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Final Report

Mobisol Project

Affordable Solar Home Systems

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0. Summary

DT Power provides an innovative solution to affordable solar energy in rural off-grid areas. The pilot project conducted between December 2011 and July 2012 set out to demonstrate the viability of this solution, showing that it can change thousands of lives and have a positive environmental effect.

This was successfully achieved with 100 *Mobisol* Solar Home System[1] units installed and successfully running in the Nakuru region of Kenya. The customers successfully made the required payments while the DT Power team effortlessly collected them via M-Pesa[2], the mobile banking solution of our partner Safaricom[3] in Kenya. The success of the pilot project has allowed the project to move forward into Phase 2, which is planned to commence distributing the improved *Mobisol* SHS by the end of 2012.

1. Objectives

The initial main objective of the project was to meet local needs for renewable energy, thereby supporting climate policy goals to reduce global carbon emissions.

Worldwide around 1.6 billion people have no access to a public electricity grid. People living off-grid rely on paraffin lamps, candles or open flames as light sources. Car batteries are used as mobile energy storage units to charge mobile phones, operate radios, refrigerators and TVs, and are transported between homes and fuel operated generators. Households without grid connection can spend anywhere from 10% to 30% of their income on these energy sources. This leaves the available energy for the world's poorest very expensive and low quality.

Some of these energy sources, such as paraffin and kerosene lamps, pollute indoor air and lead to health problems, further worsening poverty effects. The World Bank has classified indoor air pollution amongst the four most critical global environmental problems in developing countries. Poor quality energy solutions have serious negative health effects.

It is estimated worldwide each year, through use of kerosene lamps alone, about 70 million tonnes of CO_2 emissions are emitted from kerosene lamps alone. This is roughly equivalent to the CO_2 emissions of 12 million cars in the same period. It is important that energy solutions for developing nations are sustainable and help reduce worlds CO_2 emissions.

While reducing the health, social and environmental impact of energy, solar energy system's high upfront costs make them unaffordable to the bottom of the economic pyramid[4]

Our approach was to provide affordable photovoltaic (PV) solar systems on a pay-as-you-go basis, removing the price barrier to poor families living off-grid to provide affordable renewable energy and reduce carbon emissions. Several other important objectives were also identified for realizing project success:

1) Testing the technology
2) Proving the technology's affordability
3) Decreasing collection costs with M-Pesa payments
4) Controlling the system remotely
5) Providing theft-protection
6) Demonstrating minimal maintenance

2. Technical Solution

The *Mobisol* Solar Home System (SHS) is a solar photovoltaic system consisting of a PV module, a sealed solar battery and the *Mobisol* solar controller. This core technology combines a regular charge controller with electronic modules including a GSM modem for communication between the installed system and DT Power.

[1] SHS: Solar Home System
[2] Source: http://en.wikipedia.org/wiki/M-Pesa
[3] Source: http://www.safaricom.co.ke/index.php
[4] source: www.dt-power.ch

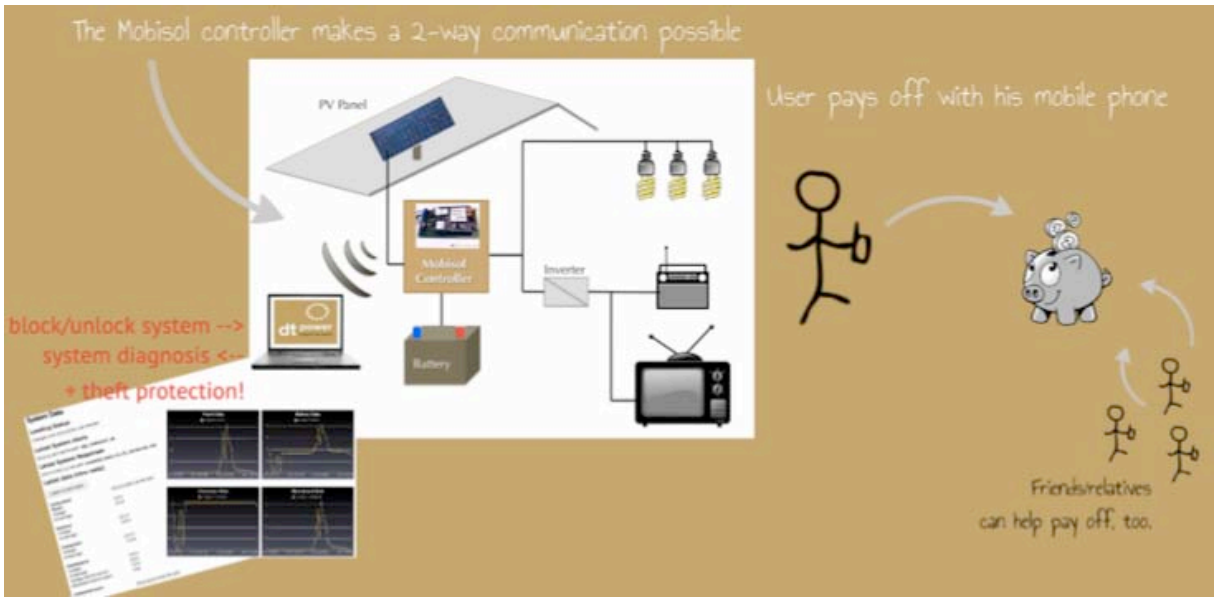

Figure 1: Main design elements of DT Power's SHS *Mobisol* system [1]

The solar system in Figure 1 shows a typical configuration powering several light bulbs, a radio, and a TV, plus system components like the battery, PV panel, inverter, controller, and remote communications with DT Power. The system cannot only be used to supply households, but can also be used for small business. Unlike other SHS on the market, the *Mobisol* SHS may be purchased together with a complete service package. Customers are not faced with high upfront costs and can instead pay for the system over a period of three years. The service package covers maintenance and repair, insuring system availability.

The unique selling proposition of DT Power`s technology derives from the *Mobisol* solar controller.

Firstly, it provides remote locking of the SHS to effectively guarantee payments and avoid unnecessary and expensive debt collection costs, especially in rural areas. Payment is made through the mobile banking infrastructure (M-Pesa), widely adopted in the target region. Remote locking further minimizes investor's risks, further guaranteeing financing and system affordability to the end user.

Secondly, the integrated GSM modem enables DT Power to remotely diagnose the system over a wide range of technical parameters. This monitoring allows effective and efficient preventive maintenance to detect minor issues before they lead to system failures, costly repairs, and dissatisfied customers. Finally, the customer interface function supports helpful communication with customers. Figure 2 outlines the *Mobisol* controller's primary functions, integral for the complete three-year product and service package.

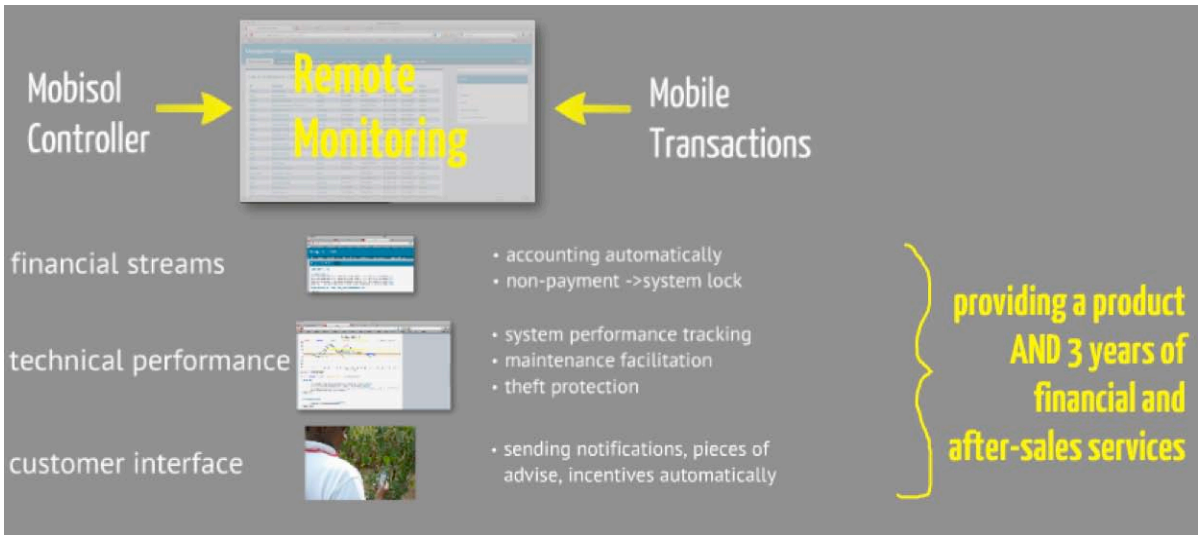

Figure 2: Functionality of the *Mobisol* controller [2]

The controller design provides for upgrades to higher powered systems with the installation of larger battery and solar modules, allowing for the use of more appliances.

Mobisol SHS comes in four different sizes to match the varying market electricity needs and payment abilities shown on Table 1.

MOBILE SOLAR HOME SYSTEM	**BASIC** SOLAR HOME SYSTEM	**PREMIUM** SOLAR HOME SYSTEM	**COMMERCIAL** SOLAR HOME SYSTEM
20 Watts Satisfies basic energy needs (lighting, mobile charging, radio)	60 Watts Satisfies basic energy needs plus several hours of TV	120 Watts Satisfies energy needs of a larger household (TV, computer, and stereo system)	200 Watts Satisfies small businesses needs (bar/ restaurant, mobile charging business, etc.)

Table 1: *Mobisol* Solar Home Systems by system size and delivered application

3. Applied Method

Approach and strategy

The DT Power strategy is to use the huge popularity of the mobile communication network and the local mobile banking solution M-Pesa to provide affordable renewable energy for the bottom of the economic pyramid in Kenya. The approach for this pilot project is to test the technology in the field with real customers to gauge the success of the payment model and technology implementation.

Steps

- Identify and survey potential customers using local partner expertise
- Develop and upgrade customers based on customer survey feedback and usage
- Train local staff in installation methods for the *Mobisol* SHS
- Select and train customers on the solar home systems use and payment structure
- Install the system
- Monitor the system with the remote monitoring database, thus reducing the need for maintenance visits
- Receive payment regularly through M-Pesa functionality
- Assess the pilot project performance at the end of the designated timeframe

The project was successfully presented and introduced by DT Power managers in cooperation with the local project organization, Scode, to the village elders representing the 50,000 members of the pilot region communities.

Figure 3: DT Power together with the village presbyters and our local project partner Scode [1]

Such meetings and exchanges played a crucial role in the customer identification process as well as throughout the implementation phase. A toll-free service number was also helpful with direct communication to users in resolving complaints, giving support, and gathering feedback.

Table 2 specifies the payment structure for the various system levels. Flexibility on when and how many payments that could be made during the month to reach the total monthly payment obligation proved successful in helping insure that users would not default.

MOBILE SOLAR HOME SYSTEM	**BASIC** SOLAR HOME SYSTEM	**PREMIUM** SOLAR HOME SYSTEM	**COMMERCIAL** SOLAR HOME SYSTEM
Down Payment: 10 % of total cost	Down Payment: 10 % of total cost	Down Payment: 10 % of total cost	Down Payment: 10 % of total cost
+ 36 Monthly Payments: 90 % of total cost	+ 36 Monthly Payments: 90 % of total cost	+ 36 Monthly Payments: 90 % of total cost	+ 36 Monthly Payments: 90 % of total cost
Note: The monthly payment sum is fixed and can be met in a single or numerous (smaller) payments			

Table 2: *Mobisol* SHS shown by respective contractual payment plans [1]

4. Results

The results of the project have been satisfying. Activities started in December 2011 followed by installations of *Mobisol* SHS carried out between February and July 2012. Training of technical and promotional staff started in January 2012 along with identification, promotion and surveying of potential customers. The first systems were installed in February 2012 and the final systems in July 2012. DT Power local promotional staff provided customer training together with our local project organization Scode to every customer. Throughout that time the systems were monitored with the remote monitoring database and payments received via M-Pesa.

The main objective was to provide renewable energy to rural people thus reducing climate change.

This was successfully achieved with the 100 *Mobisol* SHS units deployed during the pilot project in Kenya. The aim of the pilot project was to test the business case, the acceptance of the billing system by the user and respond to any requests for changes or problems. The pilot project confirmed many of the business case assumptions, particularly user acceptance of the billing system. Customer surveys and an evaluation study was conducted in June 2012. The study showed that customers were comfortable with M-Pesa and found it easy to use. Customers also commented on the limited compatibility of the TV and radio cables. As a result of this feedback the cables were modified to fit numerous brands.

The other six objectives of the pilot project are shown in the Table 2 with the results achieved.

Objectives	**Results**	**Comments**
Testing the technology	100 systems successfully installed and operational	Further improved identified for future versions
Proving the technology's affordability	Cost and payment budgets met	95% of customers paid on time while only 5% needed a grace period.
Decreasing collection costs with M-Pesa payments	Payments successfully made	Customers confidently used M-Pesa
Controlling the system remotely	Locked and unlocked the system on demand	Customers using grace periods were denied electricity until payment
Providing theft-protection	Theft deterrent or locking	Actually, the theft deterrent has proved sufficient for pilot conditions. No theft attempts were made.
Demonstrating minimal maintenance	Most SHS issues were resolved over the phone	Feedback has led to additional design improvements

Table 2: Results analysis for the main objectives of DT Power`s *Mobisol* project [1]

The viability of the business model has been confirmed as costs and payback budgets were met and the product and pricing plan was well accepted. Further, it has been also proven that the we need to make sure that any customer requiring a larger system will receive not only the option of upgrading his contract but we will also need a specific approach of taking batters and solar modules and moving either to new customers or finding other usage solution.

With one hundred systems in the field DT Power has effectively provided renewable energy to meet the local demand, thus lowering carbon emissions. DT Power has even taking the first steps for acquiring carbon credit certification. The stakeholder consultation meeting, required for the Gold Standard certification process, was attended in Arusha Tanzania on July 6, 2012.

5. Impacts

The socio-economic impacts were assessed by a series of surveys conducted by our customer care staff. The initial questions were asked when the customer signed up with subsequent questions over the phone and again after the system installation. This provided data on how the customers changed their habits and energy use patterns.

On the socio-economic side the most important impact was the radical increase in affordability for households that could not have made the initial upfront investment. The DT Power surveys tracked responses about the cost of energy before (typically kerosene for lighting and charging mobile phones) and after. The survey found that families having multiple appliances completely replaced (or replaced as much as possible) existing power sources with the premium or commercial *Mobisol* SHS systems.

Figure 4: Typical *Mobisol* SHS customer of DT Power [1]

The goal of replacing fossil fuels like kerosene was not only achieved, but children's education was also improved due to the increased availability of lighting as shown on Figure 4. Such results eventually support a reduction in poverty due to the positive impact on education. Our survey asked households how many hours of homework their children did per week. The answer was that after they had the *Mobisol* system their children did more than double the amount of homework as before.

Moreover, the local project organization Scode played an important role in encouraging local interest, reducing the cultural barrier to our customers, and laying down the basis for a successful project implementation. Mutual staff training including staff exchange from site to site resulted in better working results and worker satisfaction. Figure 5 shows Scode staff working on various sites during the pilot project implementation.

Figure 5: Local employment and learning as a result of DT Power`s *Mobisol* project [1]

One of the identified project risks was the poor experience had by community members with previous solar projects and failing low quality systems. This scepticism was overcome by *Mobisol* SHS's successful performance and the excellent promotion and support of our local staff. Once communities found out that there was only a limited number of *Mobisol* SHS systems available, demands further increased. Fortunately, DT Power is planning to proceed beyond the pilot phase by bringing further systems to Kenya later in 2012.

6. Future Prospects

Following the successful pilot project the next phase is planned with installation of more systems in the Nakuru region. With more than 30,000 families living off-grid around the city of Nakuru, the region has a high density of potential customers. The project ramp-up is intended to commence by the end of 2012. The system's technology has been further improved with the newest version of *Mobisol* solar controller, currently in production with improved TV and radio connections and further intelligent features preventing system overuse. The Figure 6 compares the pilot project controller with the newer redesigned and upgraded version.

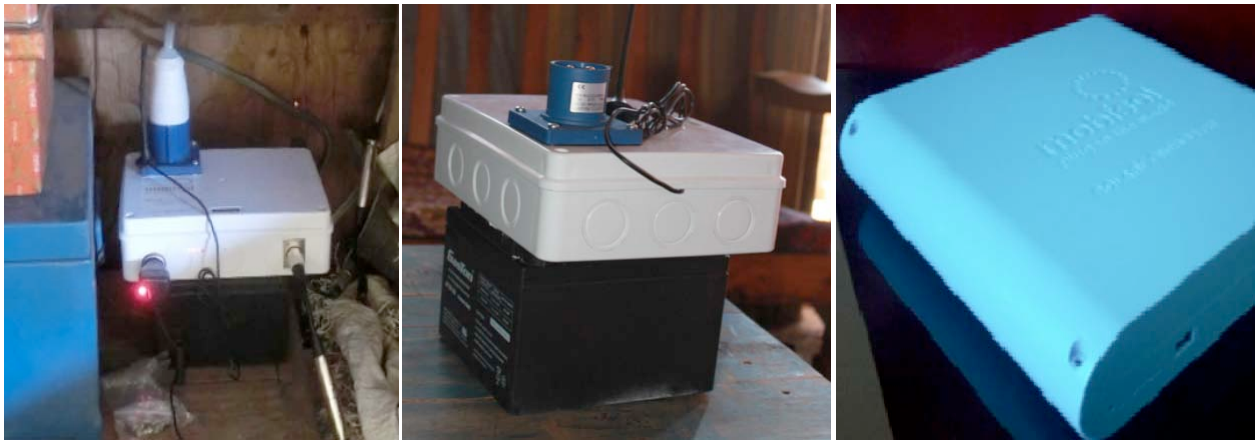

Figure 6: Pilot Project Controller (left and middle) and the Newer Redesigned Controller (right) [1]

The ramp-up of the initial sale from 100 units to several thousand systems is planned in cooperation with the global telecommunications company Vodafone or one of its competitors. Such cooperation will ensure a strong partnership with a locally established company having a strong interest in diversifying its service portfolio. The telecommunication companies have a strong dealer network throughout the country that can be used for distribution of the *Mobisol* SHS. DT Power will work closely with the telecommunications provider to provide GSM connection to the *Mobisol* SHS and collect the monthly payment with M-Pesa.

Furthermore, to spread the use of our system we are going to add features for charging multiple mobiles, renting out solar lamps, perhaps providing water pumping system for irrigation or even solutions for powering local village cinemas.

Additional improvement potential is possible in the area of maintenance through database administration, improved communication with field technicians, enhancing maximizing technical service visits, implementing spare parts inventory and distribution systems, maintaining a toll-free service hotline, encouraging customer feedback, and improving knowledge management systems for customer data, maintenance records, technical and manufacturing information, etc…

7. Conclusions

DT Power`s *Mobisol* SHS Kenya Pilot successfully completed all of its project objectives and aims. The pilot project provided important experience in the field that allowed the development of the improved product version. The survey feedback was useful for better understanding the target market and fine-tuning the service delivery for the next phase.

Challenges overcome during the process included initial resistance from target groups due to past poor experience. The *Mobisol* Kenya pilot project was able to prove the value of the product and was embraced by the target group. In order to learn from this experience we would recommend future projects to include questions in the baseline survey to determine how many similar projects the target group has personally been exposed to.

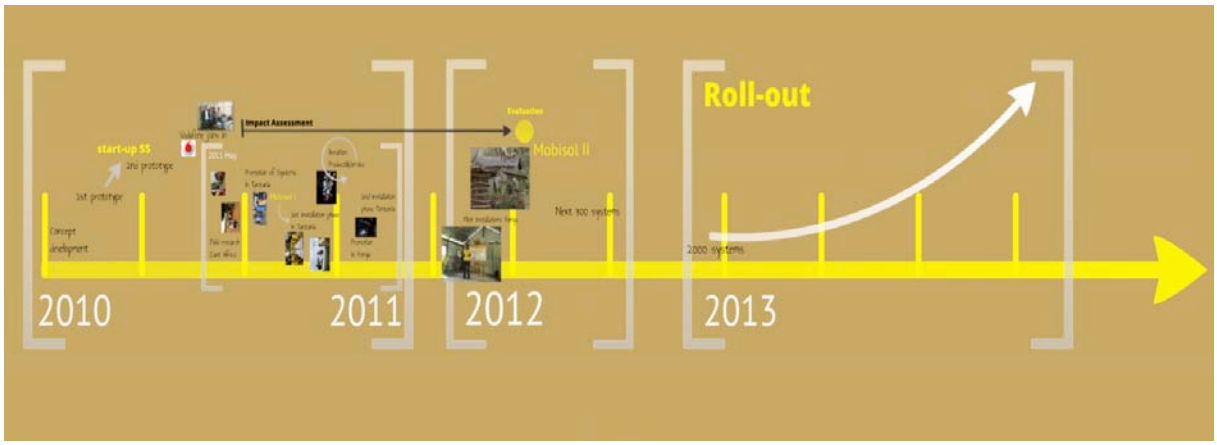

Figure 7: DT Powers *Mobisol* Project Timeline [1]

The *Mobisol* Project has been a rapid success considering that the initial business idea came only at the beginning of 2010. By the end of 2010 prototypes were already developed and the patent application completed. DT Power Switzerland was then founded in 2011 in parallel to the start of the pilot project that lasted for eight months. By the end of 2012 the roll-out plan was made forecasting several thousand systems primarily based on the not only expansion from the pilot project in Kenya, but also the parallel-run pilot project in Tanzania.

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