Phone Charging Micro-businesses in Tanzania and Uganda

By Simon Collings

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DEEP East Africa — Developing Energy Enterprises Project

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The DEEP programme supports a range of micro energy businesses in Kenya, Uganda and Tanzania. It is co-financed by the European Union (under the EU Energy Facility) and the Dutch government whose support has been critical in this work.

TABLE OF CONTENTS

Summary 1

Chapter 1: Introduction 2

Chapter 2: Findings of the market challenges survey 6

Chapter 3: Follow up study on phone charging businesses 9

Chapter 4: The customers 16

Chapter 5: GSMA – models for phone charging in off-grid areas 19

Chapter 6: Conclusions 21

Appendix 1: Technology factsheet on phone charging station 22

Summary

GVEP manages a programme which supports micro-businesses engaged in servicing the energy needs of poor communities in Kenya, Tanzania and Uganda – Developing Energy Enterprises Project (DEEP). A significant cluster of businesses registered with the programme are charging mobile phones.

Mobile network operators in Africa identify rural customer's problems with charging phones as a major challenge in expanding their businesses. Recent studies suggest that the need to recharge phones is a significant driver of demand for rural electrification services.

The average turnover and rates of growth for the phone charging businesses in DEEP vary across the three countries where the programme operates. GVEP decided to investigate these businesses in more detail in order to better understand the market dynamics and the potential for growth and possibly diversification into sales of solar lanterns and lighting systems. The study also sought to understand the impact that the DEEP programme has had on these businesses.

The study built on the initial insights gleaned from a Marketing Challenges study carried out between February and April 2011. This study included a small sample of phone charging businesses. The follow up study involved interviewing a larger number of these businesses in Uganda and Tanzania.

The main findings of the research were:

- Phone charging is a highly viable economic activity where the grid is absent or where grid electricity is present but used by few people.
- The availability of a local charging service results in greater phone use and increased expenditure on airtime.
- Phone users report significant economic and social benefits from use of their phones.
- There is considerable unmet need and significant potential for phone charging micro-businesses to grow.
- The major constraint on growth is lack of access to funds for the purchase of additional panels and accessories.
- These businesses represent a viable, cost efficient and sustainable way of addressing the phone charging needs of off grid subscribers. Supporting the development of such businesses is likely to be more effective than other options currently being considered by mobile network operators.

Chapter 1: Introduction

Ninety-eight per cent of rural households in Tanzania lack access to electricity. The equivalent figure for Uganda is 96% and in Kenya 95% (International Energy Agency, *World Energy Outlook*, 2009 – data is from 2008.) Over the last decade the use of mobile phones in Africa has grown massively from 16 million users in 2000 to more than 500 million in 2011. Mobile penetration in major cities is approaching 100% but in rural areas penetration is closer to 30% because of the lack of mobile infrastructure.

Even where services are available, mobile phone use in off grid areas presents users with a huge challenge. Users travel many kilometres to charge their phones and often receive poor service from the charging station operator. The lack of accessible sources of electricity for recharging a phone is a huge constraint on use and denies many people the full benefits to be derived from a phone which include increased economic activity, banking services, information, and reduced travel time.

There is evidence that the demand for phone charging is the dominant driver of rural electrification. People can manage with kerosene lights and traditional cooking fuels but phones need electrical power to function. This need drives demand for access to electricity. In the solar lighting sector product developers have found that inclusion of a phone charging option significantly increases the attractiveness of the product.

Since March 2008 GVEP has been managing a programme called Developing Energy Enterprises Project (DEEP) which supports micro-businesses which service the energy needs of poor households in rural and peri-urban areas. The programme covers parts of Kenya, Uganda and Tanzania. Recruitment of entrepreneurs into the programme was undertaken without any preconceptions about the types of technologies to be supported. The programme was designed to support existing or start up businesses in existing markets rather than try to create a market for a new technology. The aim of the programme has been to strengthen the businesses practices of the participating entrepreneurs, aid them in accessing small loans, and to facilitate market linkages through information sharing and network building. At June 2011 there were 634 active businesses within the programme.

By far the largest cluster of businesses is concerned with Improved Cook Stoves (ICS.) The second largest cluster is phone charging businesses. As of June 2011 a total of 132 phone charging businesses were actively participating in the programme - 78 of them in Tanzania. Phone charging businesses are far more numerous than micro-dealers in solar lanterns or larger lighting systems. This may be a by-product of the particular recruitment methods used to attract participants in the programme, or it may reflect the wider reality on the ground.

Distributors of solar lighting products have generally found it difficult to establish networks of dealers and when local dealers have been established significant investment in local marketing seems to be required because of low levels of awareness of the products. A phone charging business on the other hand can be established with fairly modest initial investment and can be easily combined with other activity.

Given the relatively large number of phone charging businesses within the programme GVEP decided to study a sample of the enterprises and their customers in order to better understand the dynamics of the market. The largest business was in Kenya (monthly turnover $256 in March 2011) while the highest average monthly turnover was reported for Tanzania. Phone charging business in Tanzania showed limited growth over the previous twelve months while those in Uganda appeared to be growing fast.

The study was undertaken to better understand these trends, to assess the opportunities for growth, the barriers to growth and the potential for diversifying into other services, particularly the sale of solar PV lighting products. Because of the relatively small number of phone charging businesses in Kenya the interviews were confined to Uganda and Tanzania.

Figure 1: *Phones of customers being charged*

Table 1: *Data for phone charging businesses enrolled in the DEEP programme up to end June 2011.*

Country	No. businesses	Average monthly turnover June 2011 ($)	Average no. phones charged June 2011	Average cost per phone charged ($)	Growth since joining programme	Top performing businesses	Potential high performers
Tanzania	78	108	580	0.17	Limited growth over previous 12 months	Best earned revenues of $170 charging 900 phones. The top 20 businesses earned an average of $143 each charging around 780 phones.	3-4 show good growth potential
Uganda	26	62	220	0.25	Very strong rates of growth	Top three making $100-110 in revenues charging 400 phones.	3-4 show good growth potential
Kenya	28	44	320	0.25	Some show strong growth, but data missing for some	Top business had revenues of $256 charging 1000 phones, second largest $225 charging 900. Average is low because a large number of smaller businesses joined the programme Jan-March 2011	3 show good growth potential

This study built on an earlier piece of work which looked at the marketing challenges faced by a range of enterprise types involved in the DEEP programme. Between February and April a series of interviews were conducted with a small sample of entrepreneurs across a range of technologies with a view to understanding marketing practices and how these might be improved. The research sample included six phone charging businesses. The research and the main findings in relation to phone charging are summarised in the next chapter.

Building on this work interviews were conducted with a further 15 businesses – 3 in Uganda and 12 in Tanzania. Fourteen customers from 5 of the businesses were also interviewed. Details of the locations of the businesses, their customers and findings from the interviews are reported in Chapter 3.

Following completion of the field work the results and findings were shared with staff at the GSMA working on the Community Power from Mobile programme. Community Power from Mobile (CPM) works to leverage the scale of mobile technology and infrastructure to improve the case for off-grid telecoms and to provide the millions of underserved access to improved energy services. CPM explores various possible solutions for the challenge of charging phones in rural area, including the potential for using surplus power from off-grid phone masts to provide a local charging service. We believe the findings of our study have significant implications for the models being explored. These are discussed further in Chapter 4. The overall conclusions of the study are summarised in Chapter 5.

Figure 2: *"Welcome, phone charging" in Swahili, painted on his door, advertises the service provided by Edward Andrew.*

Chapter 2: Findings of the market challenges survey

During February and April 2011 research was undertaken to better understand the marketing practices and challenges faced by a range of energy micro-businesses involved in the DEEP programme. (See Laura Clough, *Marketing Challenges and Strategies for Micro and Small Energy Enterprises in East Africa*, GVEP International, 2011)

Six phone charging businesses were interviewed, two in Kenya, two in Uganda and two in Tanzania. Structured interviews were conducted in English, with an interpreter translating the questions and answers where necessary. The interpreter was usually the entrepreneurs business mentor so a trusted intermediary.

Table 2: *Phone businesses interviewed for the marketing challenges study.*

Country	Name of entrepreneur	Sex	Name of business	District	Area of operation	Baseline status - Startup (1); Existed (2)
Kenya	Salama Stephen Tsory	F	-	Kaloleni	Kaloleni-Mwisho wa barabara	1
Kenya	Constance Murima	F	Mafain Traders	Mombasa	Mishomoroni	1
Tanzania	Ruth Masenye	F	TRS Phone Charging Business	Misungwi	Ibongoya	2
Tanzania	Maria Charles	F	Maduhu Family	Kisesa	Igekemaja	1
Uganda	Ssenette Musisi Nakibimge	M	-	Lutisi	-	2
Uganda	Latima Kayiza	M	Ajja Yajja Phone Charging	Luwero	Besoke	2

Key findings from the interviews were as follows:

- Average charge seems to be 20 US cents which appears standard across the region. One respondent actually described this as a 'fixed rate'. This is consistent with the unit costs recorded in the monthly tracking of the phone charging businesses in the DEEP programme. There appears to be an informal agreement amongst phone charging businesses that this is the rate. Price competition does not seem to exist.

- Customers charge their phone on average 3 times a week. A few customers have more than one phone. This suggests that the charging businesses in Tanzania are on average servicing around 180 customers each, businesses in Kenya serve around 100 customers on average and in Uganda around 70.

- The phone charging services reported lots of competition - two of the six said they had more than 7 competitors (highest level.) One business, in the Coastal region of Kenya, re-located to an off-grid area after the grid arrived in the location where the entrepreneur originally established operations. (Note: the more extensive study of phone charging businesses carried out subsequently did not find evidence of intense competition – see next chapter.)

- The biggest reported challenges were lack of adequate equipment to meet demand (because of limited access to funds), and marketing (making customers aware of the service.)

- There appears to be scope to expand into other phone accessories and possibly solar lanterns. One of the interviewees had tried renting out lanterns for a while (see *Case Study 1*)

Marketing is a key component in creating growth in micro and small energy businesses and entrepreneurs in the DEEP programme are encouraged to focus on this activity. Many entrepreneurs rely on local households as their main source of customers and can face a lot of competition within the local area. They may feel limited in the markets they can access because of their business location, available stock and finances.

Customer loyalty is low within the energy market in East Africa, with customers tending to buy from whichever business is closest or has the product available. The marketing study found that entrepreneurs are engaging in a range of promotional techniques for their business, with word of mouth a widely used tool. Advertising opportunities may arise from contacts within local organisations and government departments and material provided by product suppliers or organisations such as GVEP.

Many entrepreneurs perceive lack of finance as a hindrance to their marketing and business growth yet there is a lot which can be done with quality, price, placement and promotion within existing business resources.

For entrepreneurs involved in phone and battery charging the price of the service is fairly fixed with little variation and price reduction doesn't seem to be acceptable as a marketing approach. Far more significant is location. Entrepreneurs need to be located within 5 km of their customers – the nearer they are to a large pool of potential customers the better, e.g. in a trading centre.

Many entrepreneurs rely on word of mouth to promote their businesses in the local community. Entrepreneurs involved in phone charging can publicise the availability of the service through use of signboards, leaflets, and announcements. They can also expand by targeting nearby communities where this service is not available.

Case Study 1 - Ruth Masenye

Like most rural villages in Tanzania, Iborigoya has no electricity and people must cycle or walk for two hours to reach the nearest town if they wish to charge their cell phones or watch TV. Concerned by the cost of charging her phone, Ruth Masenye decided to find an alternative option and after saving her money, she bought a solar home system to set up her own mobile charging business. She soon had a steady supply of customers but Ruth was keen to improve her business further and after undergoing DEEP entrepreneurship skills training, she has expanding her solar PV system size as well as improving tremendously on how she runs her business. Ruth learnt the key principles of running a business – how to manage finances, make a profit, advertise and keep business records of each transaction and adoption of new marketing strategies through DEEP support. The training helped Ruth realise the need to expand and strengthen her business. To do this she purchased two more solar panels to double capacity from 28 Wp to 56 Wp.

Ruth's revenue from phone charging was US$23 a month when she joined DEEP. Now she earns up to TZS 140,000 per month from solar phone charging (US$86.) Her business is stable and has potential to grow but the capacity of the panel is not enough to serve all customers. With a robust business plan in place she has applied for the loan of TZS 2,000,000 to buy bigger solar panel (100 Wp.)

GVEP is providing a loan guarantee of 70%. Ruth experimented with renting D-Light Nova lanterns for a while – charging the lanterns for her customers. After a few months she tried to sell the used lights to buy new ones to rent. Unfortunately Ruth found her customers did not treat the lights well-meaning the batteries became weakened and it was difficult for her to sell the lights to others. She has given up the renting of lights.

Chapter 3: Follow up study on phone charging businesses

In July 2011 interviews were conducted with 15 phone charging businesses (3 in Uganda and 12 in Tanzania.) Only one of these businesses featured in the marketing challenges study – Maria Charles' business in Tanzania.

This was a qualitative study designed to generate insights into the businesses. Interviews were conducted in English, with local staff acting as interpreters when the entrepreneur and their customers did not speak English. This methodology was chosen because it provided a way of exploring in some depth the experiences of the entrepreneurs and customers. The entrepreneurs were not selected on a random basis. They came from a small number of locations in areas where the DEEP programme is active. The study focused mainly on Tanzania where the largest number of enterprises is located. Businesses in Kenya were not interviewed because most are relatively recent recruits to the programme.

The interviewees were predominantly male, reflective of the fact that most of the phone charging businesses within DEEP are run by men. In Tanzania 84% of the entrepreneurs providing phone charging are male. All of the businesses in Tanzania were in the Mwanza region which has benefitted from a number of donor programmes supporting the development of solar PV. Mwanza is also the base of Zara Solar, the largest distributor of solar products in Tanzania. The Ugandan entrepreneurs were located a few hours drive north of Kampala and were able to source equipment and technical support relatively easily in the capital.

Table 3: *Details of phone charging businesses interviewed.*

Name of Entrepreneur	Location	M/F	Start-up (1) or Existing business (2)
Kiggundu Michael	Busoke District, Uganda	M	2
Kayiza Latima	Busoke District, Uganda	M	1
Vincent Nakibinge Sedeti	Lutisi, Uganda	M	2
Mpanduji Mahanda	Isesa, Tanzania	M	2
Frank Gilbert	Mahina, Tanzania	M	2
Maria Charles	Kisesa, Tanzania	F	1
Edward Andrew	Kabangaja, Tanzania	M	2
Peter Kassemala	Kabangaja, Tanzania	M	2
David Fanuel	Kisesa, Tanzania	M	2
Emmanuel Josiah	Mbarika, Tanzania	M	2
Jumanne Maganda	Mbarika, Tanzania	F	2
Godi Chansi	Mbarika, Tanzania	M	2
Elias Robert	Nyamayinza, Tanzania	M	2
Danga Leonard	Hungumwala, Tanzania	M	2
Godfrey Damian	Hungumwala, Tanzania	M	2

Specific factors linked to the local context may influence the results observed in the study. Caution needs to be exercised in generalising from the specific findings from such a limited sample. However, the interview material provides some useful pointers for future directions, especially given the high level of consistency across the sample.

The majority of the phone charging businesses visited use solar PV panels, a charge controller and battery to provide power. In two cases the entrepreneur was using a battery which was recharged every few days from a charging station using grid electricity. Both of these entrepreneurs had purchased solar panels but these had been stolen before they could be installed. In one case the business owner was using grid supply, with an inverter and battery providing back up when the grid was down.

The businesses were operated either from people's homes or from small stores or phone charging kiosks. Security was a paramount concern. Those working from home often had the equipment installed in the bedroom. The stores and kiosks charged phones under the counter or on shelves at the back of the shop to prevent theft.

Most of the entrepreneurs had started phone charging activities before joining DEEP. Only two were start ups. All of the entrepreneurs were involved in other business activity including agriculture, chicken rearing, grain milling, running a small store, installing of solar equipment, and screening movies and Champions League football on a TV. Those who ran grocery stores said the phone charging was more profitable than the store.

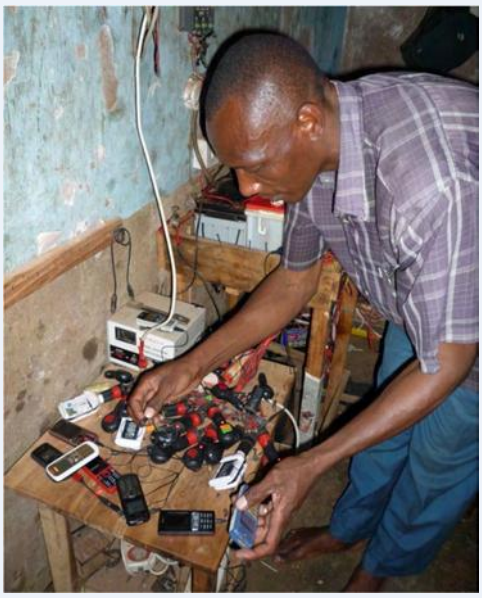
Phone charging is a highly profitable activity. On average businesses in Tanzania are charging 19-20 phones a day and in Uganda 7-8 phone a day. The strongest businesses in Tanzania charge as many as 40 phones on a busy day and in Uganda over 30 in a day. A business charging 20 phones a day (600 phones a month) at 17 US cents a go earns revenues of USD100 a month. The size of system required to service this level of business costs around $480 (excluding installation) meaning the business can pay for itself in 5 months. Provided the system is of good quality, is correctly installed and is used properly it should require minimal maintenance. Once the system is paid for the business has virtually no costs. In addition to charging phones the entrepreneurs operating from their home also used the solar PV system for lighting and TV.

Even for those using a battery which they take to a charging station reported considerable levels of profitability. In Tanzania the standard fee for charging a battery is TZS 1000 (US$ 0.62.) This provides sufficient power to generate revenues of around TZS 30,000 (US$ 18.60.) Batteries are charged every 3 days usually involving a cycle ride of 10-15 kilometres to the nearest grid connected trading centre. The entrepreneur using the grid (in Tanzania) paid TZS 40,000 (US$ 25) a month for electricity and reported monthly earnings of TZS 260,000 (US$ 160) from a combination of phone and battery charging.

Typical equipment used:

- Systems range considerably in size from 6Wp to 320Wp. Average size is 50-80 Wp. Larger systems were built up in stages by adding more panels. The person who had tried to get started with a 6Wp system was struggling – frustrated by inability to service demand.
- Systems were sourced from dealers in Kampala (for Uganda) and Mwanza (for Tanzania.) Davis and Shirtliff were mentioned in Uganda. Zara was the biggest supplier in Mwanza but Solar Planet, BEMA and Mukesh were also mentioned.
- Installations are generally performed by trained technicians but in a few cases by the owner himself.
- In almost all cases the systems were paid for out of the owners' savings or with support from other family members. Only one entrepreneur had taken a loan from a bank.

Case Study 2 – Emmanuel Josiah



Emmanuel Josiah used to be a cotton farmer. He set up his phone charging business in the trading centre at Mbarika in 2009 using his own savings to buy an 80Wp panel, charge controller and battery. The system was installed at his home by a trained technician. The equipment was bought from Zara Solar in Mwanza. He soon had more customers than he could service and added two more panels of 43Wp each using profits from the business.

He advertises the service at a small shop in the central market area which his wife manages and through 'word of mouth'. The charging facility is located in the family bedroom which Emmanuel considers more secure than the sitting room where the phones could be at risk of being stolen. He charges around 280 phones a week. The phone charging business he says is much more profitable than the store.

Mbarika, close to the southern shore of Lake Victoria is 115 km from Mwanza and far from the national grid. People come from within a 5 km radius to have their phones charged. He has two 'competitors' in the trading centre – both operating from their homes but on a smaller scale. The DEEP programme gave him confidence in the potential of the business to expand. He also learned customer care skills which he has applied in the business.

Before Emmanuel set up in business people charged their phones at the local phone mast where illegal operators tapped the power of the generator to provide a service. The cost of this service was TZS 500 per charge (considerably more than the TZS 300 normally charged by service providers in Tanzania.) It was also insecure as phones were lost or damaged when operatives from the telecoms company turned up. This illegal operation has died out since Emmanuel started his business. He plans to buy another 80Wp system and set up a charging station next to the family shop where he also plans to stock solar lanterns.

Experiences from other players

In the course of compiling this report we spoke with two social enterprises which shared results with us for phone charging businesses they are working with.

Tough Stuff has recently entered into a partnership with the Kenyan microfinance organisation Faulu to provide a phone charging business in a box. The entrepreneur gets a kit comprising 10 x 1.5Wp panels and connectors for 10 phones. Tough Stuff estimate entrepreneurs using the kit should be able to charge 20 phones a day. The package costs KES 15,000 (USD 160.) No battery is involved meaning phones can only be charged when the sun is shining but the kit should pay for itself in 1-2 months.

The US based company Fenix International has developed a battery box which can be charged using a variety of means – a grid connection, solar panel or using a stationary bicycle. Phone charging is one possible use of the ReadySet and Fenix reports that a number of entrepreneurs in Uganda are using the product in this way. These businesses apparently charge around 7-8 phones a day. Assuming a charge of US 20 cents per charge, revenue would equate to USD 42-48 a month. The system retails for $145-190 depending on the charging options used. The business should therefore cover investment costs within 3-4 months.

Other similar products exist or are in development. London based BBOXX's range of products are capable of charging similar numbers of phones. Other companies with battery box technologies are currently exploring the market and Nuru Lights in Rwanda is reportedly developing a phone charging application.

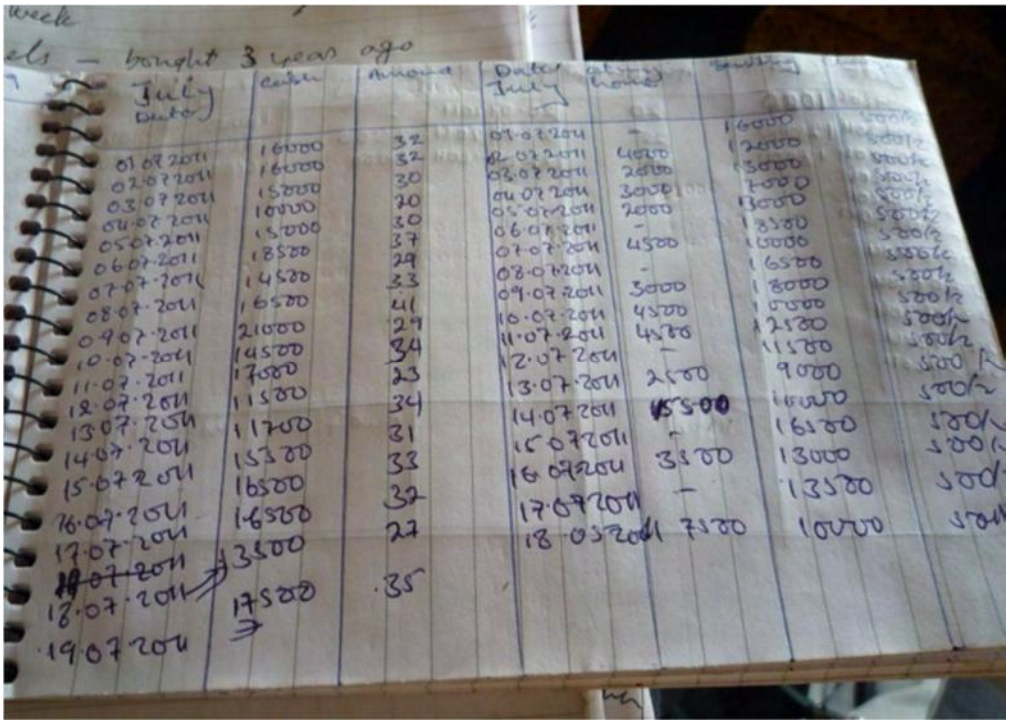


Figure 3: *Record book of Kiggundu Michael: third column from the left shows the number of phones charged each day*

The capacity of these products may be sufficient for a business to get started but entrepreneurs will need to be able to add capacity easily as demand grows. Also many people who charge phones from their home require a system large enough to also power lights, radio and TV. There would appear to be scope to reduce the costs of providing a charging service and the development of these products could help in making the business more profitable.

Case Study 3 – Mpanduji Mhanda

Isesa is an isolated Tanzanian community of 3000 scattered inhabitants with no access to the national electricity grid. The nearest town is 60km away. Mpanduji Mhanda is the owner of a home-run solar phone charging business, which serves part of the community. He also owns a solar powered hairdressing salon and a video shop which doubles up as a pop-up cinema, where he screens films using solar power.

He began his business with a 50Wp solar system - bought with a loan borrowed from National Micro-Finance Bank (NMB) for 3 million shillings (US$1,850) – 1 million was for construction of the shop. He will terminate repayment next year. Initially his business consisted of purely phone-charging but he has now saved up money to add 2 new 80Wp panels, which he uses to run the other business.

GVEP has provided Mpanduji with vital training on technology, business management skills, marketing, and customer care. Before this, Mpanduji would run his business without keeping records. However he now jots down information into one of his record books. “I take notes on expenditure and income”, he explains. “I have also created signposts to promote my business and to build customer awareness”.

Mpanduji has an average of 15 customers per day and charges TZS 300 per phone. This provides him with a stable income of about US$85 per month, which he reinvests back into his lucrative activities. He’s planning to build a phone charging shop, for example, on the main road to attract new customers who happen to pass by.

To further expand and diversify his business, he plans to begin a solar lantern rental scheme, as well as to sell other products including solar panels, batteries, inverters and charger controls. He experimented for a while selling D-Light Solata lanterns. Despite limited marketing he was able to sell around 4 lights a month. He sees huge potential in customers from the local mine as well as health workers and teachers. For these, he estimates a net profit of TZS 80,000 (US$50) per solar home system, which he can use for more extravagant family needs and to expand his business even further.

GVEP can help him to achieve his dreams by acting as a loan guarantor with Small Industries Development Organisation (a micro-finance provider) – where his most recent loan application is now being processed.

Potential for growth

Interviewees reported a number of significant impacts from the DEEP programme. Perhaps the biggest impact was the shift in mindset from phone charging being a fairly casual activity to a realisation of the potential of the activity to be a significant revenue earner. This often came about as a result of the entrepreneurs learning basic record keeping and through working on business plans.

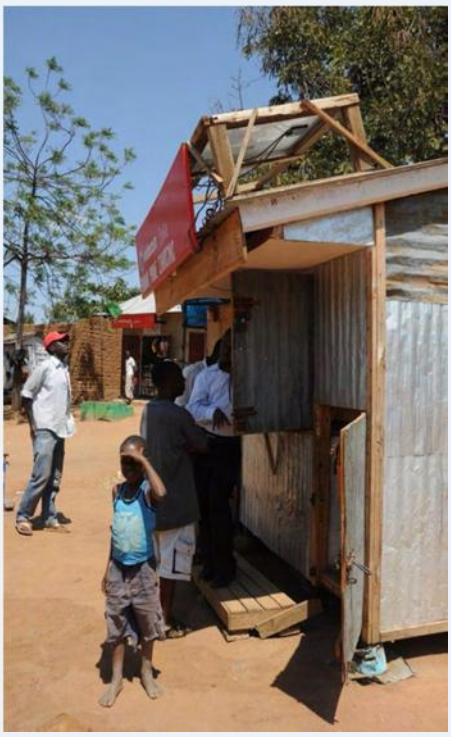
The heightened awareness of the profitability of the activity gave many entrepreneurs the confidence to approach financial institutions for a loan, something they would not have done on their own. GVEP's help in facilitating access to finance has been welcomed though the process of getting lenders on board has been frustratingly slow.

The other clear area of impact was in improved standards of 'customer care' through proper organisation, security, providing of 'full charge' as opposed to only partially charging a phone, and friendly service. Marketing activity was less developed though the majority of businesses seemed to be operating at full capacity so did not actually need to generate more business.

There is clearly considerable potential for growth.

- Most of the businesses operated seven days a week and close to technical capacity.
- In all cases there were more customers than could be serviced. Almost all of the entrepreneurs spoken to wanted to buy another panel to expand their service. Most were contemplating taking a loan to do this.
- Some charging businesses had no immediate competitor (nearest service >3km). The majority had 1-3 competitors offering similar services in the immediate vicinity.
- None of the entrepreneurs reported major concerns about competition. Demand is so high there appears to be room for all these businesses to grow.
- A few businesses already provide complementary services, e.g. charging batteries. Most saw potential for selling solar lanterns as a business opportunity.

Case Study 4 - Frank Gilbert



Frank Gilbert lives in Mahina, a new rural settlement not too far from Mwanza in Tanzania, but with no access to the national electricity grid. Like other villagers, Frank used to travel 12km to reach an electricity point to charge his mobile phone. This was costly and time-consuming.

Frank saw an opportunity to make a business out of the lack of electricity so he hired a room and bought a battery, which enabled him to charge 15-20 phones per day charging TZS 300 per phone. Following his recruitment into GVEP's Developing Energy Enterprises Project (DEEP), he decided to invest his savings into a 65Wp solar panel and all the equipment necessary to expand his phone charging business. The number of customers he could serve quickly doubled and he was soon able to charge up to 50 phones per day with a net income of around US$150 per month. This has numerous benefits for him personally, as well as the rest of the community. He now owns a shop in the middle of Mahina's commercial hub and has plans for expanding further.

DEEP training provided him with the technical expertise, and knowledge of marketing and customer care. He now promotes his business with a written sign at the top of his shop, and has also planned promotions using other written material like leaflets. This is far more effective than just advertising by word of mouth. He has also learned about record keeping: vital to the success of the business. These records help him to ensure he does not spend more than the business earns, and also helps him to manage the business because he can see how much profit he is making.

Due to an increased customer demand, Frank applied for a loan for a larger system (80Wp) and accessories, costing 1 million TSH (about US$620). GVEP is currently helping Frank with a loan guarantee to secure the loan with a local bank. This intervention is crucial in making sure that his business grows: without access to adequate finance it would not otherwise have been possible.

His future plans are to diversify the business by opening up a barber shop using solar technology and would also like another solar panel for a second phone-charging kiosk. "I am only 20", he says, "but by the time I am 25 I hope to be a big businessman with a big family!"

Chapter 4: The customers

Fourteen customers of 5 separate businesses were interviewed to understand the impact of the charging service on people's daily lives. Details of those interviewed are provided in the table below.

Table 4: **Details of customers interviewed.**

Name	Sex	Location	Occupation	No. times phone charged per week	Weekly spend on airtime (US$)	Phone charging service provider
Sylivia	F	Lutisi, Uganda	Housewife, husband 'not a farmer'	2	0.90	Vincent Sedeti
Agnes	F	Lutisi, Uganda	Teacher, single mother	2	0.90	Vincent Sedeti
Kyarisiima	F	Lutisi, Uganda	Single woman	2	0.90	Vincent Sedeti
Veronica	F	Lutisi, Uganda	Farmer	n/a	n/a	Vincent Sedeti
Nyinitunyo	M	Lutisi, Uganda	Farmer	4	9.00	Vincent Sedeti
Moses	M	Besoke, Uganda	Cultivator	n/a	1.80	Michael Kiggundu
Jimmy	M	Besoke, Uganda	Cultivator	3	0.18	Michael Kiggundu
Saul	M	Besoke, Uganda	Councillor/farmer	2	6.00	Michael Kiggundu
Steven	M	Besoke, Uganda	Student	1	9.00	Michael Kiggundu
Lucas	M	Mahina, Tanzania	Unknown	3	n/a	Mpandji Mhanda
Bagdella	M	Isesa, Tanzania	Cultivator	2	n/a	Frank Gilbert
Rashid	M	Mbarika, Tanzania	Farmer	2	3.70	Emmanuel Josiah
Elias	M	Mbarika, Tanzania	Mason	2	4.33	Emmanuel Josiah
Musa	M	Mbarika, Tanzania	Bus owner/driver	2	3.09	Emmanuel Josiah

Note: *Respondents described themselves as cultivators if they were only involved in growing crops and farmers if they also reared animals. The frequency with which people charged their phone related mainly to the strength of the battery in the phone. Some customers used more than one network – through having several SIM cards. This is common practice because of the variable coverage in rural areas. In a few cases people had airtime bought for them by relatives and did not know exactly how much airtime they used a week.*

An obvious benefit of having a local service was the saving of considerable amounts of time and money. The customers interviewed all lived within 3 km of the service provider. Previously they had travelled considerable distances (typically 7-15km) to charge a phone, often at some expense. One customer reported spending UGX 6000 (US$2.20) a week on transport to charge her phone – money she now spends on airtime.

Customers appreciated the higher quality of service – reduced risk of theft or damage, 'full charging' of the phone, and friendly service. Some customers benefited from being able to charge their phone on credit when funds were short. Because the person providing the services and the customers know each other well, strong relationships of trust were evident.

Customer Case Study 1

Agnes is a neighbour of Vincent Sedeti, and one of his phone-charging customers. Before she heard about the business, she was charging her phone in Namayumba, 4km away, once a week. The charging cost was 20 US cents, but she would spend an extra couple of dollars traveling there. "I was limited to going at the weekend when I was not working", she explains. Now she saves money and time. She can focus on her teaching and conveniently send the children to charge the phones whenever it is necessary. Vincent she says "treats us well.

Veronica is another of Vincent's customers. She is a peasant farmer who owns a goat and a pig and has 6 children to look after. She lives half a mile from the shop but heard about the phone-charging business when Vincent came to her house. Before she was charging her phone in Namayumba which is 4km away from her, and had to walk, cycle or take public transport. Charging a phone would take a whole day due to travelling and queuing. Now she has an extra day free to hand with which she can look after the animals and children, and is saving US$2 each week.

Customer Case Study 2

Steven is a customer of Michael Kiggundu's. He recently finished school and is waiting to attend university. Michael's charging business is a 'life line' enabling Steven to keep in touch with friends over the vacation and to earn money acting as a rep for a property rental company. Steven has two phones, one internet enabled. He chats with friends on Facebook and also uses the web for his business activities.

All customers reported using the phone more now that it was easy and convenient to recharge the battery though precise figures on increased use were difficult to obtain. Men reported using more airtime than women because they were involved in a wider range of business activity. The amount of airtime consumed varied very considerably - from 20 cents to $9 a week. The average was somewhere around $4 a week.

Regularly charged phones bring economic benefits for farmers and small businesses. Most of the male customers interviewed were involved in growing crops and raising livestock. They used the phone to contact customers and to manage their businesses. A farmer in Wakiso had a poultry business in Kampala and used the phone to check when feed was required (he supplied this from his farm.) Another customer was a mason. The local charging service meant he kept his phone on all the time. This enabled him to secure more work.

Another customer was acting as an agent for a property rental company while waiting to go to university. He had two phones: - one internet enabled which he used to connect with his friends on Facebook. The female customers described using the phone mainly for social and family calls. This saved them time as they did not need to visit family members so often.

Customer Case Study 3

Musa is a customer of Emmanuel Josiah's phone charging business in Mbarika, Tanzania. He is the owner/driver of a small bus which he hires out. Customers contact him through his phone. With access to a phone charging service his business has improved. Being able to recharge the battery means he can have the phone on all the time and is more accessible. "Even at home people call me," he said. Previously Musa relied on the illegal operation at the local phone mast on a hill 2 kilometres away. Loss or theft of his phone was a constant worry. He thinks the service provided by Emmanuel is "good compared to most."

Customer Case Study 4

Bagdella is one of Mpanduji Mhanda's regular phone-charging customers in Isesa, Tanzania. Bagdella used to cycle to a semi-constructed hydro-electric plant, seven miles away where he would illegally tap the energy to charge his mobile phone. This would take up the majority of the day twice weekly.

Now he can use the time he is saving with his family or for agricultural activities, as it only takes a minute to travel to the shop. He has also realised the benefits of solar power and has bought his own panel with his earnings. He can now use his mobile phones more often. "I have bought 3 phones for the members of my family" he smiles.

Chapter 5: GSMA – models for phone charging in off-grid areas

In July 2011 the GSM Association (an umbrella organisation for mobile network operators) published a report: Green Power for Mobile - Charging Choices 2011. The report highlights the disparity between rapid growth in the number of mobile subscribers in Africa and South Asia and the slow pace of rural electrification in these parts of the world. The GSMA emphasises the unique position of mobile network operators to work with vendors and rural communities to enhance the efficiency and affordability of energy access improving their relationships with off-grid customers.

Currently subscribers in off-grid areas in Africa rely predominantly on charging shops in towns – meaning long journeys and significant expense in order to charge a phone. Travel costs associated with charging the phone can make up almost 50% of a person's expenditure of their phone.

A 2009 Digicel study[1] in Haiti saw the average airtime used per off -grid subscriber increase 10-14% when the subscriber was able to regularly charge their phone. More recently, a similar uplift in airtime sales was observed in a separate trial by a private company field testing a product in Uganda in conjunction with one of the mobile networks. The GSMA estimates the incremental opportunity this presents in Africa is US$1.33 bn.

Potential solutions:

Mobile network operators are looking at a number of potential solutions. Solar handsets are becoming more widespread but face significant barriers because of cost, availability and risk of theft (as they have to be left in the sun to charge for several hours.)

External solar chargers and lanterns with a phone charging facility might in time provide a solution but again these products are not widely available - are relatively expensive and are not yet performing to a reliable standard. Some NGOs are involved in trying to spread the use of solar lanterns as this report notes.

Energy storage devises in the market could potentially represent a cheaper way for local entrepreneurs to start a phone charging business. Fenix's ReadySet battery box, featured in the report is according to the manufacturer- capable of charging 10 phones in a day. The battery can be recharged using a cycle as well as with a solar panel or grid connection.

[1] http://gsmworld.com/documents/gpfm_report_09_annual_review.pdf

The GSMA has been exploring the idea of using surplus power from mobile masts in off grid areas to provide community's access to energy services including charging services. Safaricom in Kenya has piloted this model in 30 communities with their most extensive sites also supporting mini-grid systems for community lighting. While this approach works in areas where the masts are located near the community this solution is difficult to scale considering the relative scarcity of masts and location.

In the areas of Tanzania and Uganda visited for this study masts in off grid areas were few and they are sited on hills to maximise coverage such that they were not conveniently located for providing a phone charging service. In one location visited a service had operated illegally from a local mast but this activity died out when legitimate businesses started offering services in closer proximity to the community.

In contrast with the options reviewed above supporting local entrepreneurs to provide charging services using solar PV equipment appears to be the better option. These businesses need training, and assistance with accessing loans, but once they are up and running they are self sustaining. In addition the businesses generate revenue for local residents which in turn benefit the local economy.

GVEP believes that the approach taken in the DEEP programme of developing phone charging micro-businesses represents a model which can easily be replicated elsewhere in Africa.

Chapter 6: Conclusions

Phone charging is a highly viable economic activity in rural Africa where the grid is absent or where grid electricity is present but used by few people. All of the micro-businesses (save one) interviewed in this report were earning significant revenue from the activity.

The availability of a local charging service results in greater phone use and increased expenditure on airtime according to the customers interviewed. This was difficult to quantify but many customers seemed to be saving significant amounts of money in reduced travel expense so claims that they use their phones more is plausible.

Phone users report significant economic and social benefits from use of their phones. Most of the customers interviewed were involved in some sort of income earning activity. Farmers use their phones to negotiate with potential customers, for providers of professional service the phone is the main way customers find them. People use the phone to keep track of family members, to move money, and to exchange information.

There is considerable unmet need and significant potential for phone charging micro-businesses to grow. All of the entrepreneurs reported demand for their services and most were planning to invest in additional equipment to enable them to expand. The major constraint on growth is lack of access to funds for the purchase of additional panels and accessories.

GVEPs training programme played a key role in enabling these entrepreneurs to appreciate the opportunities open to them. Training in record keeping, basic business practice, business planning, and customer service all contributed to the growth of these micro-enterprises. Through its loan guarantee fund GVEP was also able to assist business owners in accessing loans for expansion.

There may be scope to lower the costs of running these businesses through the evolution of ‘battery box’ type products entering the market.

Local phone charging businesses, if properly established and well managed; represent a viable, cost efficient and sustainable way of addressing the phone charging needs of off grid subscribers. Supporting the development of such businesses is likely to be more effective than other options currently being considered by mobile network operators.

Appendix 1: Technology factsheet on phone charging station

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.

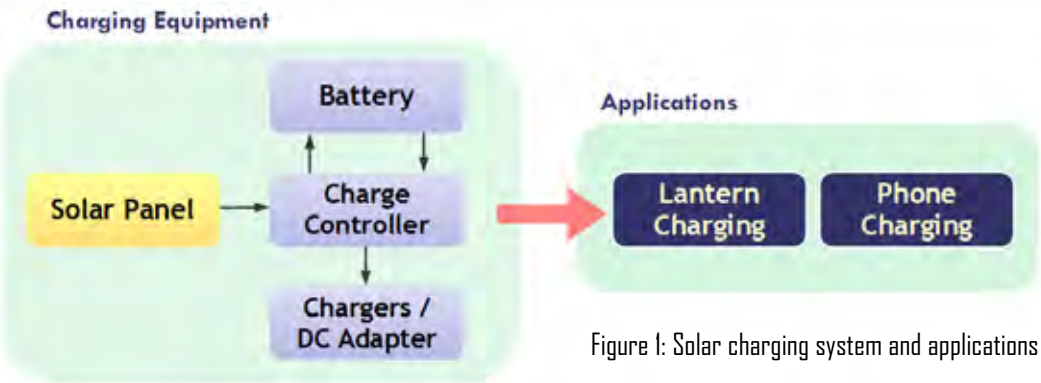


Figure 1: Solar charging system and applications

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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.

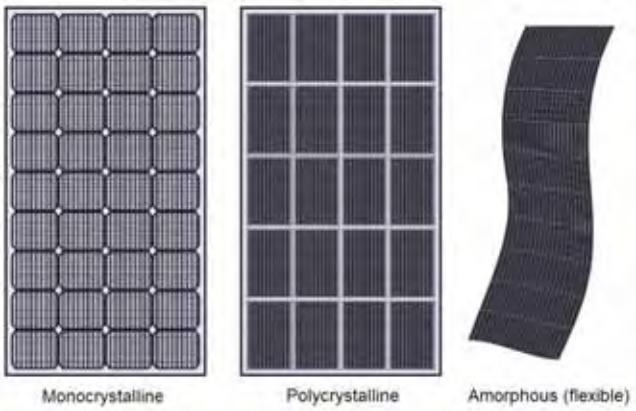

Figure 2: Solar panel types

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.

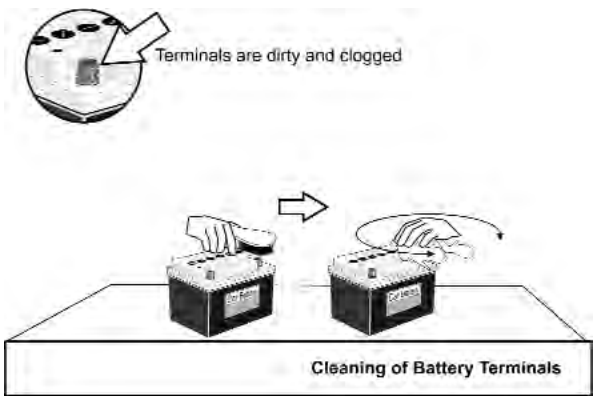

Figure 5: Cleaning battery terminals

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

This report summarises findings from a study undertaken by GVEP International (Global Village Energy Partnership) under its Developing Energy Enterprise Project East Africa (DEEP EA) implemented in Kenya, Uganda and Tanzania which supports micro-businesses engaged in servicing the energy needs of poor communities in those countries.

The study provides an in-depth look at the phone charging businesses in the DEEP programme in order to better understand the market dynamics, the current barriers and opportunities for growth and the potential for diversifying into other services, particularly the sale of solar PV lighting products. The study also seeks to understand the impact that the DEEP programme has had on these businesses.

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