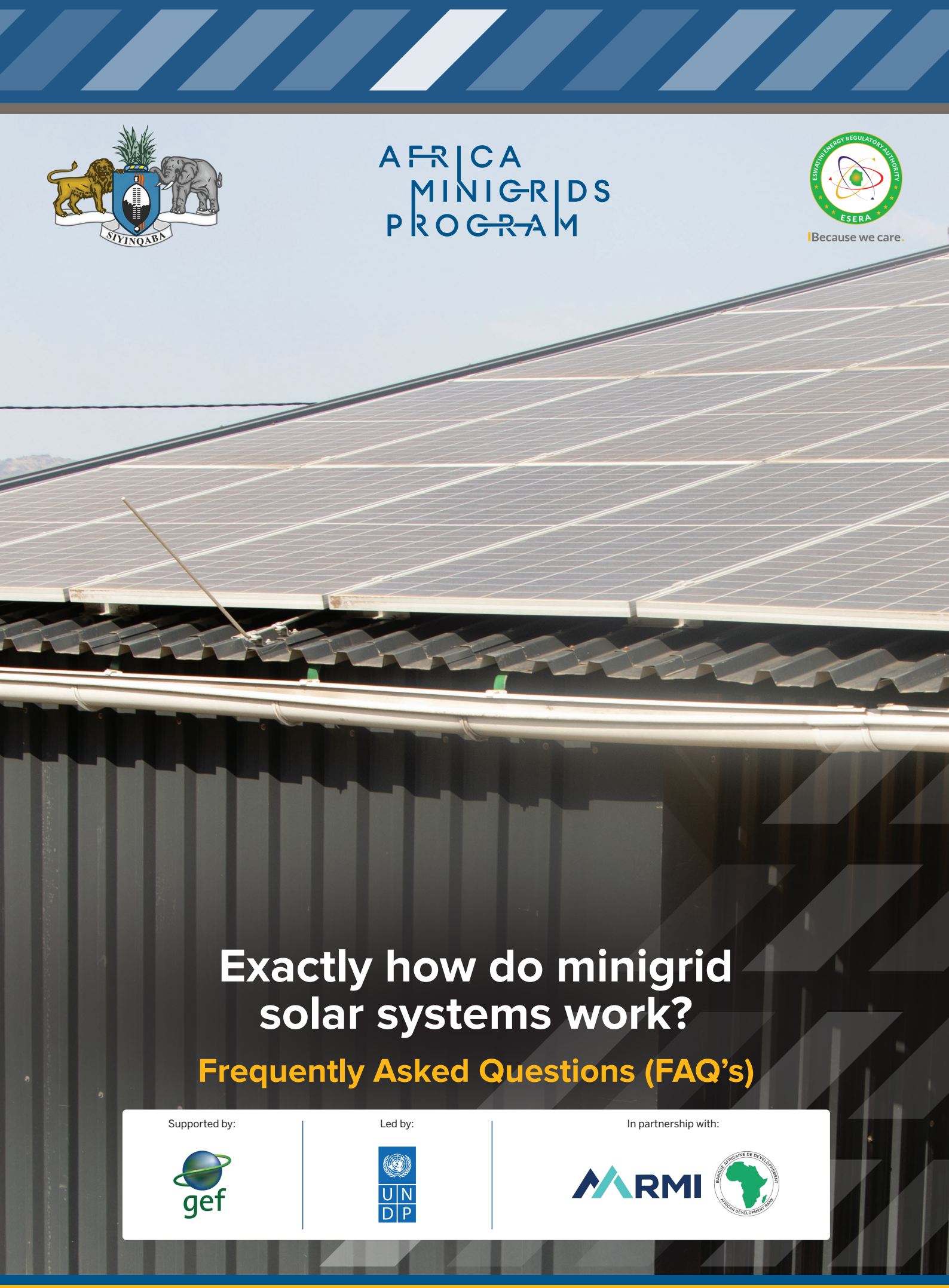


AFRICA MINIGRIDS PROGRAM

ESWATINI ENERGY REGULATORY AUTHORITY
ESERA
Because we care.

Exactly how do minigrid solar systems work?

Frequently Asked Questions (FAQ's)

Supported by: gef

Led by: UNDP

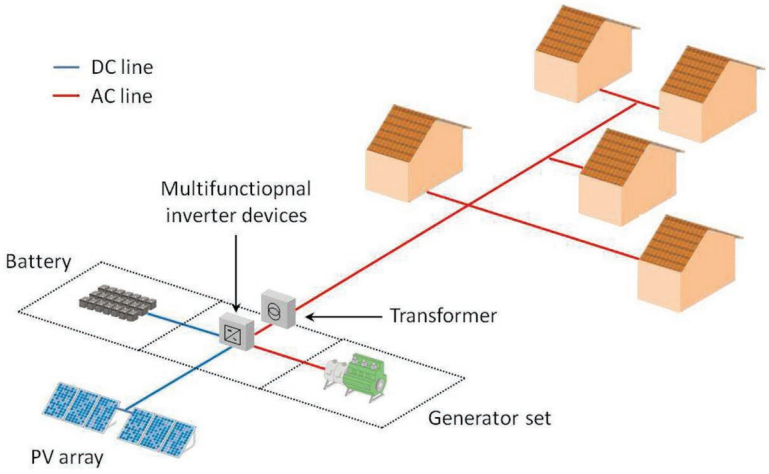
In partnership with: RMI, Banque Africaine de Développement / African Development Bank

What are off -grid minigrid solar systems?

Off-grid minigrid solar systems are power systems that have their own solar power generation source(s) and distribution infrastructure and are run and operated independently from the main electrical grid. Off-grid minigrid solar systems generally supply two or more customers with electricity.

How do off-grid minigrid solar systems work?

Off-grid minigrid solar systems generate electricity from solar panels and use it to charge solar batteries via a charger controller. The electricity generated from the panels and stored in batteries is then converted from direct current (DC) to alternating current (AC) using an inv.erter to power homes or businesses. Some off-grid mini-grids may have backup diesel generators for use in case of extended periods of insufficient sunshine to support generation from the solar PV system.



An example of an off-grid solar system

Typical off-grid solar systems use the following extra components apart from solar panels.

A solar charge controller: charges, regulates and limits the current rate being delivered to the battery bank to protect the batteries from overcharging.

A battery bank: which stores power for the solar system.

AC and DC safety disconnects: shut off or isolate the incoming flow of electrical power from solar panels to the inverter or battery bank as a safety measure in the event of a fire or electrical short circuit.

An off-grid inverter: allows for the conversion of DC power from a grid-isolated solar PV system to AC power.

A backup generator: (where available) supplements the solar PV system during extended periods of insufficient sunshine for power generation from the solar system and when the batteries have reached their allowable depth of discharge.

Can minigrids work throughout all weather conditions?

Solar panels provide peak efficiency on sunny days when they can receive plenty of sunshine without excessive heat or humidity. Other weather conditions such as cloud coverage known as inclement weather can reduce the amount of sunlight a solar panel can absorb for power generation. During such periods backup generators can thereby serve as extra energy sources that provide supplementary power.

Why does power from the minigrids switch off when there is cloudy weather?

Solar panels can work on cloudy and rainy days but not at their peak performance. This is because their efficiency depends on the level of sunshine (or irradiance) that they receive. However, in as much as clouds can block some of the sun's rays and reduce the irradiance, battery banks or backup generators can assist where available.

Solar panels can still produce 15% to 25% of their typical power capacity during cloudy days. This percentage can however vary, based on the cloud coverage level on different days and the overall efficiency of the solar panels. Hence, electricity production can intensify on cloudy days, due to the edge-of-the-cloud effect which occurs when cumulus clouds pass by the sun and their edges magnify

sunlight causing more powerful sunlight beams to reach solar panel surfaces.

However, this is often not the case on overcast days as solar panels might not produce electricity due to the thickness of the clouds which might be too thick on such days for sunlight to reach solar panels. Therefore, one way to check if your system is able to generate power on overcast days is to see if objects are casting shadows - where the absence of shadows indicates that

Source: *solar alliance.com*

How then can we ensure electricity generation during overcast days?

To ensure access to electricity at all times, off-grid solar systems require high-capacity storage through a battery bank or backup generators to provide energy where weather conditions compromise the power production levels from the solar panels for several consecutive days without sufficient sunshine.

Backup generators can operate on propane, gasoline, diesel, and many other fuel types. However, the most commonly used generators are diesel generators.

Hot temperatures and rain can also minimise the amount of solar energy that reaches solar panels whilst lightning can be very dangerous to a solar system. This is because when a lightning flash hits solar panels directly it can render a whole system useless by melting parts of the panels and damaging components in the system.

This can largely occur when a solar photovoltaic system is poorly grounded and poorly protected hence the importance of lightning protection to control the path of the lightning after it hits.

How are mini-grid tariffs determined?

The tariff design in mini-grids and off-grids systems is generally guided by Tariff Principles governing electricity pricing in any jurisdiction. These guidelines include Mini-Grid and Micro-Grid Guidelines developed by the ESERA , in determining a tariff for Mini grids projects such as Mvundla. However, a good balance between the Mini-Grid project's financial viability and consumer affordability needs to be considered in determining such tariffs whilst socioeconomic aspects should also be considered in the process.

Tariff principles

1. The average tariff for a Mini-Grid project will be determined as the total revenue requirement divided by the total number of kWh projected to be sold to Consumers in the licensed area in a specific year,

2. The total revenue requirement will be calculated as:

i. total operational expenditure,
ii. minus operational subsidies or grants, if any,
iii. plus, depreciation of capital expenditure,
iv. plus, interest expenses,
v. plus, taxes,
vi. plus, a reasonable return on equity that reflects risks faced by the Licensee,
vii. plus, fuel-cost component, where applicable as in the case of conventional fuel-based and biomass-based systems,
viii. minus, any income from additional sources of income and,
ix. any other cost approved by the Authority,

In the case of the Mvundla community, the Solar Minigrid project used expensive and newer technological components like battery storage systems, inverters and solar panels. In addition to the components used, a suitable steel structure was developed for mounting the solar panels and for housing the batteries, inverters and other critical electrical components. Moreover, grid electrical reticulation was put in place to distribute power to the households including overhead lights, street lighting and smart metering. A management system was also put in place to ensure that the battery and load management are in order.

The project in its entirety, taking into consideration maintenance costs, lack of subsidies and other income resulted in a high revenue requirement compared to the community's energy consumption (energy sales) as a result, the average tariff had to be high. However as stated in the guidelines for determining a tariff, there must be a balance between the projects' financial viability and the customer affordability element; the community members of Mvundla were charged the prevailing domestic tariff to ensure that the tariff is affordable for them and because this was a pilot project meant to assist both the utility and the Authority in learning about the Minigrids project other than profits. Otherwise based on the project's financial viability, the tariffs would have been over E4 per kWh.

What are the benefits of off-grid minigrids?

Minigrids ensure access to affordable, reliable, sustainable and modern energy for all especially in cases where it is deemed not feasible to extend the main grid. Renewable energy-based mini-grids also help increase the share of renewable energy in the Global Energy Mix.

Moreover, they help achieve gender equality by empowering women and girls and promoting inclusive and sustainable economic growth. Minigrids also promote the fulfilment of the UN Sustainable Development Goals in light of universal targets.

Rhus Office Park,
Karl Grant Street,
Mbabane, Eswatini

(+268) 2404 2103/ 8425/ 1439
info@esera.org.sz
www.esera.org.sz