., at night or during cloudy days).</p> <p><b>Types:</b> Lead-acid, lithium-ion, and flow batteries, with varying capacities, lifespans, and costs.</p> <p><b>Important:</b> Particularly important for off-grid systems or grid-tied systems with a self-consumption focus.</p>
Charge Controllers	<p><b>Function:</b> Regulate the voltage and current coming from the solar panels to the batteries, preventing overcharging and damage to the batteries.</p> <p><b>Types:</b> Pulse Width Modulation (PWM) and Maximum Power Point Tracking (MPPT), with MPPT being more efficient.</p> <p><b>Important:</b> fundamental in case batteries are connected to the PV system.</p>
Monitoring Systems	<p><b>Function:</b> Track the performance of the solar PV system, including energy production, system health, and efficiency.</p> <p><b>Types:</b> Onsite and remote monitoring systems, often accessible via smartphone apps or web interfaces.</p>

Grid Interconnection Equipment (grid-tied)	<p>Includes specific types of inverters and safety equipment that meet grid standards and regulations.</p> <p><b>Function:</b> Safely and legally connect the solar PV system to the public electricity grid.</p> <p><b>Important:</b> Needed for PV systems connected to the public grid.</p>
--------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**NOTE:** Each component in a solar PV system **must be carefully selected and integrated** to ensure maximum efficiency, safety, and longevity of the system.

## 1.3. System Layout and Configuration

Designing a solar PV system involves several key considerations to ensure optimal performance, safety, and efficiency. The form and design of the system can vary considerably depending on factors such as the application (residential, commercial, industrial), location, available space, and unique energy requirements.

For instance, residential systems often prioritize aesthetics and space efficiency, utilizing rooftop installations to maximize available area, whereas commercial systems may focus on larger-scale energy production, often employing flat-roof or ground-mounted setups. In industrial applications, high energy demands and robust infrastructure lead to extensive ground-mounted arrays or hybrid systems with backup storage. Location plays a critical role,

as areas with high solar irradiance favor optimal panel tilt angles and orientations for maximum sunlight capture, while regions prone to extreme weather require reinforced structures. Available space determines the layout, with limited areas requiring compact, high-efficiency panels, while open spaces allow for expansive installations. Finally, unique energy requirements, such as off-grid or grid-tied systems, influence the inclusion of storage batteries, inverters, and backup systems to meet specific energy reliability and usage patterns.

### 1.3.1. Solar Panels Arrangement

Select panels of either monocrystalline, polycrystalline, or thin-film type, considering their efficiency, cost, and space requirements. To fully tap into the potential of an installation, it is important to consider carefully where those are placed and their inclination angle as both aspects influence the energy ultimately produced under the same weather conditions.

- **Orientation and Tilt:** there is no standard value that can be applied to all installations as orientation depends on the geographical location. In the Northern Hemisphere, solar panels are commonly positioned facing south and angled at a degree similar to the latitude of the area to optimize sunlight absorption. Likewise, in the southern hemisphere, panels face North.
- **Shading:** Ensuring that there are no barriers such as trees, buildings, or other objects that block sunlight over the sun hours.



### 1.3.2. Mounting Structure



*Figure 5: Mounting Structure. Markus Spiske on [Unsplash](#)*

PV systems are mounted on stable structures that secure them fixed in the best possible positioning. The main options are:

- **Roof-mounted systems** take advantage of the built environment and are typically found in residential or industrial settings. These systems necessitate a robust roof that can support them and hence structure reinforcement may be needed.
- **Ground-mounted systems** are employed where there is insufficient or inappropriate roof space. Land space is necessary and therefore considerations regarding the environmental impact of the installation should be considered.

NOTE: It is also possible to include in the installation a tracking system that detects the trajectory of the sun and rotates PVs toward its direction, enhancing efficiency but also leading to an increase of the costs.

### 1.3.3. Inverter and their placement



Inverters are fundamental to convert the electricity produced by the PVs and make them suitable for the common house and office appliances. This component can be placed close to the solar panels or near the main electrical panel of the building.

*Figure 6: White inverter for solar cell system  
© Ratchapon Supprasert | Dreamstime.com*

There are several types of inverters:

- **String inverters**, which manage multiple panels together and are suitable for smaller systems.
- **Central inverters** are for large commercial systems.
- **Microinverters**, which are attached to each panel for increased efficiency and monitoring.



Additionally, **Hybrid inverters**, or **multi-mode inverters**, play a crucial role in certain solar photovoltaic (PV) systems. They integrate the features of a conventional solar inverter and a battery inverter allowing for effectively handling energy derived from solar panels, the electrical grid, and battery storage devices.

*Figure 7: Hybrid inverter for Energy Storage System  
© Hrishchenko Oleksandr | Dreamstime.com*

**Solar Inverter**, typically designed to work directly with solar panels, optimizing energy production using maximum power point tracking (MPPT).

**Battery Inverter**, designed to manage and integrate energy storage systems, enabling stored energy to be utilized during power outages or at night.

#### 1.3.4. Battery storage



Solar energy is an intermittent source as it depends on the presence of sunlight. Batteries allow us to store the energy produced and not directly consumed to use it later when the sun is not present.

These are fundamental in case the system is off grid, meaning that it is not connected to the public grid that could compensate for the electricity need when electricity produced by the PV is not available anymore.

*Figure 8: Modern battery for solar systems © Alexey Arama | Dreamstime.com*

Some considerations related to the storage are:

- **Position:** the inverter for easy integration into the system and far from hot places.
- **Size and Capacity:** The size of the battery storage system is determined based on energy production, the needs and the desired autonomy (how long the system can run without sunlight).
- **Integration:** Battery storage must be smoothly incorporated with the PV system to enable energy storage and utilization during periods of low solar production.

NOTE: Batteries are not the only way to store energy. Other options are hydrogen storage, compressed air storage and thermal storage.

### 1.3.5. Charge Controller

Charge controllers are important to ensure healthy batteries, preventing their degradation due to wrong voltage or overload of energy.

Those are usually installed between the solar panels and the batteries.

**NOTE:** The specific layout and configuration of a solar PV system can vary greatly based on individual requirements and constraints. It's essential to engage with qualified solar professionals to design and install a system that meets the specific needs of the site and the users effectively.

## 2. Safety Precautions

### 2.1. Personal Protective Equipment (PPE)

The utilization of **Personal Protective Equipment (PPE)** is essential in guaranteeing the safety of persons engaged in the operation and maintenance of Solar Photovoltaic (PV) systems. PV systems incorporate electrical elements and are frequently deployed in open-air settings, presenting diverse hazards. A comprehensive analysis of the essential PPE employed in PV systems is presented in the Table below.

*Table 2 Personal Protective Equipment (PPE)*

Category	Description
<b>Electrical Insulated Gloves</b>	<b>Purpose:</b> Protect against electric shocks when handling electrical components of the solar PV system. <b>Specification:</b> Should be rated for the specific voltage levels encountered in the system.
<b>Safety Glasses or Goggles</b>	<b>Purpose:</b> Protect the eyes from harmful solar radiation, dust, debris, and accidental splashes of cleaning or maintenance chemicals. <b>Specification:</b> Should have UV protection and be impact resistant.
<b>Hard Hats</b>	<b>Purpose:</b> Protect the head from falling objects, especially when working under or near solar panels installed at height. <b>Specification:</b> Should meet industry safety standards.
<b>Protective Footwear</b>	<b>Purpose:</b> Protect feet from falling objects, sharp edges, and electric shocks. <b>Specification:</b> Should be sturdy, have electrical insulation, and possibly steel toes for enhanced protection.
<b>Sun Protection Gear</b>	<b>Purpose:</b> Protect against prolonged exposure to the sun, which is common during outdoor work It can include long-sleeved shirts, sun hats, and sunscreen

<b>Respiratory Protection</b>	<p><b>Purpose:</b> Protect against inhalation of harmful dust, especially during cleaning or maintenance activities.</p> <p><b>Specification:</b> Dust masks or more advanced respirators, depending on the level of exposure.</p>
<b>Protective Work Clothing</b>	<p><b>Purpose:</b> General protection against cuts, abrasions, and other minor injuries.</p> <p><b>Specification:</b> Durable material, possibly with reinforced areas for additional protection</p>

**NOTE:** The selection of PPE should be based on a thorough risk assessment, considering the specific tasks, the environment, and the potential hazards associated with the operation and maintenance of solar PV systems. Regular training on the proper use and maintenance of PPE is also essential to ensure safety.

## 2.2. Electrical safety

Ensuring **electrical safety** is of utmost importance when operating and maintaining PV systems. Although these systems are eco-friendly, they require careful management of high-voltage power, which can present significant dangers if mishandled.

Below are essential factors and procedures to guarantee electrical safety:

A **comprehensive understanding** of PV system constituent parts, including solar panels, inverters, DC/AC converters, batteries (if applicable), and wiring systems. Acquiring this knowledge aids in the recognition of possible dangers. To ensure solid knowledge of electrical principles and becoming acquainted with the PV being used **appropriate training and certifications** are necessary for everyone engaged in the installation, operation, or maintenance of PV systems. Moreover, the **utilization of Personal Protective Equipment (PPE)** presented in the section above is imperative to consistently employ suitable PPE to mitigate the likelihood of electric shock and other forms of harm.

To manage solar PV systems, it is also strongly recommended to:

- **Ensure equipment conformity to national and municipal electrical codes**, as well as industry standards established by organizations like the Institute of Electrical and Electronics Engineers (IEEE) or the International Electrotechnical Commission (IEC).
- **Set electrical lockout and tagout procedures:** Enforce lockout/tagout protocols to guarantee the safe de-energization of the system during maintenance or repair. This serves as a precautionary measure to avoid unintentional activation of the system.
- **Apply safe installation practices:** It is important to make sure that all components are placed according to the guidelines provided by the manufacturer and the electrical codes of the local area. Ensuring proper grounding and bonding is crucial for minimizing the likelihood of electric shock.
- **Labelling and Signage:** It is important to mark electrical components with information such as power ratings and warning signs. This helps to alert and remind personnel about potential hazards.
- **Be aware of weather-related risks:** It is important to understand that PV systems can



produce electrical energy even when the weather is cloudy. Additionally, be aware of the increased risk of electrical hazards during wet or stormy weather.

- **Maintenance of battery Safety (for systems with storage):** If the system incorporates energy storage components, it is crucial to handle and maintain batteries correctly, as they may pose extra risks such as chemical leakage or thermal runaway.
- **Schedule periodic maintenance and inspections:** Routinely examine and uphold the PV system to guarantee its optimal functionality. This entails inspecting for impaired cables, insecure linkages, and indications of corrosion.

### 3. Regular operation procedures

The routine functioning of solar PV systems generally entails the activities of monitoring, conducting maintenance checks, and assuring optimal system performance. Although solar PV systems typically require minimal maintenance, it is essential to follow regular operational practices to ensure optimal performance and promptly detect any potential problems. Below is a 10 points summary of the standard operating procedures for solar PV systems.



*Figure 9: Dusty and Weathered Solar Panel Array © Vitalii Buria | Dreamstime.com*

1. **Visual Examination:** Inspect the solar panels for any apparent signs of damage, such as fractures, discolouration, or the accumulation of debris and vegetation. Examine the mounting systems for any indications of looseness or impairment. Make sure that there are no obstacles such as fallen branches or heavy debris on the panels.
2. **Performance Monitoring:** Examine the energy production statistics obtained from the inverter or monitoring system. Analyze the daily production with anticipated performance benchmarks using records and weather conditions. Monitor for any substantial declines in energy generation, as these may indicate potential problems with the solar panels or inverter.





Figure 10: Energy production statistics. Image by StockSnap on [Pixabay](#)

3. **Inverter inspection:** Ensure proper functioning of the inverter. Typically, inverters are equipped with an indicator light or display panel that provides real-time information about their present functioning state. Pay attention to any atypical sounds emanating from the inverter, since they may suggest internal malfunctions.
4. **Battery systems inspection** (if applicable): verify the charge levels of systems equipped with battery storage and verify that they fall within the recommended range. Observe any indicators or notifications regarding battery functionality.
5. **Connections inspection:** Verify that all electrical connections are firmly attached and there are no indications of excessive heat, such as discoloration or wire melting. It is advisable to approach this task with caution. The assistance of a professional is highly recommended, as it has inherent risks.
6. **Solar Panel Cleaning:** Periodically clean solar panels when they accumulate excessive dust, bird droppings, or other debris to ensure optimal efficiency. Utilize suitable cleaning techniques, such as employing gentle brushes and mild soapy water, while refraining from using abrasive substances or harsh chemicals.
7. **Shading inspection:** Monitor the panels for any newly occurring shading problems, which may be attributed to the growth of trees, recent construction activities, or other obstacles. The presence of shading can greatly diminish the effectiveness of a solar PV system.
8. **Environmental factors:** Take into consideration the prevailing meteorological conditions. Following severe weather phenomena such as storms or significant rainfall, it may be imperative to conduct supplementary inspections and sanitation procedures.
9. **Documentation:** Keep a detailed record of daily performance metrics, inspections, and all maintenance tasks. This record is extremely valuable for monitoring and evaluating the functioning of the system over some time, as well as for recognizing any patterns or problems that may arise.
10. **Professional Maintenance Services:** Ensure to regularly schedule professional inspections and maintenance services, since certain areas of system check-up and maintenance necessitate specialized expertise and equipment.

## 4. Routine Maintenance Practice

The execution of regular maintenance procedures is critical in ensuring the optimal operation and durability of solar PV systems. This will also ensure its maximal performance and fasten the return on investment. By dividing these responsibilities into distinct subsections, a comprehensive strategy for system maintenance is achieved. The classification of these maintenance duties is described in more detail below.



Figure 11: Solar PV maintenance. Photo by Trinh Trần on [Pexels](#)

### 4.1. PVs cleaning and inspection scheduled

**Frequency:** Typically, every 6–12 months, more often in dusty or bird-prone areas.

#### Cleaning:

- **Method:** Use soft brushes or sponges and mild soapy water. Avoid abrasive materials and high-pressure water sprays.
- **Focus Areas:** Remove debris, dirt, and bird droppings from solar panels.

#### Inspection:

- **Visual Checks:** Look for cracks, discoloration, or delamination in panels.
- **Mounting and Racking Systems:** Ensure all bolts and supports are secure.
- **Shading:** Check for new shading issues due to tree growth or new constructions.
- **Grounding and Bonding:** Ensure these are intact for safety and system performance.

## 4.2. Inverter Maintenance

**Frequency:** Monthly (minimum), Detailed Checks Quarterly

- **Visual Inspection:** Check for any error messages on the display, signs of overheating, or physical damage. Inspect mounting integrity and ensure the inverter is secure and not vibrating
- **Performance Monitoring:** Verify status indicators (LEDs) and LCD/online display for any warning/error codes and confirm proper DC input voltage and AC output voltage levels for any unusual drops or inconsistencies.
- **Ventilation:** Ensure the inverter is well-ventilated and free from dust, moisture and debris.
- **Firmware Updates:** Keep the inverter's firmware updated as per manufacturer's recommendations.

## 4.3. Battery Maintenance (for systems with storage)

**Frequency:** Monthly, with Detailed Capacity Testing Annually

**Inspection:**

- **Performance Monitoring:** measure and record individual battery voltages and string voltages.
- **Room Inspection:** Confirm battery room ventilation, temperature, and absence of leaks or fire hazards

As mentioned in Table 1, the two main types of batteries used in PV systems are lead-acid and lithium-ion. Each of these two types requires different precautions:

### Lead-Acid Batteries:

- **Water Levels:** Regularly check and top up water levels in flooded lead-acid batteries.
- **Terminal Checks:** Clean and tighten battery terminals to prevent corrosion and ensure good connections.
- **State of Charge:** Regular monitoring to avoid overcharging or deep discharging.

### Lithium-Ion Batteries:

- **Temperature Monitoring:** Ensure they are operating within the recommended temperature range.
- **Software:** Keep battery management system software up to date.
- **Visual Inspection:** Check for any signs of swelling or damage.

## 4.4. Electrical Connections Check

**Frequency:** Every 6 Months (or quarterly in high-humidity, dusty, or corrosive environments)

When verifying the electrical connection, it is important to check the following:

- **Tightness of Connections:** Ensure all electrical connections are tight and secure and perform torque checks on terminal screws and cable lugs.
- **Corrosion Inspection:** Look for any signs of corrosion on terminals and connections.
- **Temperature Inspection:** Check for any signs of overheating (discoloration, melting insulation).
- **Wiring Inspection:** Check for any signs of fraying, rodent damage, or wear on the wiring and conduct insulation resistance testing (especially after major rain/dust events).
- **Safety Checks:** Ensure all safety switches, circuit breakers, surge protection devices and disconnects are functioning properly.

### General Recommendations:

- **Documentation:** Keep detailed records of all maintenance activities.
- **Professional Inspection:** At least once a year, have a professional technician inspect and service the system.
- **Safety First:** Always prioritize safety, especially when working with electrical components or at heights.

Regular maintenance is crucial for optimizing the efficiency, ensuring safety, and prolonging the lifespan of solar PV systems. Certain operations can be managed by the system owner, however, duties related to electrical components should be performed by competent personnel. Routine maintenance not only extends the lifespan of the system but also guarantees that it functions at its highest level of efficiency, resulting in the most favourable return on investment.

## 5. Troubleshooting Common Issues

### 5.1. Diagnostic Steps for Common Problems

*Table 3 Common issues*

Issue Category	Symptoms	Diagnostic Steps	Suggested Actions
<b>Reduced Power Output</b>	Lower-than-usual energy production	<ol style="list-style-type: none"> <li>1. Inspect for shading or obstructions.</li> <li>2. Check for dirt or debris on panels.</li> <li>3. Monitor the inverter for error messages.</li> <li>4. Review historical performance data.</li> </ol>	<ul style="list-style-type: none"> <li>• Clean panels</li> <li>• remove obstructions.</li> <li>• reset, or troubleshoot inverter.</li> </ul>
<b>Inverter Issues</b>	Error messages, no power output	<ol style="list-style-type: none"> <li>1. Refer to the manual for error codes.</li> </ol>	<ul style="list-style-type: none"> <li>• Reset the inverter.</li> </ul>

		<ol style="list-style-type: none"> <li>2. Perform power cycling.</li> <li>3. Check the inverter's ventilation.</li> </ol>	<ul style="list-style-type: none"> <li>• ensure proper ventilation.</li> <li>• contact a professional if the error persists.</li> </ul>
<b>Battery-Related Issues</b>	Poor charging, battery not holding charge	<ol style="list-style-type: none"> <li>1. Check charge levels.</li> <li>2. Inspect connections.</li> <li>3. For lead-acid, check water levels.</li> </ol>	<ul style="list-style-type: none"> <li>• Tighten connections.</li> <li>• refill water (if applicable)</li> <li>• professional battery check.</li> </ul>
<b>Panel Damage</b>	Visible damage, reduced panel output	<ol style="list-style-type: none"> <li>1. Visual inspection.</li> <li>2. Check the electrical output with a multimeter.</li> </ol>	<ul style="list-style-type: none"> <li>• Replace damaged panels.</li> <li>• professional assessment.</li> </ul>

## 5.2. When to Contact a Professional Technician

*Table 4 Assistance by Professional Technician*

Issue	Description	Professional Assistance Needed When
<b>Physical Damage</b>	Cracks, discolouration, or other damage to components	Damage is significant and affects system performance.
<b>Electrical Concerns</b>	Wiring or connection issues	Problems are complex or high-risk (e.g., inverter failure).
<b>Battery Issues</b>	Problems with charging or battery health	Issues persist despite basic troubleshooting, or if safety risk is present.
<b>Safety Risks</b>	Any issue requiring work at heights or with high voltage	Safety risks are involved, or specialized knowledge is required.

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## About SESA

SESA is a collaborative project between the European Union and nine African countries (Kenya, Ghana, South Africa, Malawi, Morocco, Namibia, Tanzania, Rwanda, and Nigeria) that aims at providing energy access technologies and business models that are easily replicable and generate local opportunities for economic development and social cohesion in Africa.

Through a series of local living labs, the project will facilitate the co-development of scalable and replicable energy access innovations, to be tested, validated, and later replicated throughout the African continent. These solutions will include decentralised renewables (solar photovoltaics), innovative energy storage systems including the use of second-life electric vehicle batteries, smart microgrids, waste-to-energy systems (biomass to biogas), climate-proofing, resilience and adaptation, and rural internet access.

## SESA Partners

