WE! HUB




Solar Energy for Rural Kenya
WE!Hub – Water-Energy Hubs

Handbook

Content

Project mission and vision

Large parts of Africa's rural and peri-urban areas are poorly endowed with infrastructure; few people have access to the electricity grid or a regular supply of clean drinking water. Owing to the lack of electric power supply, people are also cut off from modern energy services. For lighting, people use candles or kerosene lamps, which are harmful to health and to the environment. Water must be fetched from rivers, lakes or boreholes, transported by foot for miles and eventually treated with chemicals or boiled to make it safe. Adequate communication and training services are mainly concentrated in the centers and capital cities.

Against this background, the "Solar Energy for Rural Kenya" project was launched with the mission to improve the livelihoods and opportunities of those people without access to modern energy services. We want to combine this aim with the global responsibility to combat climate change and reduce pollution and bring about holistic long-term improvement of disadvantaged areas and communities. Not only are off-grid solar stations an environmentally friendly and effective way to provide renewable energy and pure water in rural areas of Africa, they also help people save money, create much needed jobs, provide opportunities for education and improve economic infrastructure and health – all contributing to the United Nation's Millennium Development Goals (MDGs) and World Summit of Sustainable Development (WSSD) objectives.

The project has the vision to contribute to the economical, ecological and social

development of Kenya's rural areas and to spread this idea to other places all over the world, where access to energy and clean drinking water is not guaranteed.

At the heart of the project are the five decentralized energy stations, known as WE!Hubs – Water-Energy Hubs. The beneficiaries of the Hubs are fishermen, households, schools, small businesses and other institutions in the Lake Victoria region of Kenya. Solar energy systems supply the WE!Hubs with electricity, where a number of energy-related services are offered for small fees. The most important is the rental and recharging of battery-operated LED lanterns and lamps. These lamps and lanterns were developed with the help of local users. It is also possible to rent the charged batteries/lanterns to operate small electronic devices such as radios or to recharge cell phones. At the Hubs, the local community also has access to computers, the internet and training courses on entrepreneurship and ICT skills. In addition, clean and safe drinking water is sold. The water is mainly purified rain water, which is treated by using several filter stages and UV lamps. The project is set up as a self-sustaining social business model in combination with modern technologies and services and includes a training and know-how transfer program for the local staff and engineers. It focuses on a PV system, battery maintenance, a water treatment system and service management. Centralized maintenance of the appliances increases the lifespan of the batteries. At the same time proper recycling and/or disposal at the end of the operational lifespan is ensured. All together this results in a number of benefits for the users, the operator and the environment.

Project area

The "Solar Energy for Rural Kenya" project is located in the East African country of Kenya. The focus areas of the project are the Kenyan regions of Nyanza on Lake Victoria with the Homa Bay and Siaya counties as well as Kericho county in the Rift Valley region.

The WE!Hubs in Homa Bay and Siaya counties are installed in the villages of Homa Bay, Honge, Ragwe and Sori.

Owing to their proximity to Lake Victoria, the most important source of income for the local communities, directly or indirectly, is fishing. A large proportion of the fishermen specialize in night fishing, catching a native silver cyprinid, locally known as Omena, Dagaa or Mukene.

In general, the Lake Victoria region is poorly developed economically and socially. Its Human Development Index (HDI) has, according to UN statistics, a value of 0.497, compared to the average for the rest of the country of 0.561. Reasons for below-average development are the high incidences of diseases (malaria, HIV,

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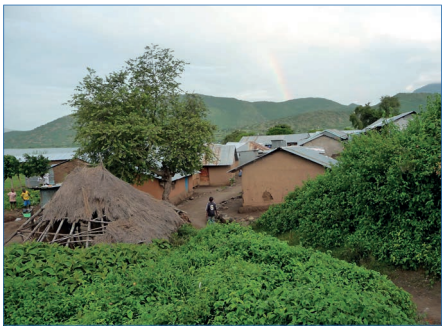
and tuberculosis) as well as the lack of education opportunities and economic possibilities. The population is comparatively young, with 58% of the inhabitants less than 20 years of age. Population density is high with more than 250 people per km^2 living in the region. This in turn, puts high pressure on the natural resources and scarce infrastructure such as schools or hospitals. Further impairment of people's livelihood results from the fact that, according to the National Population Census in 2009, only 3.3% of the households in Homa Bay, and 4.3% in Siaya, are connected to the electricity grid. The availability of clean drinking water is also a crucial problem. About 70% of the population has to cover distances of at least one kilometer to the nearest drinking water source, which often only offers water of poor quality, contaminated with bacteria and germs that trigger severe diseases. The economy of the Lake Victoria region is characterized by high dependence on fishing



and farming; industrial plants, manufacturing and services play only a marginal role.

Kericho is a city in the south west of the country and lies in the highlands, west of The Great Rift Valley. With its high altitude and virtually daily rain, Kericho is the center of Kenya's large tea industry, exporting high-quality products worldwide. The main source of income in this region comes from the harvesting and production of tea leaves but there is also a vibrant floricultural business which exports many different types of flowers to European markets.

Despite Kericho's flourishing industry, the livelihood of the laborers working on the tea farms is unexpectedly poor. The majority are housed within the farms themselves, living in small villages dotted within the tea estates. Owing to the size of the tea farms, many of these villages have no connection to suitable power and are using kerosene lanterns for lighting.

Use of kerosene for lighting

About 1.3 billion people worldwide depend on fuel-based lighting because they do not have access to the electricity grid, usually burning kerosene for light in different types of lanterns. Based on estimates by the United Nations Environment Program (UNEP) 25 billion liters of kerosene and 1.4 million tonnes of candles are burned every year for lighting, resulting in emissions of 74 million tonnes of CO_2. Kerosene lighting is primarily used in the project areas for indoor lighting for households, night-fishing, and businesses activities.

Kerosene has serious negative effects on human health such as eye and respiratory diseases resulting from the emission of toxic fumes and harbors the risk of domestic fire and explosions. Through spillages and considerable CO_2 and black carbon emissions, it is also harmful to the environment and climate. Kerosene spillage from night fishing on Lake Victoria pollutes the water and puts the habitats of fish at risk, even though most communities depend on them. What's more, kerosene lamps are highly inefficient, have insufficient light output (in lumen) and are directly connected to volatile and increasing oil prices. This makes kerosene lighting expensive for the user. Nevertheless, kerosene has one major advantage: it can be purchased

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in small, affordable quantities at a low relative price – imperative for people with irregular and low incomes. The absolute price, however, makes the use of kerosene a very costly source of lighting in the long run.

Nevertheless, a connection to the electricity grid is not necessarily the solution to the problem of providing rural areas with energy. Each house would have to be connected to the grid. The connection costs are often too high for the households to bear. Therefore, even if a village has grid access, most of the households are often not connected and are forced to choose the option of burning kerosene again, despite the theoretical availability of an alternative.

Against this background, decentralized renewable energy systems are particularly suitable for developing countries. Modern renewable energy technologies are showing improved efficiency and reliability with many advantages. Because it is not dependent on an electricity grid this type of energy is an interesting solution for rural and remote areas in developing countries and is safe, clean and cost-efficient at the same time. The positive aspects are many and varied, including improved education as children can do their homework or learn in the evening hours, and increased income possibilities through the extension of opening hours in shops.

Nevertheless, modern technologies such as solar systems still lack acceptance in society or are simply not known by the people. Moreover, new systems are often more sophisticated than traditional ones and thus need special skills and can often not be repaired or maintained by the users themselves. It's not the technology alone that supports a sustainable development. A framework of access, awareness and knowledge has to be created. That's what the "Solar Energy for Rural Kenya" project is doing.

Health / hygiene in Kenya / Africa

Lack of access to energy services and infrastructure has an influence on health and hygiene. Both can be improved with adequate equipment, awareness and Know-How.

Many diseases encountered in the project areas are a direct or indirect result of the prevailing multidimensional poverty. Low income, poor education and inadequate infrastructure contribute to the spread of infectious diseases. A household affected by illness gets into a vicious cycle of deteriorating livelihood. Rising costs for medication coupled with a temporary, or in the worst case, permanent shortfall of income can easily plunge a household into abject poverty. Infrastructure and energy services can have a strong growth effect through their impact on production costs and productivity. Infrastructure affects growth indirectly through a variety of channels, most notably by influencing health and educational outcomes.

Access to clean water and sanitation helps to improve health and thereby productivity. By reducing the cost of boiling water, and reducing reliance on traditional smoky fuels (such as wood, crop residues, and charcoal) for cooking, access to electricity also helps to improve hygiene and health – in the latter case by reducing indoor air pollution and the incidence of respiratory illnesses.

As mentioned above, Western Kenya is endowed only with limited infrastruc-

ture. The lack of safe drinking water, modern energy, and health services coupled with the absence of a regulated waste and sewage disposal system and adequate road network has hampered the development of the area.

In Nyanza 24% of the population or 310,000 people are registered as infected with AIDS/HIV. 36,000 people die each year as a result of immunodeficiency. At national level, thanks to information campaigns, free testing and enhanced medical and health services, there has been an improvement, but deeper analysis shows that there are hot spots with an alarmingly high rate of AIDS/HIV. In fishing villages, up to 40% of the high-risk group tested positive. The reasons for this are multilayered and relate to social, economic and cultural aspects. Primarily young and widowed women are affected because of their vulnerability as a result of limited income possibilities, lower education levels and gender inequality. AIDS/HIV prevalence is therefore twice as high in women as in men. Apart from AIDS/HIV, the causes of most health problems are malaria, TB (tuberculosis), diarrhea and respiratory diseases. In large part, they are caused by poor hygiene conditions.

Malaria appears epidemically in the project area. It is transmitted by females of anopheles mosquitoes which spread the disease-causing plasmodium parasite. Two thirds of the population of the district are affected by malaria every year. If untreated or if the patient has a weakened immune system, malaria can lead to death.

Drinking water availability in Kenya/Africa

The main source of drinking water in the project area is Lake Victoria. About 85% of the supply of drinking water to the population in the project area comes from Lake Victoria. It is highly contaminated, mainly due to surface run-off of human waste during rain, attributed to the low coverage with latrines and sanitation facilities in the densely populated areas. In addition there is significant contamination of Lake Victoria from oil spills from boats, fishing activity, bathing, dishwashing and washing of cars. The water is so contaminated that it can only be consumed after boiling or chemical treatment. Water-borne diseases are regularly found in almost all households. Diarrhea for example is triggered by poor hygienic conditions and the consumption of contaminated water. Locally, cholera outbreaks appear periodically.

Besides the considerable negative impacts on human health, lack of access to clean water in households is also a burden on those who have to walk to fetch this precious commodity. Women and children spend hours fetching water from the lake, rivers or wells – time that, especially for young girls, should be spent on education and homework.

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Communication and internet access in Kenya/Africa

Cell phone communication has achieved high growth rates in Kenya in the last few years. The number of subscribers reached 31 million in December 2013. This means that 78% of the total population potentially has a cell phone. Even in remote areas without a regular electricity supply, a working cell phone network is guaranteed and made possible by diesel generator or PV powered network masts. It has improved communication and information exchange in these areas enormously and provides important links with the regional and national centers and markets. Besides communication, the cell phone can perform a variety of additional tasks and provide access to services. In rural areas cell phones replace bank accounts and banks, which are represented only in major centers. Money can be transferred and payments can be made (M-pesa system).

However, improvements in communication and information technology has brought a new challenge. To operate cell phones, electricity is necessary. It is delivered by rechargeable dry-cell batteries in the cell phone. Charging these batteries presents a problem in rural areas without connections to a power supply system. This challenge has given rise to business opportunities however. Cell phone batteries are charged with small diesel generators, PV modules or, where available, a grid connection.

Besides call handling, most cell phones also offer access to the internet, which was used by about 13 million subscribers at the end of 2013. People predominantly use the networks of telecommunication companies to access the world wide web, where information searches and email are the services most frequently used.

OSRAM off-grid lighting concept – the pilot phase

The first steps in the development of a concept for sustainable energy provision and off-grid lighting in developing countries were taken by OSRAM in 2007 in evaluating the situation of off-grid lighting and discussing solutions together with the Global Nature Fund. The outcome was the OSRAM off-grid lighting concept, with its entrepreneurial and innovative approach that goes "beyond the product" and includes infrastructure, access, engineering and maintenance. Decentralized solar-powered energy stations, known as O-Hubs are at its heart. The core service is the leasing and recharging of battery-operated lanterns and lamps to replace kerosene lamps for night-fishing, households and shops. The

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batteries can also be used to run small electronic devices and charge cell phones. At the Hubs people also have access to a cell phone charging system and to clean and safe drinking water, purified by several filter stages and UV lamps. The decentralized water and energy stations offer solutions for some of the most pressing issues in remote and rural areas of developing countries. Within this framework three pilot stations were established at Lake Victoria between 2008 and 2010.

At the same time, economic verification and further technical and conceptual developments were carried out. In 2011 with the help of additional partners from Germany and Kenya, the range of services was extended, the social business focus formalized and new "WE!Hubs" – Water and Energy Hubs – were planned. The O-Hub concept was fully adopted into the WE!Hubs. The three existing O-Hubs were refurbished and are now at the same technical level as the WE!Hubs.

Lessons learned

Because of the uniqueness of the project, which aimed to set up permanent energy and water stations in remote areas and a leasing model for battery-powered light-ing product distribution, there was no previous history and no prior experience. Starting a project on the ground with little available information presented a major challenge. In some areas, the "learning by doing" approach had to be applied to advance along the learning curve. The lessons learned can now be implemented in the Solar Energy for Rural Kenya project.

I.) Starting a project in a new environment needs strong local partners

The commitment and investment in a project, market and country with much

lower stability criteria than the usual business environment of OSRAM was accompanied by high uncertainty and high financial risks. The insecurity and unpredictability in crucial variables, such as government and security issues, presented a huge challenge and could be overcome only through close collaboration with local Kenyan partners.

II.) Introduction and acceptance of new technologies and services can be supported by fast adapters and opinion leaders in the relevant communities.

Starting the business at the O-Hubs took a greater effort than expected and more time than planned. Although the introduction of the new lighting technology was accompanied by a locally adapted marketing model, potential users hesitated in making the final step and waited until others had made their first experiences. Collaboration with opinion leaders in the relevant communities finally gave the decisive push. To continue this success story, lead users in all application and project areas were selected to answer questions from new users.

Nonetheless, during the proof-of-concept phase the three O-Hubs produced almost 180.000 kWh of renewable electric energy which was used to charge over 250,000 batteries. This is the equiv-

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alent to replacing 400,000 liters of kerosene and preventing approx. 1,000 t of direct CO_2 emissions.

III.) Standardized solutions increase efficiency, efficacy and impact

The project team realized that scaling up the project needed a standardized solution that covered the needs of a broad spectrum of potential users. Economies of scale effects in construction, equipment and operational model were also needed in order to reduce costs and therefore operate at profit in different project areas and environments. Development of such a technical and operational solution was an immense effort which involved equipment and manpower in Kenya and Europe.

IV.) Investment in the training of local experts is crucial for the sustainability of a project

The transfer of know-how and the training of local experts proved to be a success factor during the implementation phase. The first step involved OSRAM experts training the local staff in the installation and maintenance of solar products. For the second step a train-the-trainer concept was set up to develop selected people so that also basic training of new employees was in local hands.

Solar Energy for Rural Kenya

Project partners

The objective of the "Solar Energy for Rural Kenya" project is to improve access to sustainable, affordable and modern lighting, energy, water and communication services in the project area at a cost which people can afford, and at the same time combating climate change and supporting the achievements of the MDGs. Decentralized solar-powered energy stations, known as WE!Hubs (Water and Energy Hubs) are at heart of this.

The "Solar Energy for Rural Kenya" project involves a variety of stakeholders and partners at different levels in Africa and Europe. At the project sites in Kenya, local communities and their leaders, beach management units in fishing villages, national and local authorities and associations are involved from site selection and land procurement to regular feedback meetings with customers. These feedback meetings in particular provided valuable information for evaluating, adapting and redesigning the products and the operational model. The WE!Hub project is also supported by Kenyan national authorities and associations such as the relevant ministries and energy agencies.

Project implementation and operation involves six partners: Light for Life Ltd, Thames Electricals Ltd, Global Nature Fund, OSRAM, The European Union and Siemens Stiftung.

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Light for Life Ltd is a Kenyan company acting as a social business to operate and expand the WE!Hub concept with its partners. Light for Life Ltd leads on-site implementation, is the contact for local communities as well as national authorities and manages the daily routine of the WE!Hubs.

Thames Electricals Ltd. is one of the largest distributors of electrical products in Kenya, representing a number of international brands such as ABB, Osram and 3M, stocking a range including luminaires, control gear, installation material and cable management systems. Thames Electricals Ltd supports the project through financing.

Global Nature Fund (GNF) is a non-profit, private, independent international foundation for the protection of the environment and nature. GNF is coordinating the project and contributes its expertise on conservation aspects and is involved in consultation and training.

OSRAM, one of the leading lighting companies in the world, launched this unique program for eco-friendly off-grid lighting in 2008. OSRAM covers the technological part of the project, designs and develops the lighting products and acts as a consultant on the basis of first-hand off-grid experience in East Africa.

The **European Union** supports the project financially through the EuropeAid ACP-EU Energy Facility Program.

In keeping with their slogan "Encourage. Empowering People", the **German Siemens Stiftung** supports the project financially and with expertise in social entrepreneurship. In addition, Siemens Stiftung fosters education and promotes local entrepreneurship by offering training and mentoring programs on business management and ICT skills together with local partner organizations.

WE!Hubs

WE!Hubs are decentralized water and energy stations. Electrical energy is provided by 72 solar panels, with a performance of >220Wp each. The total installed PV capacity of >15kWp is used to charge batteries for lamps, lanterns and cell phones, operate the water purification system and the ICT room, and power the WE!Hub itself.

Beneficiaries and services at the WE!Hubs

The beneficiaries of the hubs are fishermen, households, schools, small businesses and other institutions in the Lake Victoria region of Kenya. PV systems supply the energy stations with electricity where a number of energy related services are offered for small fees; the most important of which is the rental and recharging of battery-operated LED lanterns and lamps. These lamps and lanterns were developed and refined together with local users. It is also possible to rent fully charged batteries to operate small electronic devices such as radios or to recharge cell phones. A specially designed connector system protects against improper use. At the hubs the local community also has access to computers, the internet and training courses on entrepreneurship and ICT skills. In addition, clean and safe drinking water, which is mainly rain water purified with

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the aid of several filter stages and UV lamps, is sold here. The WE!Hubs are also used as trading centers for products in line with the project concept.

Sustainable business

The WE!Hubs are set-up as self-sustaining, profit-oriented high tech social businesses with a strong stakeholder approach. This includes a training and know-how transfer program for the local staff and engineers focusing on PV system and battery maintenance, the water treatment system and service management. Centralized maintenance of the appliances (in particular the use of a semi-automatic battery charging management system) increases the lifespan of the batteries. At the same time, proper recycling and/or disposal at the end of the operational lifespan is ensured. All together this results in a number of benefits for the users, the operator and the environment.

Source: UN Global Compact; 2012

Community involvement

As shown in the diagram above, a social business is also characterized by its strong community focus. A variety of stakeholders and partners at different levels in Africa and Europe are therefore involved. At the project sites local communities and their leaders, beach management units in fishing villages, national and local authorities and associations are involved in everything from site selection and land procurement to regular feedback meetings with customers. These feedback meetings in particular produce valuable information for evaluating, adapting and redesigning the products and the operational model.

Energy related services at the WE!Hubs

Light
Leasing

Phone charging
Selling

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Trial operations

Product sales

Water
Selling

Internet cafe, computer services and ICT training room

Technical details

Buildings and construction

All the WE!Hubs have the same layout. The right side of the building is the sales and storage room, while the internet café is located in a separate room on the left side. This uniform design allows for cost and time savings in construction and installation. The buildings were constructed by local craftsmen with maximum use of locally available goods and services, notably building materials such as bricks, sand, cement and wood.

Solar energy, PV panels and charging infrastructure

Renewable solar energy is the main energy source for the hubs. A bank of batteries is provided as backup and a generator is used in the rare instances of a lack of sunshine.

The roof-mounted PV system comprises 72 panels with ~220Wp each, giving a total capacity of ~15kWp. In-

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verters are used to convert the harvested solar energy from direct current to alternating current So that standard electronic equipment such as lamps, computers and power supply units can be powered. Each WE!Hub has up to 144 battery charging slots for recharging the battery boxes or lanterns. During one solar day up to 500 products can be recharged.

Lighting products: O-Box Solar and O-Lantern LED

To address the off-grid lighting challenges, OSRAM introduced two multi-use products, known as the O-Box Solar and the O-Lantern LED.

The O-Box Solar is a battery box with Li-ion batteries which works together with a luminaire as a light source; and can also be used to operate small electronic devices or to charge cell phones. The O-Box Solar is intended for large households, businesses and night fishing. Depending on the settings, the luminaire can be operated for up to 14 hours. The O-Lantern LED is equipped with LEDs and powered by a Li-ion battery. The lantern can also charge cell phones and operates for up to 12 hours. Both products were especially designed to work in combination with the charging infrastructure at the WE!Hubs. This also means that all necessary repairs and maintenance will be done at the WE!Hub where all the relevant tools and spare parts are available. This ensures that all the battery-powered lighting products always come back to the WE!Hub and can be properly collected and recycled if they get broken or have reached the end of their lifespan.

Cell phone charging

Communication has proven to be a trigger and supporter of development through information access and exchange. At the WE!Hubs cell phones can be recharged for a small fee. Since the WE!Hub provides standard AC power, the usual power supply units delivered with the devices can be used. Ongoing standardization based on MicroUSB plugs is reducing the need for different systems.

Water treatment

Clean and safe drinking water is one of the most fundamental human needs. This can be obtained at the WE!Hubs. Here water is collected, purified and sold to the customer. In most cases the source of the purified water is rain. Lake water is also used. The raw water is collected from the roofs of the Hubs and stored in tanks. Depending on the quality of this water, various filtration systems are used. For example, the first stage in the purification process is a combined sand/carbon filter to eliminate bad smells and large particles. In a second stage a microfiltration system eliminates small particles, and UV-C lamps sterilize the water. From there the water is sold directly to the customer through an outlet at the front of the hub. Customers bring their own containers and are informed and encouraged to keep them clean.

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Internet café and computer services

Besides support for mobile communication, the WE!Hubs offer access to computers and in more urbanized areas also to the world wide web. In the internet cafés computers can be used for surfing, typing letters and documents, printing and scanning. Each internet café is equipped with a central workstation and up to ten client workstations in a computing system. The equipment at the internet cafe can scaled up or down on a modular basis according to demand.

Maintenance / recharge / repair

Regular maintenance is crucial for keeping the equipment running for long periods. It is also part of the concept that all necessary repairs and maintenance will be handled at the WE!Hub, where all the relevant tools and spare parts are available. This ensures that all the battery-powered lighting products are always returned to the WE!Hub and can be properly collected and recycled if they break or have reached the end of their lifespan. Local technicians are therefore trained in each station to maintain and service the installation and products to guarantee trouble-free operation and long service life.

Training is based on proper training material and training plans. Each project partner contributes with training courses in their area of responsibility.

Administration and sales

The WE!Hubs are set-up as a social business and managed by Light for Life Ltd. They are administrated from the company's headquarters in Nairobi, Kenya. Nevertheless, each hub is supervised by a hub manager responsible for day-to-day business and reporting. The hub managers are also the ones in close contact with customers in the area.

The original idea that led to the WE!Hub concept was to replace kerosene lanterns – and the partners realized they had to do more than simply introduce new environmentally friendly products, they had to take a holistic approach and "think beyond the product". They also had to facilitate access and use, including financing, infrastructure, maintenance and recycling. To achieve the main objective of the project, namely the provision of community services in remote areas in a financially sustainable package, many components were crucial to success, including the social business concept, professional operations, the quality of the products offered, training and finance. WE!Hubs are therefore operated by a trained staff of local technicians and salesmen who are in charge of system maintenance, lighting product repairs and customer relationship management. As the products are of very high quality and value, customers do not have to buy the battery powered energy/lighting systems but only pay a refundable security deposit and lease them. Micro-financing can be used to support low-income households. From that moment on, customers are free to use the battery powered lighting systems. Once the battery is discharged it will be exchanged for a fully charged one. The pay-per-use fee is regulated through social business guidelines and is at least 30% lower than the equivalent price of kerosene.

Each customer has to register at the WE!Hub and pay a refundable deposit in order to start leasing the battery-operated lamps. Registration and deposits increase security for the WE!Hub operator. A database system helps the hub manager to maintain an overview and to link each leased product to a specific person. The database also indicates the amount of time a product has been in use. If a customer stops using the system and returns it to the WE!Hub the deposit will be refunded.

When the products are being used in a household, business or school or for night fishing, they will be brought back the WE!Hub whenever the battery is discharged. Since the products are not exclusive to the customer they can be immediately exchanged for fully charged ones. The customer pays a fee each time

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a discharged product is exchanged for a fully charged one.

All the other services and products at the WE!Hub are also available on payment. These payments can be made in cash or via mobile payment systems such as M-Pesa where the money will be transferred from the account of the customer to the account of the WE!Hub. Both parties receive text messages as confirmation that the payment has been successful.

Marketing activities and customer training

The most successful marketing activity is through word of mouth, testimony and participation at public marketing events and product training events.

Each user of battery-powered lighting systems will be given adequate training in handling the product and in using the different modes and settings. This increases customer satisfaction and prolongs product life.

Entrepreneurship training and mentoring program

The aim of the entrepreneurship training and mentoring program is to open up economic, entrepreneurial and social opportunities for communities around the WE!Hubs and thereby promote personal initiative and an entrepreneurial mindset. Although crucially important for business success, these skills are not sufficiently promoted during the classic formal education acquired in Kenyan schools. For the training courses, a mini study program for budding social entrepreneurs has been developed in collaboration with the School of Business at Kenyatta University and the Kenyan Business Mentoring Network The Youth Banner. In addition to instilling basic business know-how and elementary technical proficiency, this program focuses on the development of personal skills and competencies. Besides the WE!Hub managers, however, local micro-entrepreneurs and ambitious young people from the neighborhood are also trained. This strengthens the social impact of the training program and integrates the project initiatives more firmly in the village community.

Specific information on entrepreneurship training

Running a small successful business of their own is something many people would like to do. For people living in remote rural areas of Kenya, however, it is often the only opportunity they have to generate their own income. There are few employers and many people live from hand to mouth, taking any occasional job that presents itself. But these people often have promising ideas that could be implemented successfully, provided they receive systematic backing and the right tools for the trade.

To promote personal initiative and an entrepreneurial mindset, practical training courses and regular mentoring for micro-entrepreneurs and ambitious young people are offered at the WE!Hubs. These training courses provided by Siemens Stiftung and its local partner organization The Youth Banner pursue a two-level approach:

1. Practical training courses

During four- to six-week training courses, participants receive basic instruction

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in business management, customer service, accounting, and financial management. The development of personal competencies such as communication skills or conflict resolution forms an equally important part of the program.

2. Mentoring and coaching program

A subsequent six-month mentoring and coaching program supports participants on the road to becoming successful micro-entrepreneurs. The young entrepreneurs meet up regularly in small groups to exchange experiences and receive advice on creating their business plans. In some cases, help is provided in arranging micro-credits. Experienced local business people are also on hand to pass on their know-how to their mentees, helping them to establish crucial contacts.

After successfully completing the whole program, participants receive a certificate which is signed by Kenyatta University's School of Business.

At the internet cafés, villagers are continually recruited into the computer training classes and taught the basics of computers, given introductions to computing and keyboard skills, MS Word, MS Excel and MS PowerPoint, and how to use the internet to communicate and search for information. The students are evaluated at the end of the training courses, which take about two months, and Certificates of Competence are issued. At the end of the training courses, business owners who were previously computer illiterate are able to keep proper records of their business transactions, make reports, process their own business permit applications and handle critical correspondence tasks on their own.

Conclusion

The "Solar Energy for Rural Kenya" project provides modern, renewable energy services at low cost, reduces the burden for households and offers the possibility of catching up with more developed urban areas.

In an UNDP study, researchers came to the conclusion that "at the household scale, modern energy services directly contribute to economic growth and poverty reduction". Especially in rural areas of developing countries, reduced poverty levels can directly translate into developmental processes; this conclusion is also valid for this project.

The demand for modern energy services reached remote rural areas years ago. Electricity to power mobile communication, farming equipment and adequate lighting are only some example of this. Up to now, inaccessibility due to high costs and inadequate provision prevented households from deriving any sustainable benefit. What's more, low income households were forced to use expensive, inefficient, dangerous and polluting energy services.

For household lighting users, the services available at the WE!Hubs bring a substantial improvement in lighting quality through better illumination and lower costs. For small-scale businesses, affordable light sources can be directly converted into income through extended opening hours. Harmful fumes, poisonous fuels and the risks from open fires are completely eliminated for the users. By recharging cell phones with renewable solar power the costs for cell phones can be cut by 25%, thereby reducing the cost of communication. The same energy source is used to purify drinking water, which considerably reduces water-borne diseases in consumer households. Solar energy also powers the internet café and ICT-training room, providing access to information and know-how previously out of reach.

Besides these positive socio-economic impacts, the replacement of kerosene

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lamps with environmentally friendly solar lanterns notably reduces harmful spill-overs into soils and water systems and especially the emission of climate gases, considering that with over 25 billion liters of kerosene burnt every year for the generation of light, 60 million tons of CO_2 and 270,000 tons of black carbon (with a warming effect equivalent to an additional 240 million tons of CO_2) are emitted into the atmosphere.

Through the decentralized energy production and the operation of the WE!Hubs by the local social business, additional benefits arise through job creation in agriculture and fishing dominated areas.

By facilitating access to modern, renewable energy services, a direct and immediate effect on the user household's life quality can be observed. As lighting plays a pivotal role in people's everyday life, the choice for a lighting source has an impact on many direct and indirect aspects such as income generation, health and security, but also education and the protection of natural resources. Reduced poverty and higher incomes can be directly converted into savings and investments to raise productivity, higher quality and quantities of food as well as better education for children. Finally the vicious energy-poverty circle can be turned into a virtuous energy-development circle.

Imprint

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