
TRANSFORMING LIVES IN ZIMBABWE

Rural Sustainable Energy Development Project

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The renewable energy access work of Oxfam and Practical Action in the Ruti and Himalaya communal areas of Zimbabwe has:

- **Improved health outcomes;**
- **Widened access to education;**
- **Increased production and boosted business and enterprise;**
- **Strengthened livelihoods;**
- **Enhanced quality of life.**

It is on the way to creating green communities that are independent of the national grid and becoming self-sustaining through the model it has developed. This paper contains a series of mini-reports documenting the human impacts of the work and the ways in which the systems operate.



INTRODUCTION

This paper captures the story so far of the Rural Sustainable Energy Development Project (RuSED) in Zimbabwe, and of some of the women and men living in poverty whose unflagging determination and hard work have driven it forward and who are now benefitting from it.

Zimbabwe is not producing enough energy to meet the country's demand, and is therefore partly dependent upon energy imports to provide its cities with electricity. In rural areas there are immense challenges facing attempts to extend the national grid. Fuel, spare parts and skills are all in short supply; poverty and isolation are widespread. In rural areas only 19 percent of people have access to electricity – and often not reliably. Without electricity, farmers cannot process their crops, add value or diversify their livelihoods. In schools and homes children struggle to study without light and are cut off from modern technology. Health clinics and particularly maternity wards are limited in the care they can provide, and women and infants can suffer and die as a result.

This is why RuSED was conceived. Running from August 2011 to January 2016, this project has received two million euros in funding from the European Union and Oxfam and is being led and implemented by Oxfam in partnership with Practical Action and in association with the Ministry of Energy and Power Development and the Rural Electrification Authority of Zimbabwe.

The project aims to enhance the lives and livelihoods of poor rural people by harnessing the powers of the sun and running water to bring electricity to remote and isolated communities in ways that are affordable and sustainable. Over the course of the last four years, Oxfam has implemented a solar energy scheme in Gutu District in Masvingo province, and Practical Action a micro-hydro project in Himalaya in Matshu District in Manicaland. The Himalaya scheme was commissioned on 8 April 2015. The Gutu scheme has many elements, including a solar pumping extension to the Ruti irrigation scheme which was commissioned on 10 April 2015.

RuSED further aims to bring the experiences and lessons learned to the attention of policy makers and more widely. This document contains a series of case studies that show how access to electricity improves health outcomes (which in turn boost people's productivity), widens educational horizons and boosts achievement. Above all, these case studies show how access strengthens livelihoods. The experience of the RuSED programme so far demonstrates that access to affordable and reliable electricity from the sun or from running water is crucial to boosting enterprise and increasing production.

While energy is necessary for increasing production it is not, however, sufficient in itself and the case studies highlight how energy access must be complemented by other activities – largely non-energy related – in order for people to be able to take full advantage of business

opportunities. The case studies also demonstrate how access to electricity improves the quality of people's lives, and in particular, the quality of women's lives. Access improves the social and psychological health of communities and, if implemented properly, their sense of empowerment. The process of attaining energy can literally 'energize' communities.

However, the story of solar equipment and hydropower projects in many countries – particularly when done with the aim of 'development' – is littered with examples of systems that have failed after varying periods of time. The whole basis of the work done by Oxfam and Practical Action has been to enable communities to take ownership, set their own priorities for energy use and devise payment systems such that they will be able to finance the ongoing operation and maintenance, and ultimately also expansion and improvement.

These case studies highlight lessons learned from what has been achieved so far in creating a 'solar system' in Ruti and a 'water cycle' in Himalaya so that they ultimately become largely self-sustaining – far from the grid, yet at the same time intimately connected to the world through modern communications and information technology. Much remains to be done in terms of activities to complement energy access that will enable enterprises to thrive, but progress so far has been very encouraging.

It is our hope in compiling these case studies that government, donors and partners will learn lessons from what has been done – and from what still needs to be done – that will prove useful in scaling up access to renewable energy across Zimbabwe as part of the rural electrification strategy and associated government initiatives. We hope too that general readers will be interested in our work, and for those particularly interested in solar and micro-hydropower, the case studies include technical annexes with equipment specifications.

The world is facing the twin challenges of how to increase access to energy, particularly electricity, to billions of people who lack it and whose lives and livelihoods are poorer as a result; and the necessity to do this while reducing use of fossil fuels that emit the carbon that is responsible for man-made climate change. As technology advances, and as solar and other renewable energies become increasingly attractive business propositions, the world is witnessing an accelerating renewable energy revolution. With its abundant natural attributes of sun and, in many areas, water, Zimbabwe – and its remotest villages in particular – could be in the forefront of this 'green energy revolution'.

'We are seeing a total transformation from a poor rural village to a globalized community. It is changing our lives and will change the lives of generations beyond. Now we feel part of globalization and it is also clean energy so we are contributing to the environment and reducing climate change.' – Denis Mawayo, Himalaya

CREATING A SOLAR SYSTEM: HOW ENERGY ACCESS CAN BE ACHIEVED

Oxfam has implemented a 'solar system' in the Gutu area that aims to create a self-financing and therefore sustainable solar energy market via a virtuous circle of increasing demand and supply. The supply of energy is the key to enterprise development, and enterprise development in turn drives effective demand for more energy.

The idea for RuSED grew organically. It came from using solar pumping to extend the potential of the Ruti irrigation scheme from 40 hectares to 60 and to benefit a further 96 farmers, bringing the total number of farmers in the scheme to 270. As explained later in this report, the irrigation project has been a great success – it is currently seeing farmers produce an average of 4 to 5 tons of maize per hectare, whereas on their dryland plots they have harvested almost nothing this year (2015) due to serious drought. They are also expanding into growing nutritious crops such as potatoes and valuable cash crops such as tomatoes and sugar beans.

Oxfam staff began the project with a survey in Gutu district to ascertain the costs that people bear in paying for energy. The survey found that typical expenditure on kerosene and candles came to between \$8 and \$15 per month, or between \$100 and \$200 per year. As so many of those surveyed indicated, that expenditure was still not enough to enable children to read at night, for farmers to extend their working hours or for women to give birth safely.

People were desperate for reliable, affordable and efficient light and electrical power.

At the same time, many people had justified suspicions of solar energy. Some types of solar lanterns on the market were cheap but unreliable and were, in fact, a waste of money. Furthermore, although the Rural Electrification Authority had installed solar facilities at several clinics in previous years, some had developed faults, ceased to function and were not being repaired. And solar programmes throughout the world have faltered because of two problems: the relatively high up-front capital costs of solar photovoltaic (PV) equipment, even lanterns, to get programmes started; and the lack of after-sales repair or replacement services to keep programmes going.

To overcome these problems and create a demand that was both keen and informed, Oxfam decided to establish a programme to enable markets to form and function successfully. Oxfam therefore next initiated a scoping study to determine the types and quality of solar lanterns on the market in Zimbabwe, and from this created a catalogue of products to which rural communities could refer. The next step was to identify solar

suppliers and invite them to meet the communities and exhibit, demonstrate and explain their products and answer questions. Eight exhibitions were organized, attended by some 700 people, 65 percent of whom were women.

These exhibitions were held at the Collection and Information Centres (CICs) at Gomba, Mataruse, Magombedze, Munyikwa, Denhere and Himalaya. The CICs are institutions set up under a previous food security programme with European Commission (EC) funding. They are linked to a series of market gardens and serve as places where individual farmers take their crops to be accumulated and offered in bulk to buyers. Members of the CICs examined the solar products and made individual choices about the products they wanted – almost always solar lanterns, although a few solar home systems were also requested.

To pump-prime the market Oxfam provided an initial batch of lanterns to each of the CICs. The CICs then sold them to their members and reinvested the money in various community initiatives through community fund mechanisms. To pay for the lanterns Oxfam encouraged people to form Internal Savings and Lending groups (ISALs), registered with the CICs. 25 groups out of 30 trained are now active, with 184 members in total.

Demand for lanterns spiralled as more and more people expressed a desire for them. To build up the community funds and create market momentum, Oxfam acted as the agent with the suppliers, bought the lanterns requested at wholesale prices and delivered them to the communities. The lanterns were then sold through the CICs to customers at retail prices and the funds invested in community energy initiatives. By May 2015, more than 3,840 solar lanterns had been ordered and sold in this way. As time has progressed however, communities have also increasingly been linking directly to the suppliers and have bought several hundred more lanterns with their own funds.

Over the course of time a number of lanterns were identified as being more reliable than others and the weaker ones were filtered out as communities gained more exposure to the products on the market and more experience of using them. The lanterns that were subsequently embraced by the communities are in an Oxfam catalogue and all meet 'Lighting for Africa' standards (see the technical annexes in this report).

The CICs already had premises in order to sell the produce from the market gardens, so the next step was to use part of the buildings to set up solar shops, called 'energy kiosks'. Each is powered by solar panels on the roof. Upon entering these energy kiosks, one sees rows of shelves of twinkling solar lanterns in the process of being recharged, along with numerous mobile phones.

With the energy kiosks established, and as money began to accumulate, Oxfam assisted communities to create Community Energy Funds (CEFs) and devise 'community-based energy plans'. These funds are dedicated to reinvestment in growing the solar energy business. In drawing up these plans, communities identified priorities in terms of their unmet

energy needs. For example, the community of Mazuru bought a 'solar suitcase' for their clinic, which they had seen demonstrated at a solar exhibition. Members also began to consider how access to energy could help them when thinking about setting up businesses: a solar fridge, for example, provided a further stimulus to ideas for fish farming and poultry rearing, and solar light enables sewing and tailoring to take place. The CEFs are managed by a fund manager and committee, working closely with the local chiefs and government, and they were provided with assistance and training from Oxfam. The training included business and fund management, links to markets and cost recovery planning for the services offered.

The cheapest solar lanterns, costing about \$15, are generally sold outright at the energy kiosks. The more expensive lanterns cost \$60 but are very much in demand because they are extremely bright, robust and long-lasting. For these lanterns energy kiosks typically have a rent-to-buy scheme whereby each buyer pays \$5 per month, or alternatively \$24 up front and \$2 per month thereafter, and at the end of 12 months the buyer obtains the lantern and also receives the solar panel to go with it (up until then they must recharge the lantern at the energy kiosk). A customer can recharge her or his lantern or phone for a typical fee of only 20 cents. As each lantern should work well for two to three years, this represents a massive saving over time on the cost of candles and kerosene. Repayment rates have been 87 percent.

A further crucial aspect of RuSED is the training provided to technicians at each energy kiosk so that they understand the products thoroughly, whether water pumps, solar lanterns or solar home systems. With this training they can demonstrate how to use each product and answer questions; repair solar panels, power units and lanterns; and replace batteries and other components. The technicians will provide maintenance services locally at a reasonable price.

At Denhere community the energy kiosk – which in this case is actually inside and owned and operated by the clinic – has just opened for business. The kiosk manager Richard Shonhiwa tells customers that there are six compelling arguments for choosing a solar lantern. These are:

- A guarantee they will be repaired or replaced if anything goes wrong;
- The brightness and the longevity of the light;
- The educational benefits that ownership provides to children;
- The robustness of the lamp;
- That having a lamp in the fields scares away hyenas and jackals;
- That light increases household security by deterring thieves and intruders.

Oxfam will be ending its role in RuSED by the beginning of 2016 but the solar system should continue to develop because links have been established between customers and suppliers, and business has been shown to be lucrative and beneficial to all parties. At Gomba Agro-Business Centre, where the community has already raised \$16,685, CIC

secretary Susan Mavuvo explained: 'Now we are able to buy our own stock of lights. We know the suppliers and we know which to get and where and how much each make costs, and in future we will be able to sell on our own and use the profits for the benefit of our families and of the community'.

At Magombedze clinic, for example, future maintenance of the solar systems will come from charging for the clean water which is provided by the solar pump and available at the school. Each of 63 villages in the catchment will pay \$10 per quarter and the two schools served will pay \$200 per term. In addition, individuals who come to fetch water will pay \$1 per month. At the energy kiosk, Tizvione Gutuza, the area officer for the Department of Agricultural Technical and Extension Services and (Agritex), explains how the community plans to use the proceeds from selling lanterns to support solar systems at the school and clinic, install solar water pumping in gardens and further refurbish the CIC building whose roof was torn off by strong winds. When Oxfam ends its role, he said, 'We will just keep on ordering the same lights. We will aim to work with the suppliers and correspond directly with them – because they are keen to make money!'

The amount of money raised in Gutu district through the sale of solar products and reinvested in community projects had reached almost \$53,000 by the time of writing and is growing every day.

Alongside the creation of a solar market the RuSED programme also installed solar power at four clinics and two schools, using solar panels to provide various combinations of lights and water pumping. The clinics have also benefitted from solar refrigeration. These particular clinics and schools were identified by the Rural District Councils and the Rural Electrification Authority as being a long way from the grid and lacking electricity. The health and education staff then met and decided which functions and places were priorities for solar electrification, for example maternity wards at a clinic or a laboratory for computers at a school. The solar systems can be extended later to power other parts of the buildings as funds become available. In Mataruse, for example, the community decided to use CEFs of \$6,000 to move solar panels from an existing borehole which had dried up in order to extend the solar array and put the panels on a new borehole to supply the clinic, as well as supply clean water to the primary and secondary schools. These interventions have had considerable impacts on health and education, as this report will later show.

The total number of people benefitting in one way or another from solar power across the district, as farmers and entrepreneurs, pupils and patients, is nearly 32,000.

Key aspects of the solar system

- Community-based energy planning to identify needs and set clear priorities
- Market analysis with a product benchmark of international quality standards
- ISALs mobilized and organized, and registered with CICs
- Renewable energy exhibitions by private sector suppliers giving people informed choice
- Kick-starting the market through Oxfam paying the private sector to supply chosen lanterns
- CEFs established to invest in prioritized energy plans

GOMBA: A GREEN VILLAGE FAR FROM THE GRID

The community of Gomba has come a long way in a short time to show how it is possible for villages in Zimbabwe to be energized through solar power, with a virtuous circle of increased production, better health and increased capacity to pay for solar products.

The 46 women involved in Gomba Agro-Business Centre certainly know the drawbacks and perils of using expensive and dangerous substitutes for green energy. Abigail Mawona described how, when she sent one of her sons to fetch mealie meal (a flour made from maize) by candle light, he accidentally dropped the candle and burned their house down. Mavis Sukali explained that she has asthma and using paraffin lighting made her condition much worse.

The CIC at the Agro-Business Centre raises funds primarily by selling solar lanterns and also by charging for mobile phone recharging. Since forming in August 2011, they have raised a remarkable \$16,685 (as of May 2015), which they have reinvested in making their community a better place to live and work.

They bought a 'solar suitcase' for their nearest clinic at Mazura (see the case study on health), and they have fitted out their energy kiosk, built toilet blocks and purchased a fridge, which will be used as a fish farming enterprise scales up. They have also purchased extra solar capacity. The majority of the lanterns so far have been bought by Oxfam on the community's behalf to build up their funds (see 'solar system') but CIC secretary Susan Mavuvo explained that the community is already ordering additional lights: 'Now we are able to buy our own stock of lights. We know the suppliers and we know how to get lights and where and how much each costs and in future we will be able to sell on our own

and use the profits for the benefit of the community’.

Solar lanterns are sometimes looked down upon because they only provide light and not power for machines, in contrast to solar panels and, to an even greater degree, micro-hydropower. However, this fails to sufficiently recognize how the presence of light enables people to employ their strength, dexterity and time so much more effectively and effortlessly – nurses are able to perform medical procedures, women are able to sew without straining their eyes, children are able to read at home, farmers are able to work late in the fields.

Perhaps as important and far-reaching as the material changes that have occurred are the changes in the mindsets of the participants. When interviewed for this report in May 2015, one woman confessed: ‘We used to drink beer and sit under a tree and do nothing but now we don’t have time for that, all we think about is... the project and how to make a profit!’ Others agreed that, ‘this has challenged us to use our minds and be innovative in terms of raising funds that we can contribute to the group, and now even the appearance of our households looks better’. Another woman added; ‘Our husbands are happy and now they give us money which they never used to give us to support our initiative’. Asked about their ambitions, the women agreed these are three-fold: to send their children to university, to open up more projects and streams of income (and do that sustainably), and to solve the water shortages affecting the community.

TRANSFORMING LIVES: HOW ENERGY ACCESS CREATES BETTER HEALTH

In parts of rural Zimbabwe, the cost of two candles can be the difference between health and hunger, and even sometimes between life and death.

Because clinics lack light, expectant mothers who are about to give birth are told they must bring their own candles to light the maternity ward. But as Primary Care Needs worker Merjury Shoko, of Mataruse Health Centre, explained ‘Two candles cost a dollar, which is the same as paying for one visit to the grinding mill to grind maize meal for your children’s dinner. That is a real dilemma for some women who cannot afford to pay. Do I go to the clinic now, or do I feed my children? It’s obvious they prefer to go to the mill’.

As a result many women, especially if they live far away, leave it until the very last possible moment to travel to the clinic; that is often too late and

they do not make it but instead give birth by the roadside, usually at night.

Health centre staff relate horrific tales of having to carry out emergency first aid procedures in the dark, with only a candle or a mobile phone torch to guide them. At Denhere clinic, Nurse in Charge Anastasia Mabhura described how when a young girl gave birth to a large baby, she struggled for four hours to stem the bleeding because she had no light to see to suture the tear. She had to wait until daylight to be able to see properly. At Magombedze clinic, Primary Care Nurse Mercy Chamisa explained: 'If you had to use a mobile phone torch you had to hold it in your gloved hand while operating, with all the blood perhaps on your glove; and then if, say, you had to repair a torn cervix you need a light beam that goes straight so you had to hold the phone in your teeth'.

'When you have to deliver a baby by candlelight it is terrible. The candle may fall or go out. The mother starts to scream...all of us are in the dark looking for the candle or matches'.

– Nurse Aid Diana Magapa, Mazuru clinic

At Mataruse clinic, Nurse in Charge Haruna Mukatyera described how she and colleagues struggled desperately to save the life of an expectant mother who needed intravenous fluids: 'It is difficult enough in the dark to locate the vein but she was also in shock so the veins had collapsed. There were four of us with three candles and it is so very time-consuming'.

Now at all five clinics solar power has transformed the working environment, the health of patients and the morale of staff. Magombedze, Mataruse and Denhere all have solar lighting, water pumping and refrigeration, Mazuru has solar water pumping and Muniyikwa owns an energy kiosk on the premises that has raised over \$1,000 so far, which will be used to invest in solar facilities at the clinic.

Anastasia Mabhura, Head Nurse at Denhere clinic, described what a boon the solar vaccine fridge has been. In the past, when gas canisters ran out, she had to get a bus 56km to the district centre. On the way back she often had to carry the heavy gas cylinder on her head for the last 2km. Now that the solar fridge is in place, the cold chain (i.e. the temperature-controlled supply chain) is completely reliable and the clinic has a 100 percent vaccination rate.

'For the first time, I'm actually able to perform my duties well! It was very difficult when you have all the knowledge and information as a nurse, but you can't perform your duties fully for lack of light'.

Improvements to the vaccination rate have also occurred at Magombedze. Primary Care Nurse Judith Masoka recalled how when the gas ran out there used to be a frantic race – usually by bike – to get the vaccines to the nearest clinic that had a working fridge, which was 17km away. Then the vaccines had to be retrieved when there was gas again, by which time some people had missed their appointments.

– Anastasia Mabhura, Head Nurse at Denhere, on the difference solar power has made to the clinic

All the clinics report increases of up to 50 percent in the numbers of women giving birth there instead of at home. Nurse Jerita Makura at Mataruse clinic said: 'Thanks to the project the dispensary and the maternity wards all have electricity and we can do deliveries at night without any hassle. More women are opting to come to the clinic for delivery, even from the neighbouring district, and having clean piped water from the solar pumps means better sanitation and hygiene'. Improvements in sanitation and hygiene practices have also been noted in the schools that share the clean water.

Primary Care Needs worker Merjury Shoko at Mataruse happily described how, when the external light turns on at 6 p.m., 'it's a sort of beacon!' She says people who would never have known that there was a clinic there see it and realize that the clinic is open.

Nor are the benefits of solar energy for health confined to what happens at the clinics. Even if a woman is unable to get to the clinic and must give birth at the roadside, solar power can be a life-saver. Batirai Chamunorwa, a traditional midwife, relates how she accompanied her niece Cecilia Mavingise in a race to get to Mazura clinic about 7km away. They didn't make it. But Batirai had a \$15 solar lantern with her, and this, along with her extensive midwifery experience, enabled her to assist the birth, tie the umbilical cord and finish the delivery process. She said: 'Many thanks to the solar lantern that I had bought because we used it all the way from home to clinic and it helped us a lot when she delivered her baby on the road. We don't know what we would have done if we had no light that night; the child and the mother could have died'. When Cecilia reached the clinic, the staff were able to use their 'solar suitcase' to illuminate the ward and carry out all medical checks on mother and baby.

Solar power has further health benefits. At the schools access to safe water means better hygiene and sanitation – and the clinics all say incidences of diarrhoea have dropped considerably. In the home, use of solar lighting improves cleanliness. Patricia Takorera, who had just given birth – by solar light – at Mataruse health centre explained: 'We are all farmers and busy all day so when we get home it is dark but now I have solar in every room I can see to clean my house'. In the fields, light enables farmers to avoid snakes and pitfalls. And via solar irrigation, more and more varied crops can be grown to boost nutrition, as at Ruti.

THE CASE OF MAZURU CLINIC

Mazuru clinic, which serves a population of 6,700 people, is some 20km from the electricity grid and some 70km from the main growth point (i.e. a place chosen as a development hub). It was supplied with a diesel water pump in 1988 but the water supply was rarely adequate because Gutu Rural District Council could only supply the diesel erratically. Head Nurse Ratiel Chikuvire explained: 'Besides that, even when diesel was available, the amount that we were allocated per month [25L] was inadequate to last for a month'. Furthermore, people in surrounding villages relied on the clinic's pump for their water too, which put great strain on the system. More costs were incurred every month in sending someone to Mupandawana growth point to bring the fuel back. In all, the clinic was spending about \$40 a month and still having problems. Ratiel Chikuvire said: 'We always had problems with maintenance of the diesel pump. In early 2000 the pump broke down and it took six years for it to be repaired'. After the pump broke, the clinic's staff had to go to Dopota Primary School 5km away to get water before commencing work each morning, and people in the neighbouring villages had to go to a dam or other open air sources.

The Rural Electrification Authority tried to overcome these problems by

installing a solar system, but by the time it was installed, the battery was old and did not work well so it was not able to provide enough power for lighting at night. Patients had to bring their own candles, and also their own water. As a result, women were reluctant to go to the clinic and the number of home births remained high.

All that has changed since Oxfam installed a solar water pumping system to replace the diesel pump and set up an additional 5,000L water tank. This benefits the clinic and its patients, the inhabitants of the neighbouring villages and the 765 staff and pupils at the local primary and secondary schools. Ratiel Chikuvire said: 'Ever since the solar water pumping system was installed we have never faced any water challenges. We switch the system on for an average of two hours per day and all the tanks will be filled with water, which can last for three days'. The solar pump is not only cleaner and quieter, it is much cheaper to run and has freed up funds to invest in better health care provision. Acting Nurse in Charge Judith Mandava said: 'The community around is now also getting free, safe water and the number of patients with diarrhoea is reducing – in fact now I have never come across a case since February'.

As well as the solar water pumping, the patients at Mazuru clinic have also benefited from a community-led initiative to purchase a solar suitcase for the maternity unit. The women from Gomba Agro-Business Centre saw the solar suitcase demonstrated by the supplier at an exhibition of solar equipment organized by Oxfam and they decided it was exactly what their clinic needed. It cost \$2,800, but they had raised enough money in their CEF through the sale of lanterns and recharging services. Judith Mandava demonstrated how the robust, bright yellow plastic suitcase holds three strong solar lights, a blood pressure gauge, a foetal scope and cell phone charging sockets. She said: 'It is nearly always midnight when women give birth and before when you were delivering the light would go out and you would be shouting at the mother, "Stop! Stop!" which was embarrassing! But the community saw the problem and they bought it for us in July 2013. Since then three-quarters of the women who give birth here [in this district] have given birth with solar'.

TRANSFORMING LIVES: HOW ENERGY POWERS LEARNING

Thanks to the RuSED programme, solar electricity for lights, water pumping and computers is being provided to two secondary schools, at Gomba and Mataruse, which were previously off the grid. Now the schools have leaped from being off-grid to being globally connected through the Internet.

On the day of interviews for this report, eager pupils were crowded around computers at Gomba High School for a history lesson that was designed to 'analyse the controversies related to the origins and rise of Great Zimbabwe'.(ruined city and UNESCO World Heritage Site.) Evidence, theories, deductions and opinions were projected onto the wall of the IT lab. History teacher Takuranavo Chivasa explained that although some pupils had visited Great Zimbabwe, others had not and trips were expensive. But for them 'it isn't necessary because we have the videos about the controversies and you can see the walls and the patterns, and it's the same as if you were there'.

For pupils, he said, having access to the Internet has fired their imaginations and encouraged reading. It has even changed their attitude towards learning because – he smiled in amusement – they seem to believe that what is on the Internet must be more reliable than what teachers or textbooks tell them, 'even though we say it's the same information as is in the textbooks'.

He explained there were two great advantages for a teacher. One is simply being able to project text onto the wall and not have to spend time writing in chalk on the blackboard with his back to the class. The second is the ability to find and download new textbooks, many by foreign publishers. This is much cheaper and easier than trying to locate textbooks locally as they can be scarce, old, expensive or damaged.

At Gomba the solar systems installed by RuSED were not sufficient to electrify the whole school so teachers were asked to prioritize which buildings and functions should be served. They chose to electrify the administration block, a computer laboratory and library for evening study. The teaching aids have increased to include five computers and a projector. Three computers are used by students and two are used by staff. Access to the Internet is thoroughly secured, and limited to academic sites.

Photocopying and the printing of exam papers are now done in the administration block, which not only saves money to use for other purposes but the school also now serves as a hub to print or copy papers for other schools in the area, and charges a fee for the service.

Solar lighting and electricity for computers are also on show at Mataruse Secondary School. They have three computers and for the first term in 2015 each student has been required to pay a one-off levy of \$15 so that the school can procure more. The school's ambition is to purchase at least eight computers and a photocopier/printer.

At both schools solar light bulbs enable students to study after school hours. At Mataruse, Deputy Headmaster Denlly Maphosa explained: 'The children really want to read! But they don't have a chance during the day, they are so busy. So it is only at night, and if they have no light they cannot'. The school re-opens at 6 p.m., the solar bulbs are switched on and often up to 30 students will return and read or do their homework; sometimes Denlly Maphosa will teach extra lessons. So keen are the pupils to learn that evening classes can go on as late as 10 p.m.,

although he notes that, unfortunately, access to late evening classes must usually be restricted to boys as girls face dangers travelling during the night.

At both Mataruse and Gomba lack of water and electricity was also a major impediment to finding qualified teachers. Instead the schools would be given temporary teachers, some of whom were unqualified school leavers. Denlly Maphosa said: 'We used to have serious water problems. We teachers used to have to go and fetch the water for the school and sometimes we'd be gone so long that the children would miss lessons. Now it is near our houses and that makes for much better retention of teachers'.

Health and hygiene for pupils and teachers was also at risk as there were no working facilities for hand washing at the toilets. At Mataruse both the secondary school and the primary school are benefitting from the solar water pumping system that was installed at Mataruse Clinic. An extension pipe was laid from the water tanks at the clinic to the schools.

At Gomba High School solar water pumps and two 5,000L water tanks were installed, and this reliable supply of clean water for children, teachers and local people alike has improved general hygiene. People who benefit from the water supply are charged a small fee that goes towards maintenance and repair of the system.

TURNING DREAMS INTO REALITY

Caution Gama, is a high flying student who has dreams of becoming a lawyer – but it was not always so and his progress is at least partly down to solar lights.

Caution, now in the lower sixth form at Gomba High School, was a poor student throughout his primary education and when he started secondary school he could only manage an average pass rate of one subject in seven.

He didn't like to study at night using candles and kerosene lamps. Even if he had wanted to, it was not always possible, either because his family could not afford the \$8 or so per month required to buy candles or kerosene, or kerosene was simply not available at the market.

The tables started to turn for Caution when he was about to sit for his Ordinary Level examinations. His mother Violet bought two solar lanterns in May 2013 and encouraged him to read every night.

Now he has six O-level passes at B or C grade in Geography, Shona, History, Religious Studies, English Language and Integrated Science. Caution said: 'When I passed my Ordinary Level, I decided to go to high school. I aspire to be a lawyer when I pass my Advanced Level and I will continue to study at night using solar lanterns to enable me to pass and achieve my dreams'.

And he is even more pleased that he can now study using computers,

'When my mother bought solar lanterns, I started reading every night from 8 p.m. to 11 p.m. and my performance started to change remarkably'.

– Caution Gama, student, Gomba High School

especially for Geography, his favourite subject. He talked excitedly about how '[he] can search and get access to photos and films of Mount Kilimanjaro and learn more about volcanoes'.

TRANSFORMING LIVES: HOW ENERGY ACCESS STRENGTHENS LIVELIHOODS

Access to water is fundamental to the fertility of farmlands and the prosperity of farmers across the nation. But getting water from A to B can be a backbreaking task.

At the market garden at Mazuru, rows and rows of vegetables stretch for hundreds of yards, forming a lush green carpet. The women working there proudly gather and show off the fruits of their labours for the visitor to see – spinach, cabbages, beans, tomatoes and other crops that will be sold via the CIC at Gomba Agro-Business Centre. But it is indeed hard labour that has produced this harvest, and one of the hardest and most time-consuming labours of all is fetching water.

Each gardener has an allocated 11 rows and in the dry season it is essential to water each row every day. Each woman has a walk of some 400m to the dam site and then back, carrying a bucket of water on her head. It takes two to three trips to properly water one row, so it may be necessary to make 20 to 30 journeys to the lake each day. A woman may walk 4km or more with a heavy bucket of water on her head. Watering can take a gruelling six hours: women start at 7 a.m. and do not finish until 1 p.m. That leaves little time for all the other essential work such as hoeing, weeding and tending to the plants – and the women are also responsible for the household cooking and cleaning. A diesel pump used to provide water to the garden but the women couldn't afford the rising fuel costs, and eventually the pump broke down.

Now the market garden members have decided that they have enough money in their CEF to buy a solar water pump which Oxfam is going to support. Jonathan Njerere, Oxfam Programme Manager, explains that with a solar pump women will be able to come to the site at mid-day when the tank has filled up and be able to water their gardens within an hour or two. And of course they will not have to pay for diesel.

At the Ruti dam the potential of irrigation is being realized on an even bigger scale. There, 60 hectares are being watered and cultivated and the results have been remarkable. 270 smallholder farmers who were previously growing little more than subsistence crops of maize can feed themselves, earn incomes and benefit their neighbours. Two thirds of the

Ruti scheme uses gravity-fed irrigation, and now a third phase of production is well under way using two solar booster pumps that pump water to a night storage reservoir. The Ruti scheme also hosts an energy kiosk powered by rooftop solar panels, which is providing cold storage and solar charging.

Irrigation enables farmers to obtain three harvests a year, and rotate between food crops and cash crops such as potatoes and sugar beans on the same land. Jeffrey Chara, treasurer for the irrigation scheme, said: 'This year we have harvested four to five tons of maize per hectare here, but we have harvested nothing on our dry land plots because of the drought due to climate change – and that is on top of the other bad drought recently [in 2013]'.

One of the biggest benefits of the irrigation scheme has been employment creation. Farmer Ipaisha Masvingise said: 'Long ago we used to have to go 93km searching for food on large scale farms. As you worked you were given food but to transport it back you had to sell some to pay for the bus fare. Now we don't need to go anywhere, we are empowered and what is more, we are giving other people jobs so job creation has been achieved'. Jeffrey Chara explained that workers receive maize for work and the irrigation farmers also have surplus maize to sell. He said: 'Our lives have changed significantly in all aspects. We are eating well and we are healthy and strong and we are working together as a family, husband and wife'.

An Oxfam evaluation of the Ruti irrigation scheme in 2012 found that household incomes had increased by 286 percent for the very poor, 173 percent for the poor and 47 percent for the middle wealth groups.

Oxfam has documented the achievements of the Ruti irrigation scheme. A forthcoming report will highlight the impact on jobs, incomes and food security in the wider area around the scheme. A report published by Oxfam in 2014, entitled 'Irrigation Schemes and Weather Extremes: The challenge for Zimbabwe'¹, argued that irrigation is becoming even more crucial as climate change bites deeper and extreme weather events become more frequent and more damaging. Irrigation can help even out the challenges presented by wildly fluctuating weather. In 2013/14 however, even this proved impossible. First, serious drought meant that water levels in the reservoir plummeted. Then heavy rains caused floods that sent boulders tumbling down onto the outlet pipe, fracturing it and reducing the water flow. The Ruti farmers have now repaired the pipe and embedded it in concrete for extra protection.

There are still challenges to overcome before the scheme can achieve maximum potential. Water pressure is a problem; the solar pump's capacity is reduced on cloudy days; the total amount of water flowing through the pipe has to be divided now between more farmers; phase 3 soils are not as fertile and need more inputs; and the storage dam requires a plastic membrane to stop it leaking. But the farmers are organized and working together to solve these problems, just as they worked together to repair the damaged pipe.

The farmers at the micro-hydro scheme at Himalaya are also now irrigating and looking forward eagerly and with renewed optimism. The project supports two irrigation schemes totalling 25 hectares, the second of which began running in May 2015, with winter crops like rape quickly

becoming established. There the electricity powers a pump at the bottom of the hill which pumps water up an 800m plastic pipe into a 300,000L storage tank. The water is then run out under gravity to hydrants and sprinklers.

With irrigation, farmers will be able to grow three crops a year and the area has the potential to recommence the commercial growing of valuable cash crops such as potatoes, sugar beans, wheat, peas, cabbage and fruit. Numerous companies that have heard about the scheme have been in contact.

Irrigation benefits are not confined to large-scale schemes either. The clinics and schools in Gutu that have solar water pumping have taken advantage of the new water supply to cultivate gardens next to the classrooms and they are selling the produce to raise funds.

CREATING A WATER CYCLE: HOW ENERGY ACCESS CAN BE ACHIEVED

In the mountainous eastern highlands bordering Mozambique lies the isolated subsistence farming community of Himalaya. It is 35km from the nearest tarred road and even further from the nearest electricity grid. But it is blessed by abundant rainfall, the year-round flow of the river Nyarukwetu and relatively fertile soils ripe for irrigation.

Through the RuSED programme, the community in Himalaya is now aiming to create a 'water cycle' that will see the power of water harnessed to generate profits, which in turn will enable the community to maintain and ultimately expand their energy system.

The hydro-electric potential of the area has long been understood: in the 1950s, a farmer built a canal to channel water to a grinding mill and to use for irrigation. In 2010 Practical Action installed a micro-hydro scheme in the neighbouring community of Chipendeke and created a mini-grid there. Now anyone who travels through Chipendeke sees a green and fertile valley with sprinklers emitting jets of water over the fields. Many people in the Himalaya community participated in building the micro-hydro scheme because their nearest clinic was – and still is – at Chipendeke. When the RuSED project started in 2011 the people of Himalaya had already seen some of the growing benefits at Chipendeke and were highly motivated to emulate and even out-do their neighbours.

Practical Action provided the expertise in programme design but the community provided all the labour and locally available material. The community was faced with a formidable physical challenge: how to lay a penstock pipeline for 300m up a steep, rough, boulder-strewn hillside. It would take 50 steel pipes, each 6m long and weighing 316kg. In addition, they would have to build pillars along the route to carry the pipe.

Eutious Chakanyuka Chirara, the secretary of the scheme, explained that

10 men lifted each section of pipe. The men worked in five pairs, one each side, and they carried the pipe on wooden yokes resting on their shoulders. Moving each pipe into position took two hours and it then had to be supported and bolted into place with the previous one. This work had to be done in between normal farming activities, yet was still completed in two months. 150 men took part in the process of moving the pipes. The women too had heavy work: nearly 100 women participated, carrying bags of cement and stones up the hill and bags of sand from the river to make the pillars. The cement was also used to repair the sides of the canal which had sprung several leaks, and renovate a forebay tank where the river water settles and discharges debris. From the forebay the pipe takes water down to the turbine, and there are also offtake pipes to the grinding mill and to the irrigation scheme.

The community then had to refurbish the 1950s power house and install the new generator, capable of a minimum 80KW. An even bigger task was to set up the power lines that carry the electrical power 4.6km to the energy kiosks and irrigation schemes that use it. For this a total of 74 poles were needed, which would have cost more than \$7,000. However, the community offered to provide all the poles from their own plantation as part of their contribution to the scheme. With Practical Action's help a pole treatment plant was set up and the treated poles now carry the power line.

The drive and determination of the Himalaya community has been extraordinary and gives great hope for the future. Both original households and resettled households worked together. Speaking in early 2015, Wilson Chemwanyisa said: 'Even before any monetary benefits accrue to the community, we are beginning to see the fruits of this good work. We used to be a forgotten community where service delivery was a nightmare. Now we even have news crews coming down and we are known even in Harare. Now the issue of the poor road network is on the table with the council and a lot of other big plans. In the past unity was just chanting slogans but now we are a united people. The enormous task we have done is testimony to this fact'.

The electricity powers two energy kiosks or energy centres. These are the focus of the income-generating potential of the project. Simbengadzibve Energy Centre has a grinding mill and a saw mill. The grinding mill is up and running and will provide services to 250 small farmers.

The saw mill is the most crucial money-making part of the system. The co-operative community owns abundant potential raw materials in the form of a 1300 hectare eucalyptus plantation, but has been unable to earn much income because they could not create added value, as unprocessed timber earns 10 times less than cut planks. Operations at the saw mill were delayed, to everyone's frustration, because of faulty components. But these were fixed and the saw mill began operating in mid-May 2015.

Tasimuka Energy Centre has five rooms to house small businesses. There are pre-paid metres in each and a computer at the turbine house

'We already have a large order for planks from a company in Mozambique who saw us on the television and with the saw mill up and running we should be able to provide them and others with regular supplies of cut planks'.

– Eutious Chakanyuka Chirara, secretary of the micro-hydro scheme at Chipendeke

with billing software. The enterprises operating or likely to operate include a barber's shop and a carpentry workshop, a business recharging solar lanterns and mobile phones, a general dealership, a dress-making and sewing enterprise and a community centre for watching TV which can be rented out. The tariffs set for the enterprises, in consultation with the Zimbabwe Energy Regulatory Authority (ZERA) and the Zimbabwe Electricity Supply Authority (ZESA) is 28 cents per kWh. Solar lanterns are rented out at \$5 a month for 12 months on a rent-to-buy scheme with a small fee of 20 cents for recharging. Gordon Mazhuwa, chairperson of the management committee, said: 'People have to go to Mutare for many groceries at the moment so having stocks here will be a great benefit, and the refrigeration to keep food fresh'.

The Himalaya micro-hydro project has enormous potential to improve livelihoods and some of this potential is starting to be realized. The Chipendeke micro-hydro scheme has been very successful and shows what is possible and as the two communities are fairly close together, this should make it easier for buyers to access produce and turn the whole area into a 'development pole', or regional development centre. At Himalaya, Practical Action made a deliberate attempt to connect the energy scheme with agricultural livelihoods from the start, particularly by including the irrigation component at the community's request. In a recent (July 2015) report ('The Energy-Water-Food Nexus at Decentralised Scales (poor people's energy briefing 3)')², Practical Action said: 'This dual irrigation and community services approach is a conscious improvement on the Chipendeke scheme, which though benefiting farmers through the provision of such services as power for grinding mills and workshops for fixing tools, failed in the early stages to recognize the needs, and crucially, the current water usage of some farmers'.

However, it is obvious that many challenges remain and for Himalaya to achieve its potential will require concerted efforts by government and the community. To diversify livelihoods requires more than just energy.

The community is constrained by its geographical position, especially by a poor road connection to potential markets and potential services. However, as Wilson Chemwanyisa indicated, the community now feels more empowered to demand road improvements. The community is also pressing for a health centre to be set up now there is ample electricity to power one. The nearest is at Chipendeke, but this is a full 35km from the very furthest point of Himalaya; six women have given birth on the road before they reached Chipendeke clinic in the recent past.

There is also the matter of what the community itself must undertake. The commissioning of the 80 kW Himalaya micro-hydro scheme in April 2015 was a key milestone in the RuSED project. As Dr Samuel Undenge, Minister of Energy and Power Development, said at the inauguration: 'You have been empowered, do not let go of this; otherwise you will return to being a bunch of subsistence farmers'.

Kevin Ndemera, Oxfam's Deputy Country Director, said: 'The problem is chicken and egg. The energy has great potential to overcome poverty, but poverty is in the way of realizing that potential. Until the enterprises

are fully up and running – and running well – then there will be challenges funding the energy infrastructure, but to get the enterprises going well requires strengthening people’s capacity to make money’.

To meet the challenges Oxfam and Practical Action agreed on a six-month extension to the project to run from July of 2015 to January 2016. In this period further work is being done with the Himalaya community – equally women and men – to further strengthen what has already been done in business planning and skills training, leadership and management training, facilitating contacts with contract farmers and further support to the local technicians who have been trained in maintenance.

Practical Action’s ‘Energy-Water-Food Nexus’² report concludes: ‘Overall our experience in Zimbabwe further illustrates that where there are no clear links made between the energy supply (or water usage) and mainstream agricultural livelihoods, important opportunities for development are missed, and the performance and sustainability of the energy scheme is put at risk. At the same time, undesirable trade-offs may well emerge. We found that it was only the strength of community institutions, built up through the approach taken to planning and constructing the scheme, together with the ownership and management structures put in place, which meant these trade-offs could be effectively dealt with’.

ANNEXE

SOLAR SYSTEM DESCRIPTIONS AND SIZES

Gomba High School is in Ward 13 of Gutu district of Masvingo province, 70km east of Mupandawana Growth Point and 20km away from the main electricity grid. It is close to the Gomba Shopping Centre and Gomba Clinic.

The school is equipped with a solar power system for lighting and power for computers at the school, which comprises the following equipment:

- A **2880W** solar array for recharging system batteries consisting of **12 X 240W** panels
- A **48VDC 420Ah** deep cycle gel batteries bank for power storage consisting of **8 X 12VDC 210Ah** batteries
- An **80A** Outback MPPT charge controller for controlling battery charging
- A **3000W** inverter/charger for AC power production powering lights and computers

The load for the solar equipment comprises **43 X 5W LED** bulbs and power points for computers.

The school is also equipped with a **1hp** solar powered water pump, which is powered by a **960W** solar panel array and pumps water into a 10,000L storage tank, distributing the water through five water tape points.

Mataruse Secondary School is in Ward 14 of Gutu district of Masvingo province, 78km east of Mupandawana Growth Point and 28km away from the main electricity grid.

The school is equipped with a solar power system for lighting and power to computers at the school, which comprises the following equipment:

- A **1950W** solar array for recharging system batteries consisting of **10 X 195W** panels
- A **48VDC 400Ah** deep cycle gel batteries bank for power storage consisting of **8 X 12VDC 200Ah** batteries
- An **80A** Midnite MPPT charge controller for controlling battery charging
- A **3000W** inverter/charger for AC power production to power lights and computers

The load for the solar equipment comprises **38 X 5W LED** bulbs and power points for computers.

Mataruse Rural Health Centre (clinic) is sited in a remote part of Ward 14 of Gutu district, Masvingo Province, 75km from Mupandawana Growth Point and 30km away from the main electricity grid.

The clinic is equipped with a solar power system for lighting and power for cell phone charging, which comprises the following equipment:

- A **520W** solar array for recharging system batteries consisting of **4 X 130W** panels
- A **24VDC 200Ah** deep cycle gel batteries bank for power storage consisting of **2 X 12VDC 200Ah** batteries
- A **30A** charge controller for controlling battery charging
- A **1000W** inverter/charger for AC power production to power lights and cell phone charging

The load for the solar equipment comprises **16 X 5W LED** bulbs.

The clinic is also equipped with a **1hp** solar powered water pump which is powered by a **900W** solar panel array, pumping water into a **7,500L** capacity storage tank for the clinic, secondary school and primary school in the area. The clinic is also equipped with a solar powered vaccine fridge powered by a **260W** solar array and a **100Ah** battery bank, maintaining temperatures between 0 and 4°C.

Mazuru Clinic is in a remote area of Ward 13, Gutu district, Masvingo province. It is 70km from Mupandawana Growth Point and 20km from the main grid. The ward has a total of 1,865 households and 7,594 people.

The clinic is equipped with a solar power system for water pumping, which comprises the following equipment:

- A **450W** solar array for water pumping comprising of **9 X 50W** panels
- A **1hp** solar powered water pump which is pumping water into a **10,000L** capacity storage tank for the clinic.

The clinic was also a beneficiary of a government programme led by the Rural Electrification Agency and received a donation of a solar powered electricity system for lighting the clinic and staff quarters.

The lighting system was boosted by the solar suitcase that was bought by the community using their community fund for renewable energy (see the section on health). The suitcase is a solar powered medical tool kit comprising a blood pressure (BP) testing machine and a small PV solar panel, battery charger and outlets for energy-efficient LED lights. It also includes several LED overhead lights and a headlamp, a foetal heart monitor, an outlet for 12VDC medical devices, as well as battery and phone chargers.

Magombedze Clinic is in a remote part of Ward 12, Gutu district, Masvingo province. It is 79km from Mupandawana Growth Point and 15km from the main grid. The ward has a total of 1,642 households and 6,701 people.

The clinic is equipped with a solar power system for lighting and power

for cell phone charging, which comprises the following equipment:

- A **720W** solar array for recharging system batteries consisting of **6 X 120W** panels
- A **12VDC 420Ah** deep cycle gel batteries bank for power storage consisting of **2 X 12VDC 210Ah** batteries
- A **60A** Outback MPPT charge controller for controlling battery charging
- A **300W** inverter/charger for AC power production to power lights and cell phone charging

The load for the solar equipment comprises **16 X 5W LED** bulbs.

As at Mataruse, the clinic is equipped with a **1hp** solar powered water pump which is powered by a **960W** solar panel array, pumping water into a **27,500L** capacity storage tank for the clinic, secondary school and primary school in the area. The clinic is also equipped with a solar powered vaccine fridge powered by a **240W** solar array, maintaining temperatures between 0 and 4^oC.

Denhere Clinic is sited in a remote area of Ward 2 in Gutu district, Masvingo province, 50km north of Mupandawana Growth Point and a full 50km from the main grid.

The clinic is equipped with a solar power system for lighting and power for cell phone charging, which comprises the following equipment:

- A **720W** solar array for recharging system batteries consisting of **6 X 120W** panels
- A **12VDC 420Ah** deep cycle gel batteries bank for power storage consisting of **2 X 12VDC 210Ah** batteries
- A **60A** Tristar MPPT charge controller for controlling battery charging
- A **300W** inverter/charger for AC power production powering lights and cell phone charging

The load for the solar equipment comprises **22 X 5W LED** bulbs.

The clinic is equipped with a **1hp** solar powered water pump which is powered by a **960W** solar panel array, pumping water into a **27,500 litre** capacity storage tank for the clinic, secondary school and primary school in the area. The clinic also has a solar powered vaccine fridge powered by a **240W** solar array, maintaining temperatures between 0 and 4^oC.

Gomba Agro-Business Centre (CIC) is located at Gomba Shopping Centre in Gutu District Ward 13, Masvingo Province. It is 70km east of Mupandawana Growth Point and about 20km from the nearest electricity grid.

The CIC is equipped with a solar power system for lighting and cell phone recharging which comprises the following equipment:

- A **250W** solar panel array for recharging system batteries
- A **12VDC 400Ah** deep cycle gel batteries bank for power storage

- A **20A** Stecca MPPT charge controller for controlling battery charging
- A **1200W** inverter/charger for AC power production.

The load for the solar equipment comprises of **4 X 5W LED bulbs** and 3 power points for cell phone recharging.

The CIC is also equipped with a **230L** solar powered freezer supported by a **250W** solar panel, **20A** Stecca MPPT controller and a **12VDC 200Ah** deep cycle gel battery bank. The freezer is capable of lowering the temperatures to below -11°C .

Solar Renewable Energy Products used in the RuSED programme

Product Name	Sun King	d.light Kiran S20	Little Sun Solar Lantern	Mobiya TS 120s Lantern	Schneider Home One Light Kits	Solar powered Medical suitcase
Product Picture	 <p>Photo: Greenlight Planet greenlightplanet.com</p>	 <p>Photo:d.light www.dlight.com</p>	 <p>Photo: Little Sun www.littlesun.com</p>	 <p>Photo: Schneider Electric www.schneider-electric.com</p>	 <p>Photo: Schneider Electric www.schneider-electric.com</p>	 <p>Photo: We Care Solar wecaresolar.org</p>
Specifications	<p>10W solar panel with an adjustable stand. Lamp detachable to be mounted or carried. Lithium ferro phosphate batteries, five year battery life. 46 hours daily run time. USB phone charging port.</p> <p>120lm.</p>	<p>Three–five times brighter than a candle or paraffin lamp. Integrated solar panel. Lasts four hours on a full charge if on high setting (eight hours on normal setting). Ultra-light replaceable iMH battery.</p> <p>25lm.</p>	<p>Replaceable battery. Panel, LED and body can last up to 10 years. Four hours' charging will provide lighting for eight hours before dimming. 25lm. Can be worn on a neck-tie.</p>	<p>Solar panel with 5m cable. Three brightness levels and backup duration. Up to 48 hours lighting per day on low setting, six hours on high. Lithium ferro phosphate battery. Mobile phone charger with USB port.</p> <p>120lm.</p> <p>Robust, water resistant. Can be hook- or wall-mounted or put on a bottle.</p>	<p>LED light with 50,000 hours of lighting. 12V Battery. 5Ah sealed battery. Light output 630lm, 5.5W when operated on AC.</p> <p>630lm.</p>	<ul style="list-style-type: none"> • LED medical task lighting • Universal cell phone charger • Battery charger • 12VDC outlets • 40 or 80W of solar panels (depending on needs) • Lead-acid battery • LED head torches • BP monitoring machine • Hand held foetal scan
Guarantee/Warranty	2 years	2 years	1 year	1 year	2 years	

<i>Product Name</i>	<i>Sun King</i>	<i>d.light Kiran S20</i>	<i>Little Sun Solar Lantern</i>	<i>Mobiya TS 120s Lantern</i>	<i>Schneider Home One Light Kits</i>	<i>Solar powered Medical suitcase</i>
<i>Advantages stated by RuSED participants</i>	Cell phone charging Portable Three power stages	Ultra light and portable Extremely durable	Durable and affordable, portable , popular design	USB port for cell phone charging Brightness Very robust User friendly: adaptable to various mountings	User friendly, portable, durable	Provide emergency DC lighting and key medical equipment such as the BP machine
<i>Manufacturer</i>	Greenlight Planet USA	d.light USA	Little Sun Germany	Schneider Electric France	Schneider Electric France	We Care Solar
<i>Purchase Price</i>	\$45	\$15	\$15	\$60	\$60	\$2800
<i>Main Supplier/Distributor</i>	Alight Zimbabwe	Zimbabwe Energy Group and Total Zimbabwe	Alight Zimbabwe	Samansco	Samansco	Zimbabwe Energy Group

NOTES

All web links were last accessed in July 2015.

¹ Magrath, et al. (2014) 'Irrigation Schemes and Weather Extremes: The challenge for Zimbabwe'. Oxfam. <http://policy-practice.oxfam.org.uk/publications/irrigation-schemes-and-weather-extremes-the-challenge-for-zimbabwe-322350>

² Gallagher, Mary and Stevens, Lucy (2015) 'The Energy–Water–Food Nexus at Decentralized Scales: Synergies, trade-offs, and how to manage them'. Practical Action. <http://practicalaction.org/media/view/48475>

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For further information on the issues raised in this paper please e-mail jmagrath@oxfam.org.uk.

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