



**ENERGY
ACCESS
HANDBOOK
NO. 1**



Pico Solar Systems

Everything you need to know...



How to use this Handbook

This handbook is intended to help you – as user of a pico solar system – to get the best use and the most benefits from your solar system. Like all equipment and systems, you can get more benefits from the system if you understand how it works, how to use it wisely and how to maintain it when there are any problems.

The scope of this handbook is to cover pico solar systems. This means portable solar devices which contain basic lighting, radio and / or USB charging ports. These pico solar devices (also called pico PV or picovoltaic devices) are essentially appliances with built-in solar charging and battery storage.

Pico solar systems are increasingly available ‘off-the-shelf’ in hardware stores or appliance shops but it is advisable for customers to check that the systems comply with quality standards (such as the Verasol quality framework) to ensure maximum benefits and value for money. Customers can contact the Belize Bureau of Standards to verify whether the pico solar systems are quality-approved.

Pico solar systems can play a valuable role in providing basic levels of lighting, cellphone charging and operation of small USB appliances when there are no other options for electricity services.



The international standard is available on the following QR code:



Pico solar devices can also be very useful even when electricity services are available from a stand-alone solar system, a mini-grid or the national grid because they are portable and operate independently (and in parallel) of these other systems.

The Government of Belize is currently promoting the use of pico solar systems – with the support of the European Union and selected Civil Society Organizations – to help all citizens in Belize to benefit from some level of access to electricity. This initiative by the Government of Belize is a key element of fulfilling the national development objective of “Universal access to electricity in Belize by 2030”

This handbook serves as a guide for all owners and users of pico solar systems to understand their system and to make the best of their pico solar systems.





Humana People to People Belize (HPPB) distributing pico solar devices to villages with no electricity access in Southern Belize
Photo Credit: HPPB

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Introduction to **pico** solar systems

What is a pico solar system?

As the name suggests, pico solar systems are very small portable solar systems that incorporate battery storage and a charge controller with lighting, cellphone charging, USB power outlets in a single device – sometimes together with an integrated solar panel or a separate solar panel that is connected with a charging cable. In larger pico solar systems the lights can also be separate and connected by cables.

Compact pico systems	Larger pico systems
	

The cost of pico solar systems varies depending on the size of the system and number of lights (or other appliances).

Quality-approved pico solar systems are guaranteed to operate reliably for two years with no maintenance required (apart from keeping the solar panel clean).

What are the benefits of a pico solar system?

Pico solar systems provide small amounts of extremely valuable energy services – such as lighting, cellphone charging, radio reception or power for small USB appliances – in situations where there is no existing electricity service from the national grid, a mini-grid, generator or a standalone solar system. They can be very useful for households that have no access to electricity and – even – for recreational use in the evening or at night. Pico solar systems are invaluable in cases of emergencies or natural disasters – such as hurricanes – as they are portable and can operate independently of other systems to provide essential services of light and communication.

The main benefits of pico solar systems include:

1. They are portable and easy to use in any location
2. They provide safe, reliable and more affordable lighting, cellphone charging and USB power compared to candles, kerosene or no service at all
3. They are more affordable for customers than larger solar systems
4. They are also available in hardware stores or appliance shops in Belize
5. They are easy to use and do not need a technical specialist to install or maintain them
6. They can continue to provide valuable services even when electricity is available from the national grid or a mini-grid
7. They are also a clean energy source with no carbon emissions when compared to candles diesel or kerosene

How does the pico solar system operate?

Pico solar systems operate in the same basic manner as any other solar system.

The solar panel captures energy from the sun to charge the battery with a built-in charge controller when the sun is shining on the panel and the battery provides electricity to operate the light(s), cellphone charger and / or USB charging outlet(s) whenever these services are needed (and while there is enough electricity stored in the battery).

The system charges most effectively when the solar panel is oriented optimally (see below) and exposed to direct sunlight between 09:30am and 04:30pm when the solar energy is strongest.

Pico solar systems often have some switch(es) to operate the light (or lights) and indicator lights to inform the user about the state of charge of the battery. Sometimes there is a way to control the lighting level to save electricity if a bright light is not essential and more hours of use are preferred.

What are the main parts of the pico solar system?

Pico solar systems come in a range of shapes and sizes with a typical system being made up of the following components:



Pico solar module - usually less than 10 watts - to capture the sunlight to generate the electricity for charging the battery

A built-in rechargeable battery - usually a lithium-ion battery - to store the solar electricity and for use for lighting, cellphone charging or USB power when needed





A built-in charge controller with battery management circuitry to protect the battery from overcharging or over discharging

Indicator lights to show the state of charge of the battery.



An integrated light – usually a small, highly efficient LED light – that is built in as standard

A light switch – sometimes with different levels of lighting – for controlling the light



Power sockets with plugs and cables to connect and power devices such as phone, tablets, external lights and other USB devices

Adaptable mounting stands to orient the solar panel to the sun for charging during the day and hanging the device indoors for lighting at night (some solar devices)



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How to use your pico solar system

to get the maximum benefits

Knowing how to use and look after the system will ensure the best performance and benefits.

There is a limit on amount of electricity produced and stored with pico solar systems. This depends on the system size and quality of the solar panels, batteries and lights (and radio or USB appliances).

To enjoy the usage of electricity (especially during hours of no sunlight), the following recommendations include:

- Know your system – to understand how much electricity it can generate and store on a typical day so that you can adjust your use of appliances to correspond with this generation and storage capacity. Owners should carefully read manufacturers instructions manual
- Use energy efficient appliances that are suited to pico solar systems
- Use these appliances wisely within the generation and storage capacity of the pico solar system



Basic guidelines include the following:

1.	Keep the system clean and dry at all times to prevent damage from water or spills
2.	Store the system in a safe place when not in use to prevent physical damage or theft
3.	Charge the system regularly when the sun is shining to keep the battery charged
4.	Try to ensure that the battery is fully (100%) charged at least once a month
5.	Start to charge the system in the morning to ensure the best charging output over the full day
6.	Find a safe and unobstructed (from the sun) location to place the solar panel for charging during the day
7.	Point the solar panel at the sun in a way that the shadow of the panel is as small as possible – this ensures that the panel is oriented correctly for the maximum charging of the battery
8.	Move and rotate the solar panel during the day to maintain the best orientation
9.	Keep the panel in the optimal orientation in the direct sunlight from (at least) 09:30am to 04:30pm to collect the solar energy when it is strongest during the day
10.	Use the light, radio and USB power wisely to save energy and maximize the use of these services when they are really needed
11.	Gently clean the solar panel and light bulbs every few months to ensure maximum efficiency and output
12.	Do not abuse the power cables. Never use the cable to carry the device or to pull the PV panel or light from a location
13.	Keep the wires away from flames, heat, oil, sharp edges or moving parts.

- 14. Check for loose screws and tighten when needed
- 15. Make sure the power switch of the solar lantern is off before performing any inspection, maintenance, or cleaning procedure.

How much electricity can my pico solar system provide?

The average daily energy or duration of lighting, cellphone charging or USB power that is available from a pico solar device is dependent on three basic factors:

1. The size / capacity of the pico solar system
2. The solar charging per day – in terms of the weather conditions and duration of sunshine for charging
3. The total electricity per day is shared by the appliances used. For example, using cell phone charging reduces the hours of lighting per day.

Generation Capacity	Ave. Daily Electricity for Appliances	Typical Appliance Use
1 W	3 Wh/day	<ul style="list-style-type: none"> • 1 LED light of 1 watt for 3 hours per day
4 W	12 Wh/day	<ul style="list-style-type: none"> • 1 LED light of 1 watt for 4 hours per day • 1 cell phone for 3 hours per day
10 W	33 Wh/day	<ul style="list-style-type: none"> • 4 LED lights of 4 watts for 4 hours per day • 1 cell phone for 5 hours per day

What type of appliances can I use on my pico solar device?

It is important to know the types of appliances/equipment that can connect on these pico solar devices. Below are examples of these for a system up to 4 watts. The recommendation for a small fan (3W / 5 or 6 volts DC) can be compared with the energy requirements for cell phone charging.



What do I need to know when purchasing a pico solar device?

There are three main factors to consider when purchasing your pico solar device.

1. **Functionality** - what energy needs do I have to utilize and which device will be most suitable to meet those energy demands?
2. **Safety** - Is the product safe for usage?
3. **Quality** - Is the product durable for long term?

It is very important that your pico solar device has high quality standards and are certified or guaranteed for long term reliability. Quality standards are benchmarks that set baseline level of performance, safety, quality, durability and truth in advertisement to protect customers. Warranties are also added benefits. Here below is a summary of quality standards or attributes to look for on the infrastructure and packaging of the pico solar device.

Manufacturing Product Name & Model no.	<i>Accurately specified labelling</i>
Lumen Maintenance	<i>L90 time is greater than 2000 hours</i>
Wiring / Cable connectors	Appropriate thickness, length, coverage from the elements and miswiring protection is necessary to prevent early failure. The shorter cable facilitates faster charging of batteries. The user interface should be designed to minimize the likelihood of making improper connections.
Battery	Must be durable and adequate overcharge protection; preferably Lithium batteries with a fuse connected. Batteries may not contain mercury or cadmium, products are safe.
Warranty	Consumer-facing with at least one year of coverage on manufacturing defects under normal use.
Performance Information	Run time and brightness reported along with a note about the impact of auxiliary appliance use, such as mobile phone charging.

Source: Lighting Global Pico/PV Quality Standards, version 8.0 December 2018

Here are some examples of inadequate components versus high quality standards on a pico solar device:



Exposed wiring and electrical connectors that are easily breakable or damaged due to no strain relief support or protection against dust and moisture.



Adequate coverage with proper protection and strain relief that prevents the electrical connection from damaging or easily breaking



Thin and lengthy wiring causing easy breaking and longer time to charge batteries



Thick and high quality wiring to enable effective battery charging and to prevent easy damage

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How to troubleshoot your system

Issue	Causes	Solution
The light does not work	<ol style="list-style-type: none">1.Light not switched on2.Battery discharged3.Light broken	<ol style="list-style-type: none">1.Switch on the light2.Check the indicator lights for battery state of charge3.Replace light (if separate from the battery unit)

Issue	Causes	Solution
Battery only lasts a few hours	<ol style="list-style-type: none">1.Cloudy weather2.The solar panel could be dirty or in shade during the day3.Old batteries (after two or more years)	<ol style="list-style-type: none">1.Recharge the battery on sunny days2.Clean the solar panel. Move the panels so that it is not in shade.3.Charge the battery fully (at least once per month)4.Replace the system if required.



VeraSol

Quality Assurance for Modern Off-Grid Energy Solutions

For over a decade, Lighting Global Quality Assurance has operated as the foundational platform for the off-grid solar industry, serving as a critical and stabilizing force. By working with the sector to set quality standards, promote durable off-grid products, and adopt harmonized policies, Lighting Global Quality Assurance has instilled confidence in what was once a nascent and unproven industry.

On February 18, 2020, Lighting Global, CLASP, and the Schatz Energy Research Center launched VeraSol, an evolved quality assurance program that responds to the market's growing needs. VeraSol builds upon the strong foundation laid by Lighting Global, and expands its services to encompass appliances, productive uses, and component-based solar home systems. visit the website versol.org for more information.



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Information Resources

- **Energypedia** -
https://energypedia.info/wiki/Features_of_PicoPV_Systems
- **Caribbean Centre for Renewable Energy & Energy Efficiency** -
www.ccreee.org
- **United Nations SDG 7** -
<https://sdgs.un.org/goals/goal7>
- **EU Energy Community** -
www.energy-community.org
- **Solar Energy Industry Association**
- www.seia.org/initiatives/about-solar-energy
- **Belize Bureau of Standards** -
<https://bbs.gov.bz/>

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