Technology Factsheet

Developing Energy Enterprises Project East Africa (DEEP EA) provides start-up and growth support to energy-based enterprises in East Africa.

This is one of a series of factsheets that cover a key set of technologies that have real business potential in the region. In fact, around each, there are already many examples of entrepreneurs making successful businesses.

The factsheets are for entrepreneurs fresh to the technologies, who want objective and relevant information to meet their needs. They complement DEEP EA's programme of business and energy training and mentoring.

Solar charging PV station

1 Technology Basics

Solar photo-voltaic (PV) is a technology for converting energy from the sun into electricity. Read on for more details about using this technology as a business:

Applications

Solar charging is a viable business in most rural areas in East Africa, meeting markets such as:

- Mobile phone charging
- Car battery charging
- Lamp/lantern charging

Benefits

To a consumer, your charging station could offer the following benefits over existing charging services:

- **Convenience:** reduced distance to walk or travel to reach alternative charging services;
- **Cost-effectiveness:** solar PV running costs are low so the charging service could be less.

Components

The diagram in figure 1 below shows a typical Solar PV charging system. It is important to choose the equipment carefully, below is a description of what you need to know about each component:

Solar Panel

The panel generates electricity from the sun. The key things you need to consider when choosing a solar panel are:

- Rated electrical output power (Watts)
- Cost of the panel
- Reliability

There are three common types of panel;

1. **monocrystalline** (single crystal silicon cells);
2. **polycrystalline** and
3. **amorphous** (thin film cells).

They differ in price and efficiency; high efficiency means that for the same physical area of solar panel you get more electricity output as shown in table 1.

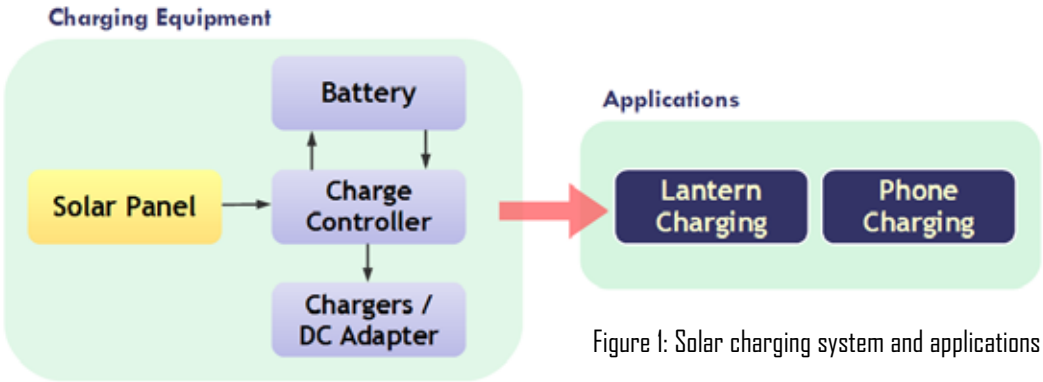

Figure 1: Solar charging system and applications

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Table 1: Panel comparison

Panel Type	Output Power (Efficiency)	Price
Mono crystalline	(11-14%)	Higher
Poly crystalline	(10-12%)	Medium
Amorphous	(6-8%)	Lower

Some popular brands in the market include: Kyocera, Unisolar and BP solar among others.

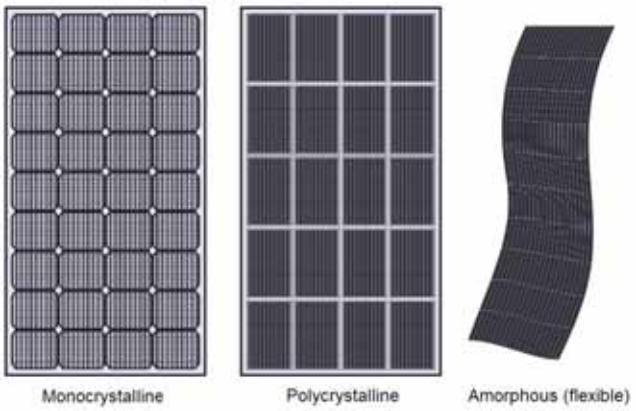

Figure 2: Solar panel types

Charge Controller

The charge controller regulates the flow of electric charge. It is essential to prevent damage to the battery.

Batteries must be protected from both:

1) **Overcharging,** which causes battery plate corrosion, gassing and loss of water, and
2) **Over discharge**, which can cause permanent damage to the battery or reduce the lifespan of the battery.

Figure 3: Types of charge controllers

When choosing a charge controller, some of the key things to consider are:

- **Rated power**, or size (Watts/Amps), matched to panels.
- **Display features** e.g. low battery voltage indicator or voltage/current readings.

Some of the popular brands include Stecca, Morning star and Phocos.

Battery

The battery provides energy storage so that you can still supply energy even when there is no sunlight and or during the night. A solar PV charging station should use solar batteries that can withstand deep discharges. There are two main types of batteries; 1) Lead acid and 2) Nickel-Cadmium (Ni-cad) batteries.

Things to consider:

- **Depth of discharge** (%), this should be specified on the battery label.
- **Cell life** (number of years)
- Whether the battery cells are **sealed or unsealed** (see maintenance below).

Table 2: Solar battery charecteristics

Type	Depth of discharge (%)	Cell life (years)	Cost
Lead acid			
Solar	50	5-10	Lower
Ni-cad			
Sealed	100	3-5	Higher
Unsealed	100	20	

N.B. Car batteries (though sometimes used) are not suitable as they do not withstand deep discharges.

Chargers

DC-to-DC chargers that convert the solar system voltage (usually 12V) to the required charging voltage (e.g. 4V) are readily available in the market. They are useful because they ensure the load is operating under the appropriate voltage levels.

Suppliers

It is important to procure solar PV equipment from reliable suppliers. Unfortunately many brands on the market do not meet minimum quality standards (such as Kenya Bureau of Standards KS 1673-1). Advice should be sought from the solar energy associations or national standard organisations. In addition, as a buyer you should insist on product warranty to cushion you from manufacturer's defects. Warranty is commonly given on charge controllers, batteries and solar panels.

2 From technology to business

Now you have got a feel for Solar PV and how to set up a charging station, the next step to take is how you could turn this into a viable business.

Why solar charging could work for you:

- Large and growing potential market
- Low ongoing operation and maintenance costs
- Clean and unobtrusive technology

Business Opportunities

In East Africa, where access to the national grid is very low, solar PV offers an alternative to kerosene, generator power or dry cells:

Charging of mobile phones
Many people in rural areas have mobile phones but are faced with the challenge of charging, often travelling for long distances to do it. Setting up a charging station can be both profitable and make life easier for those around you!

Charging LED lamps
Light Emitting Diode (LED) lamps are an appropriate alternative to kerosene in the rural households. You could provide charging facilities to those around who have them.

Leasing or Stocking LED lamps
An entrepreneur could own several LED lamps and offer them for use at a fee. For example, in a rural market place, LED lamps could help business people continue business after dark. The entrepreneur could also stock LED lamps for sale.

With a larger solar PV system, a solar PV charging station could be used for:

Providing ICT Services
A solar PV charging station could be integrated with a provider of Information and Communication Technology (ICT) services (e.g. internet, telecoms). There is high potential for rural ICT, still untapped in East Africa.

Investment

Table 3 indicates the investment that might be required to set up a mobile phone charging station. It is evident that the most expensive component is the solar panel. Prices are coming down, and it may also be possible to buy all components together from a stockist.

Table 3: Typical investment required for a mobile phone charging station

Equipment	Rating	Number of units	Cost (USD)
Solar panels	50 W	1	$290.00
Solar battery	75 Ah	1	$87.00
Charge controller	5 A	1	$67.00
Cables		20 m	$13.00
Switches		2	$7.00
Junction box		2	$7.00
Total			**$471.00**

3 Technical Pointers

The following should help an entrepreneur get started along with his or her solar charging business.

Estimating Demand

You will need to buy the right size of equipment, and the first step is to estimate demand; how much energy will you need per day? To do this, you need to follow these steps:

1. List all the appliances you might charge, and how many of each you would expect to charge every day [column 1 & 2 below]

2. Find out how much power (Watts) each charger requires, and for how long it must be plugged in [columns 3 & 4]

3. Multiply together to determine daily energy requirement (Watt-hours) [Column 5]

Table 4:Typical energy demand estimation

Item	Units to be charged (No. per day)	Charger power rating (W)	Time to fully charge (hrs)	Daily Energy Needed (Wh per day)
LED lamp	4	3	3	36
LED lamp	5	2	4	40
Mobile phone	15	1	2	30
Total				**106**

In the example above, the demand, or daily energy requirement is **106 Wh.**

Component Sizing

Now, what size of components do you need? A simple way to choose is to use a solar system design table as shown in table 5.

1. Estimate the daily energy demand as shown above (106 Wh)

2. Look down the column 1 and using the nearest value, read across the column to get the recommended size of the solar panel, battery size and charge controller:

Table 5: Solar PV system design table

Daily energy demand (Wh)	Panel current (Amps)	Panel Size needed (W)	Battery Storage Capacity needed (Ah)	Charge Controller Size needed (Amps)
40	0.8	14	26	5
60	1.2	20	40	5
80	1.6	30	50	5
100	2.0	40	65	5
120	2.4	45	75	5
140	2.8	50	100	5
160	3.2	50	100	5
180	3.6	65	100	5
200	4.0	65	100	10
220	4.4	75	130	10

In this example, you would need a **40W** panel, **65Ah** battery and **5A** charge controller.

Note:

The table is developed based on the following assumptions and therefore the specification could vary from one country to the other.

- 20% system loss
- 5 peak sunshine hours (**psh**)
- Battery with 50% allowable depth of discharge & 3 days charge storage (known as autonomous days)

Operation Considerations

Solar PV panel location

The solar panels could either be mounted permanently (fixed) or on a detachable stand (tracking – either manual or automated). The location and inclination of the panel should be able to get the sun all day. Shading of the solar panels will result in reduced or often no electricity being produced by the panel.

Battery location

A suitable site for the batteries should be found, taking into account:

- Ventilation of the fumes
- Mechanical protection of the battery
- Safe from interference – this is usually achieved by having a specially designed box with enough air circulation in it.

Charge controller

The controller should be located as close as possible though not directly above the battery (this is to avoid corrosion due to gases being emitted by the battery). It should be located at a position that is easy to read.

Charging board

The charging terminals should be positioned in a good location for access, but not too far from the battery to minimise voltage losses in the wires.

Maintenance Considerations

Battery

The battery will require regular maintenance. This comes in two ways: re-filling the distilled water in the battery and cleaning it.

- During normal operation the battery water level will gradually fall. You should keep the battery topped-up with distilled water to ensure it does not drop below the minimum level. The battery water level should be checked at least every 2 weeks.

Figure 4: Refilling the battery water

- The exterior of the battery should be washed at least once a month with plenty of water and then wiped with a dry cloth. This is to prevent accumulation of dust and moisture from electrolyte on the battery, which can lead to corrosion of the terminals and loss of energy from the battery.

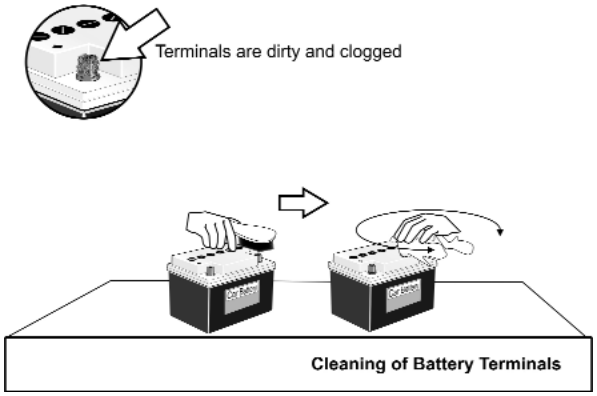

Figure 5: Cleaning battery terminals

Solar modules

The solar modules should be kept dust free as accumulated dust on the solar panel partially reduces the surface area of the panel exposed to the sun, which lowers performance. It is advisable to mount the solar panel on a detachable pole that can be erected in the morning and removed in the evening. The pole mount can even be made in such a way that the panels can be adjusted manually to face the direction of the sun.

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SECO Factsheet No. 24 Estimating PV System Size and Cost