

# The social value of solar lights in Africa to replace the use of kerosene

## Scoping report

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The word cloud on the front page was generated in NVivo using the qualitative transcripts from the interviews undertaken in this report. We would like to thank Thomas Gould, Liverpool John Moores University, for his help in designing the word cloud.

## Executive Summary

Approximately 600 million people in Africa have no access to electricity and use kerosene as a source of light. Kerosene is a combustible hydrocarbon liquid which is damaging to health. Direct contact with kerosene on skin can cause acute irritation, and inhalation of its fumes or smoke can result in symptoms such as coughing and dizziness, leading to possible long-term respiratory illnesses. In addition, kerosene is harmful to the environment by producing greenhouse gases. SolarAid is a charity working to build a sustainable market selling solar lights to communities in Africa as a safer alternative to the use of kerosene. SunnyMoney, SolarAid's social enterprise, supplies solar lighting as an affordable, safe and clean lighting alternative that allows families to study, work and live without the harmful effects of kerosene.

SolarAid are proactive in gathering and publicising their impact. SolarAid commissioned researchers at the Centre for Public Health, Liverpool John Moores University, to bring together the evidence relating to the impact of SunnyMoney. This was achieved by collating existing reports and databases, and conducting semi-structured interviews with SolarAid staff in the UK and working on the ground in Africa. The results were triangulated and presented by stakeholder group (organisations and individuals who experience a change as a result of an activity).

The key stakeholders benefitting from solar lights were SunnyMoney customers in general, the local community and environment, schools, children and families. A wide range of outcomes were demonstrated mainly relating to health, wellbeing, education, finances, and socialisation within and outside of the family.

It is recommended that a Social Return on Investment (SROI) analysis would provide an assessment of the environmental, social and economic impacts of solar lights on African communities. An SROI enables an organisation to support their impact using financial approaches. It balances the value of the investment with the value of the impacts; this method culminates in a statement that claims "for every £1 invested in the [service, organisation or activity], £x of social value is created (or destroyed)".

## Introduction

Approximately 600 million people in Africa have no access to electricity and rely on kerosene (typically known as paraffin) as a source of lighting in schools, homes and places of work. It is estimated that around a quarter of household income is spent on kerosene; as a result families may not be able to afford other essentials such as school fees and healthy food. Kerosene is a flammable hydrocarbon liquid which is a fire risk, and is also damaging to health and the environment. Inhalation of kerosene vapours or ingestion of the liquid can cause dizziness, headaches and vomiting. Repeated exposure by contact with the skin can cause dermatitis. Serious lung injury, such as pneumonitis, can occur if the liquid kerosene is taken directly into the lungs. Furthermore, kerosene lamps produce a black smoke which contributes to indoor pollution leading to eye irritation and respiratory illnesses.

SolarAid is an international charity that aims to eradicate the use of kerosene in Africa before 2020 by selling solar lights to rural and/or off-grid communities in African countries. Activities of the charity work in two ways: SolarAid sell solar lights in the UK, the price of which includes a donation for two solar lights to an African community; and a social enterprise, SunnyMoney (see Box 1), that raises awareness, promotes and sells solar lights on the ground in Africa. To date, SunnyMoney has successfully reached communities in Kenya, Malawi, Senegal, Tanzania and Zambia. The social enterprise has grown from selling 1,000 solar lights per month in 2010 to 50,000 each month in 2014. In March 2014, SunnyMoney sold its millionth solar light.

### **Box 1. The SunnyMoney model (taken directly from SolarAid (Summer 2013). Impact Report. p.6)**

“SolarAid believe that sustainable development is vital to the ambition of eradicating the kerosene lamp from Africa by 2020. This is why we have created an innovative model based on trade not aid. SolarAid does not give lights away; we sell them at a full but fair retail price through our social enterprise SunnyMoney. We create markets for pico-solar lights in remote African communities where low volumes mean that their sale is currently challenging. SunnyMoney undertakes the expensive and difficult task of building trust in, and access to, solar lights in areas with little infrastructure and poor retail networks. We know that when a thriving market takes shape, other players will enter the market, ensuring better supply, reduced prices and more availability to all.

This business-based approach not only gets solar lights to people quickly but provides job and business opportunities. We know that for some it is a struggle to find money to invest in a light so SunnyMoney also works on financing initiatives, such as pay-as-you go technologies, to make the technology more accessible in future.

SunnyMoney’s field teams visit an area, provide access to the lights through schools and then move to the next area. This maximises our reach and means more people get the opportunity to see how life-changing these lights are for themselves. As a social enterprise wholly owned by SolarAid, all of SunnyMoney’s income is reinvested back into our work. Donations are therefore recycled time and time again, giving more people access to clean and safe solar technology.”

Solar lighting is a safe and cost-effective alternative to kerosene with no installation or maintenance requirements and low costs. The benefits gained by switching from kerosene to solar lighting include:

- Improving health outcomes by removing the risk of kerosene exposure

- Contributing to reduction in fuel poverty and redirecting income towards food, school fees and farming inputs
- Improving education by allowing children to study or do homework in the evening
- Protecting the environment by reducing the amount of carbon dioxide that is produced during kerosene burning
- Increasing wellbeing by supporting social activity in families and communities
- Promoting freedom of choice and improved standard of living.

SolarAid have a comprehensive process for demonstrating impact whereby they conduct follow-up interviews with customers and stakeholders who benefit from solar lights. The data collection is standardised across the countries, analysed internally and communicated externally to illustrate their work and impact. SolarAid commissioned Liverpool John Moores University to conduct a scoping exercise to collate the current evidence they have collected on the impact of the SunnyMoney social enterprise. The aim of the scoping exercise was to indicate areas of key impact which could be used to demonstrate the social, economic and environmental effect of selling solar lights in Africa. This activity will inform the development of a full evaluation on the impact and social value of SunnyMoney using Social Return on Investment (SROI) (see Box 2).

### **Box 2. What is social value and SROI?**

The Public Services (Social Value) Act 2012 made it a requirement by law for public bodies in England and Wales to show how they improve the social, economic and environmental wellbeing of an area or community. Social impact methods, including Social Return on Investment (SROI) attempt to measure the wider benefits and value of commissioning or spending on customers, communities and the public; in essence social value asks the question: 'If £1 is spent on the delivery of services, can that same £1 be used to also produce a wider benefit to the community?'. SROI places a monetary value on key outcomes and calculates a ratio of the total value of the impacts to the total value of the initial investment or overall running costs. SROI provides a result that states "for every £1 invested in the [service, organisation or activity], £x of social value is created (or destroyed)". There are two types of SROI. Evaluative SROI is conducted retrospectively, and is based on activities and outcomes that have actually occurred during a specified amount of time (e.g. the last 12 months). A forecast SROI looks to the future and predicts how much social value is expected to be created if future activities meet their intended outcomes.

## Methods

### Semi-structured interviews

Seven people were interviewed between 20th March and 3rd April 2014 (four males and three females). Those interviewed included two staff from the UK based charity SolarAid and five people involved in SunnyMoney in Africa whose roles included: field staff focussed on selling solar lights; members of the research team who conduct research to look at product demand and identify what people are using for energy; researchers who looked at the impact of the solar lights upon beneficiaries and their community, and also used findings to increase knowledge and raise awareness of the solar light market; and those involved in running the school campaign.

The interview schedule was semi-structured and covered:

- the participants' involvement in SolarAid/SunnyMoney;
- the aims and main activities of SolarAid/SunnyMoney;
- the effects of using kerosene as a source of light;
- initial responses/perceptions to solar lights in African communities; and
- the main impacts of using solar lights instead of kerosene.

The interviews were transcribed and thematically analysed in order to generate key themes or patterns that emerged from the interview data. Using a qualitative method of data collection and analysis emphasises the participants' perceptions, feelings and experiences of the subject under investigation and provides a rich description of the entire data set.

### Secondary analysis

The focus of the secondary data analysis (i.e. existing reports and databases) was to identify outcomes of the solar lights for each stakeholder group. Stakeholder groups for the purpose of SROI analysis are people, organisations, or services that have an input into, or experience a change (positive or negative), as a result of the activity under question – in this instance, SunnyMoney selling solar lights in Africa to reduce the use of kerosene. This part of the analysis was used in triangulation with the qualitative data to illustrate areas of key social value of SunnyMoney and to inform the further work that would be needed to enable an SROI calculation.

#### *Document analysis*

The information included was gathered from three reports<sup>1</sup>. One was written internally by SolarAid and two were externally conducted pieces of research not commissioned by SolarAid but utilised their data and customers. These reports look at the ethos of SolarAid, including methodologies behind the SolarAid model and practice, and the impact of solar lighting upon stakeholders.

#### *Database analysis*

A number of databases containing information from interviews with customers, head teachers and parent teacher association members (PTA), household members and market surveys were examined in order to glean information relating to actual and possible impact of using solar lights.

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<sup>1</sup> References:

SolarAid (2013). Impact Report. Available from: [www.solar-aid.org](http://www.solar-aid.org)  
Smeets, L. and Beckers, M (2013). *Monitoring exercise TWAVEZA*. SolarAid/TPS Partnership. Route 67.  
Esper, H., London, T. and Kanchwala, Y. (2013). *Access to clean lighting and its impact on children: An exploration of SolarAid's SunnyMoney*. Next Generation Child Impact Series. Michigan, USA: William Davidson Institute, University of Michigan.

In the first instance, customer follow-up interviews were explored. Each country (Kenya, Malawi, Tanzania and Zambia) was initially looked at separately. For each country, outcomes that were identified were taken from collected data and analysis (charts and tables) that had previously been carried out on the data by SolarAid. After which, common outcomes across the four countries were identified. The head teacher and PTA, health workers, household members and market surveys databases were then considered to see if any additional impacts were evident.



## Results

### Qualitative analysis

A number of themes were identified from the analysis of the semi-structured interviews with participants. The main themes were: the aims and activities of SolarAid and SunnyMoney; the perceived benefits of solar lights; barriers to accepting solar lights; and views of the future of solar lights in Africa. These themes are discussed here accompanied with quotes to illustrate the points where possible. Where quotes have been used, participants have been allocated a number to preserve anonymity.

### The aims of SolarAid and SunnyMoney

All interviewees were clear and agreed with what the key aims of SolarAid and SunnyMoney are; the main one being the eradication of the use of kerosene lamps in Africa.

*“The aim of SolarAid is to reduce the use of kerosene in Africa. That is what we’re doing here in Malawi and it’s doing a great job.” (P2)*

*“We are all united with one goal to eradicate the kerosene lamp from Africa by 2020.” (P7)*

The way in which this is being achieved is through the SunnyMoney social enterprise to provide better access to clean, renewable and brighter energy through the distribution and sale of the “pico” (small) solar lights in rural Africa, where people do not have access to electricity.<sup>2</sup>

*“Generally [the aim is] to increase the market for solar lights and direct people away from using kerosene to a more sustainable form of energy.” (P3)*

### Methods of raising awareness, disseminating information about solar lights and purchasing solar lights

The main activities of SunnyMoney that were highlighted were the school campaign (see Figure 1 for a diagram of how the school campaign works) and the agent network programme. Market research, looking at existing lighting methods and awareness of the solar lights, and research looking at the impact the solar lights is conducted by SolarAid to assist the charity and SunnyMoney in distributing solar lights effectively.

*“Currently the main activities revolve around our social enterprise SunnyMoney who are the largest donor [seller] of solar lights in Africa. It’s all about delivering and enabling people to purchase solar lights in Africa through the education networks, feeding the market and building demand so that local people can benefit from the market and economic opportunities it builds.” (P7)*

#### School campaign

Everyone who was interviewed was aware of the processes that were involved in raising awareness about the benefits of solar lights, particularly from an educational perspective, and selling solar lights to those in rural areas.

*“The main activities are selling different solar lights to the rural people of Malawi particularly targeting school children to help them with their education.” (P2)*

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<sup>2</sup> The majority of respondents referred to the entry level lights as the main products that were sold to individual people/families. A number of other solar lights are available (country dependent), and details of these can be found in: Esper et al (2013). *Access to clean lighting and its impact on children: An exploration of SolarAid’s SunnyMoney*. Child impact case study No.4. Ann Arbor: The William Davidson Institute.

The main method of disseminating information about the solar lights appeared to be through the school campaign, working alongside schools through the Ministry of Education for specific regions. Within this campaign, head teachers were used as a vehicle through which to promote and increase knowledge about the solar lights as they are seen as respected and trusted members of the community.

*“We use head teachers as we want to promote the solar light as an educational tool, but they are also well respected and trusted members of the community. They are a good access point and also a good way of educating people and raising awareness as some people have never seen the lights before.” (P1)*

Following on from this, once a set period of time had lapsed (usually 2-3 weeks), the head teachers would take payment for the lights from students/families and then exchange this for a solar light. Follow-up sales were also provided for those people who were interested in buying a solar light, but needed additional time to save. The initial wave of beneficiaries buying solar lights through the school campaign sometimes encouraged other individuals to buy a unit on recommendation from their friends and neighbours. Follow up deliveries of solar lights to the head teachers from SunnyMoney were conducted at suitable times. It was highlighted that the entry level lights were very popular as they were most affordable.

#### *Agent network programme*

A newer arm to SunnyMoney’s activities that was highlighted by a number of interviewees is the agent network programme. This makes it possible for communities and/or individuals to buy lights directly from SunnyMoney and sell these on. One respondent gave an example that SunnyMoney provides agent training to local entrepreneurs and encourages members of the community to save up a small amount of money to start a small business that sells SunnyMoney solar lights.

*“The community responds by either buying the products by buying them directly from entrepreneurs or from the heads [head teachers] themselves. The families have access to the lights through the heads.” (P2)*

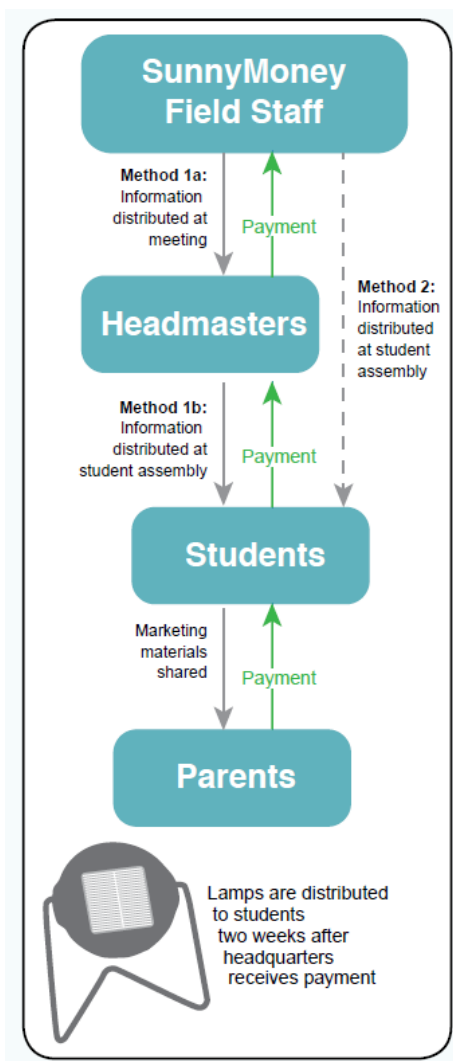
It was highlighted by one of the respondents that beneficiaries were informed that although the agents were fully responsible for selling the solar lights, they would be selling them at a higher price than if they had been bought directly from the school.

#### *Word of mouth/experience of using the solar lights/previous purchase*

Word of mouth was considered very important in raising awareness and also encouraging people to purchase solar lights. It was highlighted that once customers had bought one light, many went on to buy more. Also, where there was possible doubt about the efficacy of the product, for example, with the ‘pico’ lights and the amount of light produced, once customers had purchased a light, they could see how they worked and were encouraged by this.

*“...once a customer has bought a light the word gets round that they are good and they work.” (P4)*

*“...because of word of mouth there is a tendency of [mis] trust in the product where actually they don’t know if this is a true product, but if they see a neighbour with this light then they say ‘wow, I want to buy this, where can I get it?’ so they tell them where they get it from....anything up to 50-60 per cent of sales are from people who are buying because of word of mouth.” (P5)*



**Figure 1. SunnyMoney School Campaign Model<sup>3</sup>**

### **Perceived benefits of solar lights (compared to using kerosene)**

Participants were asked three questions. The first asked about the main adverse effects of kerosene. The second explored the initial response to solar lights in African communities and the third requested the participants to share their insights of the main impacts of using solar lights as opposed to kerosene. Due to the nature of the responses given, in that there were a number of common overarching themes that emerged across the questions, it was decided that responses from these three questions would be reported upon together.

When asked about the perceived and actual impacts and adverse effects of the use of kerosene, respondents highlighted a common number of areas where issues were apparent. It was cited by all respondents that those purchasing and using the solar lights have a better overall quality of life and health and wellbeing. They also stated that having solar lighting provided people with better opportunities, such as improved financial stability, improved educational attainment, and better social interaction and relationships.

<sup>3</sup> Esper et al (2013). *Access to clean lighting and its impact on children: An exploration of SolarAid's SunnyMoney*. Child impact case study No.4. Ann Arbor: The William Davidson Institute.(p.17)

### *Health*

A number of common health complaints were cited with the use of kerosene, including sore eyes, coughs and lung complaints such as chest infections, and kerosene poisoning.

*“...also for the small kids at home because for some reason people decide to keep kerosene in a soda bottle, I don't know why, so you can get a kid taking a soda bottle and trying to drink it thinking it's water.” (P5)*

All of the respondents stated that self-reported improvement in health was common amongst those who had purchased solar lights.

*“...where families have stopped using kerosene they have reported less coughing in the house, fewer/less chest problems.” (P1)*

### *Education*

It appeared that the solar lights were predominantly used for child study because of the way in which the lights were marketed and distributed.

*“What we have seen from our schools campaign, is that for people in Africa, education is an investment, so solar is being used mostly, so around 80 per cent of the sales that we get it's solar lights being given or purchased for the students to use at home.” (P5)*

It was reported that head teachers and customers described children studying for longer, attending school more often, having better concentration and generally being more motivated. Previously, kerosene would have provided limited light to study after dark and also there would have been financial cost implications of studying by kerosene light.

*“..children are studying together more, so studying in a group around a solar light and I don't know if that's just because solar lights give off more light or because people are motivated to study with the light there. And these are only really early observations, but I think that's really exciting.” (P7)*

One respondent considered that it had also improved educational quality overall.

*“Educational quality at both ends, so for teachers – they are given lights as well so that they are able to plan lessons better – and students.” (P1)*

### *Communication*

Generally there was the view that solar lights encouraged and improved social relationships. One respondent said that there was the perception from customers that they feel more developed at an individual or household level in terms of their standard of living because they have access to this form of lighting.

*“[there is the] Perception that they feel more developed, important, when people say 'it feels like we're living in town' because the electricity's that bright...they have an awareness of development, of improvement.” (P1)*

It was discussed by the interviewees that people spent more free time together as a family and interacted with social networks more often because they had bright light available. Also they did not have to worry about the cost of powering a kerosene lamp to provide light. The increase in social connection was considered a very important benefit of the solar lights that was often overlooked.

*“..people are more social, having friends over. They don't send children to bed when it goes dark. They sit and have dinner together.” (P1)*

*“What we’ve found is a lot of customers telling us that they use their solar lights for just sitting around and talking in the evening or being able to spend time as a family and that’s a really important if often overlooked benefit of having [solar] lights.” (P7)*

It was suggested by one respondent that solar lights were used for improving social networking and overall communications through, for example, phone charging and listening to the radio.

*“With technology, most of the solar lights also have other components like phone charging and radio, so it means there are much more benefits that the community is getting when they get solar lamps like the ones that we are selling which have a phone charging element everyone needs access to better communication. There are phones in the community, but where do they charge them they have to walk long distances or pay extra money. So apart from just lighting it brings other necessities that the community needs like phone charging and radio, so better communication and information sharing.” (P6)*

#### *Financial*

It was felt that kerosene was very expensive (taking up to 25% of a household’s income) with fluctuating prices due to poor availability and sales on the black market. After an initial outlay, it was suggested that solar power was cheaper as there was no regular outgoing of money (just one payment for the solar light), and this had been supported by anecdotal evidence given by customers. The interviewees discussed SolarAid data that suggested that the money spent on a solar light could be recouped in up to 12 weeks.

*“The biggest one and the most direct one customers talk about the most is the savings they make, so [the customers] purchase the light then they can recoup the cost of that lights quite quickly within 12 weeks, so yeah it’s a big investment but after 12 weeks all of that extra income is total savings.” (P1)*

*“The return on investment when you buy pico solar lights should be mostly one or two months, rather than buying kerosene, which has a lot of harmful effects and then it doesn’t have any return.” (P5)*

The money that the customers no longer spent on kerosene was now spent on necessary items, such as food, education, transport and business.

*“So families can reduce whatever method it is that they’ve been using before, so batteries for torches or kerosene for lamps. And so once the solar panels are there to charge from the light that money’s not being spent on lighting and their savings are spent on food, educational costs (school fees, books, uniforms) and farming inputs, business development (such as a market stall).” (P1)*

*“One immediate impact is that the financial burden is lifted off the families because then they don’t have to buy kerosene or batteries or any such thing. And mainly it really does improve their life because they spend less on lighting.” (P3)*

One respondent also highlighted that families were saving money because they were not spending as much money on medicines because they did not have as many health issues which needed to be treated.

#### *Environment*

It was suggested that the impact of solar lighting upon the wider environment was not necessarily something that was thought about at a household level by those people who had bought the solar lights. From an organisational level, many of the respondents

acknowledged that solar energy was a 'clean' form of energy that has a global impact as it reduces (through the reduced use of kerosene) CO<sub>2</sub> emissions that contribute to greenhouse gases. It was also highlighted that a reduced use of kerosene has an immediate impact upon the local environment and levels of air pollution in terms of reduced smoke (which contains black carbon and CO<sub>2</sub>).

#### *Other*

Respondents generally reported that solar lights provided instant, brighter light and made people feel safer (for example, nearly all of the respondents spoke of the reduced risk of house fires and associated impact) and more confident.

*“Kerosene and candles are a big fire hazard, with poor light they can't see what they're doing. They are more confident and feel safer having this [solar] light.” (P1)*

*“...villages burning due to falling down of kerosene lamps causing death of children especially, loss of property.”(P2)*

Another example given by two of the respondents was that the lights help people to see potential threats such as snakes as the solar lamps were used as torches to look after animals after dark.

### **Barriers to uptake of solar lights**

#### *Awareness*

It was highlighted by many of the respondents that there was a need to build awareness of the solar lights as a new technology and also the associated impact that they have upon, for example, health and finances when compared to the use of kerosene.

*“The demand is there, but awareness is a challenge...In general people want and like solar lights. They do understand why they need them. So we need to raise awareness as most people don't realise/don't believe there are other alternatives out there.” (P6)*

One respondent stated that this was of particular importance in rural areas.

*“...maybe the level of awareness for solar lights needs to be increased as it is low in rural areas and it gets lower the further you go in to more rural settings. That's where you find the response to the lights gets even more positive as people are looking for one option for lighting.” (P3)*

Generally, however, it was felt that those who did come in to contact with the solar lights were impressed with them.

*“...there is one response that cuts across most respondents [customers]...most of them are surprised and a little bit impressed with the lights. So most of the respondents that you introduce the lights to have never heard of it or seen it before so they are impressed by it and develop an interest, and I haven't met anyone who has been shown the light and has had a negative response to it.”(P3)*

#### *Availability and timing*

One respondent suggested that people wanted to have access to the SunnyMoney team on a more permanent basis, or at specific time of the year. In this instance, however, it was highlighted that improvements were being made with the introduction of the agent network, which enables people in the community to sell the lights.

*“One of the common requests is that they want us to be there in the community all the time for that they want us there at a specific time of year, for example, during harvest time as that’s when the families have a lot of disposable income; whereas if you’re going at a different time of the year they’re just never going to be able to have that income to hand. So that’s another one of the biggest barriers.” (P7)*

### **Cost**

All of the respondents agreed that the cost of the lights was still seen as a huge barrier, as purchasing one required people to make a significant initial investment (\$10USD for an entry-level light). This is money that they may not necessarily be able to spare (even though in terms of comparing to cost of kerosene it is cheaper in the long term). However, it was highlighted by one respondent that different ways of paying were being explored, such as pay-as-you-go technology.

*“..we only have a small percentage uptake, but we’re doing lots of work to explore pay-as-you-go technology, that will enable people to pay by weekly instalments or monthly instalments that will enable them to not have to pay out more than they would normally pay on kerosene each week.” (P7)*

*“...I think there is a different culture around savings than you might have in a developed country, so it’s not often easy and again that’s why it’s important teaching and raising awareness about solar lights and why it’s good to buy one and then people understand that they will save money in the long run because when you’re living without savings it’s not something you think about every day.” (P7)*

It was also suggested that if the solar lights were something that the individual/families really wanted they would find the money from somewhere.

*“..if it’s something they value and truly want they will find the money from somewhere.” (P7)*

### **Trust in the product**

It was highlighted that because the product is new and there are also fake or imitation, poor quality products on the market, trust is an issue. One respondent also stated that there was mistrust because community members think the lights should be free and that someone is trying to make a profit from selling solar lights.

The use of teachers in the school campaign was highlighted as a way of encouraging people to have trust in the product.

*“So they really are very integral to everything we do because we’ve found that the main barrier we had when we first started trying to sell solar lights was trust in the product, affordability is a problem, availability is a problem, but actually even once you get in to a community for someone who has been using kerosene all their life and they need to make a big investment in the solar lamp. It’s a huge debt to make, but by seeing a trusted figure in the community use the solar light and advise that they should also use them, we are kind of breaking that barrier of trust. So they really are very, very integral to our model.” (P7)*

### **The future of SunnyMoney**

A number of suggestions were outlined by the respondents:

- Catalyse a market for the solar lights as a self-sustaining product. This would focus upon increasing competition within the market, which will directly impact upon quality and pricing.

*“..It’s about building that longer term legacy that means people are getting better access in terms of both price and availability. That’s the big part of the story as well.” (P1)*

- Continuing to build awareness for how solar power is cheaper and healthier than kerosene lighting. Also making people aware that there are actually alternatives to using kerosene that are available.
- Expanding the agent network programme.
- It was highlighted that some communities felt that the costs were a little bit high for the standards of the people; therefore it may be necessary to promote other ways of paying for the solar lights. For example, the pay-as-you-go scheme mentioned earlier.

*“...also need to look at the cost. So make sure that the product is within the buying power of the community, so should be affordable enough that everyone should be able to buy if we are to hit our target of eliminating kerosene lamps from Africa everyone has to have a good light so price factor is very important as well.” (P6)*

- Ensure the longevity of the product.

*“Longevity of the product is vital, essential when trying to sell the lights as [people] don’t want something that is going to stop working not long after it has been bought and then need to pay more money to replace.” (P6)*

## **Secondary analysis**

The main outcomes that were identified during the analysis of the existing data and information can be found in Tables 1 and 2. The outcomes are separated by the beneficiaries of the SunnyMoney activities of selling solar lights to replace the use of kerosene as a source of light. For each outcome, we indicated whether it was an actual outcome (has been shown to have happened) or a potential outcome (not yet taken place). Two reports (Esper et al, 2013 and Smeet and Beckers, 2013) contained a wealth of information relating to the impact of solar lights on children. This showed that the effects were different for customers’ children aged less than eight years compared with those aged over eight years. It also linked the effects of SunnyMoney on dealers’ children and children in the wider community. Our analysis concentrated on the overall outcomes associated with children; however, the specific details relating to the different groups of children can be found in Appendix A.

A wide range of benefits were identified. Outcomes relating to health and wellbeing, education of children, saving money that would have been spent on kerosene, social activities and reducing the harmful effects on the environment were shared between the document analysis and database analysis.



**Table 1. Outcomes identified from the document analysis**

<b>Beneficiary stakeholder group</b>	<b>Outcome</b>	<b>Actual or potential, future benefit</b>
<b>General/all customers</b>	<p><b><i>Better overall health</i></b></p> <p>Reduced respiratory issues (coughs, chest infections), risk of burns, eye irritation and poisoning from reducing indoor air pollution. Indoor smoke is said to cause 400,000 deaths in sub-Saharan Africa per year</p>	Actual
	<p><b><i>Financial savings</i></b></p> <p>Savings are made from spending less on kerosene (equivalent to £50/year) and other forms of lighting (such as candles and batteries) as well as savings from kerosene-related medical expenses</p>	Actual
	<p><b><i>Providing jobs and business opportunities</i></b></p>	Actual (business opportunities) Potential (jobs)
<b>Children (general)</b>	<p><b><i>Increased study hours</i></b></p> <p>This equates to an average of one hour additional study time per day</p>	Actual
	<p><b><i>Improved performance in school</i></b></p> <p>For example, scholastic achievements and grades</p>	Actual and potential
	<p><b><i>Better aspirations and developing higher expectations</i></b> (for the future)</p> <p>Confidence that they can do well in their education and seek higher paid jobs</p>	Actual
	<p><b><i>Increased attendance, motivation and concentration in class</i></b></p>	Actual
<b>Environment/local community</b>	<p><b><i>Overall improvements in air quality</i></b></p> <p>Improvements in ambient air and reduction in carbon emissions that significantly contribute to climate change (figures show 40% of customers interviewed cut kerosene use completely after buying a solar light)</p>	Actual
	<p><b><i>Reduced risk of fire</i></b></p> <p>Decrease in the number of house fires caused by live open flames and kerosene lamps exploding</p>	Actual

<b>Families</b>	<p><b><i>Improved general wellbeing</i></b></p> <p>This comes from the freedom of being able to choose this type of power (solar lights) for their home (it reduces their reliance upon kerosene and other forms of lighting) and the feeling that it has a visible impact on their social status</p> <p style="text-align: center;"><i>“I am very happy because the living standard of our family is more like one in town now” (p.5, SolarAid 2013).</i></p>	Actual and potential
	<p><b><i>Perceived improved standard of living</i></b></p> <p><i>“Households are proud of their solar lights and think of themselves as technologically advanced for using them.”(p14 Esper et al 2013)</i></p>	Actual and potential
	<p><b><i>Socialising</i></b></p> <p>Families can spend more time together even when the sun goes down. For example, parents and siblings spending more time with each other on educational activities (which benefits the whole family)</p>	Actual
	<p><b><i>Time</i></b></p> <p>Women are able to spend more time during the day (when it is light) on income-generating activities and complete household chores after sunset. Parents use the entry level lights for cooking, ironing, farming, walking outdoors at night</p>	Actual

**Table 2. Outcomes identified from the database analysis**

<b>Beneficiary stakeholder group</b>	<b>Outcome</b>	<b>Actual or potential benefit</b>
<b>General/all customers</b>	<p><b><i>Financial savings</i></b></p> <p>These savings are then used in other areas such as investing in farming/business, food, savings, school fees, medication, paying bills, clothing or soap</p>	Actual
	<p><b><i>Health improvements</i></b></p> <p>From for example, reduced coughing/chest problems, reduced contact with toxic air/flames, reduced allergies, reduced eye problems, healthier diets (savings used for food), safer form of lighting</p>	Actual
<b>Children (general)</b>	<p><b><i>Children are able to study for longer and at night</i></b></p> <p><i>“It is beautiful how they changed from using the smoky paraffin light to solar lights for their evening prep.”</i></p>	Actual
	<p><b><i>Increased or improved educational performance and better exam results</i></b></p> <p>This was overall for those using solar lights and also when compared to those children who do not use solar lights. For example, they are completing their homework on time and even asking for further study. This was also suggested to have an impact upon attendance, because with positive performance in school, the children are encouraged to attend more</p> <p><i>“A great difference in their performance ‘cause they were using solar lights.”</i></p> <p><i>“I can clearly say that there is a difference as one boy bought it and he was able to study and emerged the best in the zone and later proceeded to a very good secondary school.”</i></p>	Actual and potential
	<p><b><i>Improved reading and writing skills</i></b></p> <p><i>“They are able to study in their home and performance is impressive and it is improving and also their reading levels are now improving as this was a problem we were experiencing with most of our pupils.”</i></p>	Actual
	<p><b><i>Reduced tiredness in children attending school</i></b></p> <p>The children are able to study by brighter, more efficient lighting, which makes them less tired and has less health impact than the effects of inhaling kerosene smoke, for example, eye irritation and headaches</p>	Actual

	<p><b>Improved health of students</b></p> <p>Head teachers cited improved health of children attending school who have solar lights, so less coughing, headaches and sore eyes, particularly when the children are preparing for exams</p> <p><i>“Most of the solar light student users have better performance, and their health I well improved since they are not prone to coughing or headache soon after exams due to big preparations they do during the exams.”</i></p> <p><i>“There is a big difference; the ones with the lights are doing fine at school.”</i></p>	Actual
	<p><b>Psychological wellbeing</b></p> <p>The use of the solar lights means that students are no longer worried that they do not have enough time to prepare for exams for example.</p> <p><i>“Most students have improved their performance, and their health have been stabilised as no much chest problem affected them and they have no worries on the limited time to do exams preparations.”</i></p>	Actual
Environment/local communities	<p><b>Reduced pollution from the smoke</b></p> <p>Solar lights are a safe, clean and reliable form of lighting/energy</p>	Actual
	<p><b>Increase/improved social activities</b></p> <p>It was suggested that solar lights were an aid communication in that people use their solar lights to charge their phones; they are also able to socialise (‘chat’) more with family and friends; take walks outside after dark</p>	Actual
	<p><b>Increased safety</b></p> <p>The solar lights meant that people had lighting during blackouts; makes cooking easier and safer; can be used as a torch when outside; used while sleeping or in bedrooms</p>	Actual
Healthcare system	<p><b>Financial savings</b></p> <p>Whilst those using solar lamps showed definite improvements in health, when needed, it was cited that additional money that was saved through not using kerosene, was also being spent on healthcare and medication</p>	Actual
Health workers	<p><b>Work-related safety</b></p> <p>They stated using the solar lights as a light to check patients on ward at night time, and for lighting in the labour</p>	Actual

	<p>ward, also as a back-up when the hydroelectricity was not working and to provide light when writing monthly reports</p> <p><i>“When the hydroelectricity is not working I use it when writing my monthly reports and attending to patients at night.”</i></p> <p><i>“I use it when I am going round the wards and I use it as a torch at night when I am movin[g] from the outpatient department to the wards as there is a distance between the two.”</i></p>	
	<p><b>Safety during travel</b></p> <p>Lights were used for safety when travelling to and from work</p>	Actual
<b>Local/wider economy</b>	<p><b>Financial savings</b></p> <p>These savings are spent in other areas such as investing in farming/business, buying food, and clothing, which will have a positive impact upon the local/wider economy</p>	Actual
<b>Patients</b>	<p><b>Quality of care for patients</b></p> <p>Health care workers suggested that solar lights have had a direct (positive) impact upon the quality of care given to patients. In instances where lighting may have gone out, patients can still be cared for and assessed or looked after without any inconvenience</p> <p><i>“The care given to the patients has changed very much, when we would use candles we would not be able to put drips or do infusions on patients as it was really hard to see but the solar lights have adequate lighting and now it is possible to do these things.”</i></p> <p><i>“Very much, now we can do episiotomy suturing when the lights are off during load shedding which was very hard to do before with battery torches or torches from phones.”</i></p>	Actual
<b>Schools</b>	<p><b>Financial savings</b></p> <p>It was suggested that the money saved from not buying kerosene was then spent on school fees, which has a positive outcome for both the children attending school and the school itself</p>	Actual
<b>Teachers</b>	<p><b>Improved quality of teaching and lesson content</b></p> <p>Teachers use solar lights at night for writing lesson plans</p>	Actual

## Discussion

SolarAid is an international charity that aims to eradicate the use of dangerous kerosene lamps in Africa before 2020 by encouraging the use of solar lights in rural and/or off-grid communities in Africa. Since setting up its social enterprise, SunnyMoney, more than one million lights have been sold. Solar lighting provides a cleaner, safer and cost-effective alternative to kerosene with no installation or maintenance requirements.

This scoping exercise found that there was a wide knowledge among staff as to the aims, objectives and health benefits of solar lights sold by SolarAid and SunnyMoney, and that this united approach was evident across all African regions. The school campaign worked well, and was considered the main method of disseminating information and distributing solar lights. The agent network programme also worked well in supporting communities to develop small businesses and entrepreneurial skills.

Word of mouth proved the most successful way of raising awareness of the lights; with many customers returning to purchase more once they had seen them in use for themselves. Many myths (regarding quality of the light) were dispelled once the lights had been seen in communities, which led to more sales. However, a number of barriers were also reported, relating to: awareness of the solar lights; the initial outlay of the solar lights; and trust in the product.

The synthesis of data and information identified a variety of stakeholders being affected by SunnyMoney - from the direct customers, their children and families, to wider beneficiaries such as the environment and local community. The main benefits of the solar lights instead of kerosene lighting were wide-ranging. These included: a better overall quality of life and health and wellbeing; improved education and social interaction; cost savings; and an improved local environment (Table 3). However, some of the outcomes may create a chain of events so that there may be future, more significant, social impact that cannot be captured yet. For example, education is very important for children and families in these African countries. Having access to clean, safe lighting increases the amount of time students spend on study in the evening. Whilst this is an important result for scholastic achievements, there are intermediate and long-term outcomes that may signify a higher social value, such as the ability to move on to further education and/or secure a better job. These outcomes are indicated in the final column of Table 3.

In summary the evidence showed that, although initially buying a solar light is an investment for low-income families, there are multi-faceted benefits creating social, economic and environmental outcomes.

### Recommendations

This report has summarised data and documents that were made available relating to the impact of SolarAid and social enterprise SunnyMoney. As much social value is gained from the purchase of solar lights, it is recommended that an evaluative SROI is conducted to fully understand the impact of SunnyMoney in terms of social value. Briefly this would involve the following activities:

- Involve and liaise with the stakeholder groups to decide on a monetary value for each outcome that satisfactorily describes its worth to the majority of the beneficiaries
- Determining how much of the outcome can actually be claimed by SunnyMoney. To do this, stakeholders decide on the levels of deadweight (how likely the outcome would

have happened anyway), attribution (how much other influences have contributed to the change), and drop-off (how long the outcome lasts)

- Estimate the sample size of each stakeholder group (where the stakeholder group are individuals rather than an organisation) and work out how many individuals actually experience each outcome to support the SROI calculation
- Determine the value of the inputs into the activities of SunnyMoney mainly those relating to SolarAid, but also possibly the time schools invest promoting solar lights via the school campaign
- Constructing the impact map (a tool used for recording the information and computing the SROI result) and calculating the ratio of the total value of the investments to the total value of the outcomes.

A proposal detailing the methods and costs to conduct an evaluative SROI has been provided to SolarAid separate to this report.

**Table 3. The key stakeholders and current and potential future outcomes of SunnyMoney**

<b>Stakeholder</b>	<b>Input into SunnyMoney</b>	<b>Outcome</b>	<b>Potential future impact</b>
<b>SolarAid/ SunnyMoney</b>	Staff salaries in Africa; marketing; distribution; research and M&E		
<b>General/all customers</b>		Improved health	Less reliant on medical interventions/services/medication (long-term impacts possibly greater for children than adults)  Higher productivity and less time off work
		Improved wellbeing including feelings of safety	
		Better communication/socialisation	
<b>Local community/ environment</b>		Redirection of finances not spent on kerosene (food/household items)	Families of local businesses have higher income/improved standard of living
		Improved local air quality	Reduction in CO <sub>2</sub> levels
<b>Schools</b>	Promoting solar lights through the school campaign	Redirection of finances not spent on kerosene (school fees)	An extra child being able to attend school
		Better attendance of students at school	Better overall grades/achievements of school population
<b>Children</b>		Increased study hours leading to better educational performance	Better grades/better job/further education
		Increased aspirations	
<b>Families</b>		More family time and socialisation	
		Redirection of finances not spent on kerosene (farming inputs and/or businesses)	Improved standard of living (using household income or self-reported perceptions as the measure)



## Appendix A. Impact relating specifically to children

The document by Esper et al, (2013) looked at the impact of solar lights on children aged 8 and under. This research involved a review of the literature, speaking to 'thought leaders' about the types of impact using 'clean light' has on children, and conducting in-depth qualitative interviews and focus groups with key stakeholders (namely SunnyMoney customers, dealers and the broader community) in Kenya and Tanzania. Three separate groups of children were highlighted: customers' children, dealers' children and children in the broader community. The impacts relating to each of these groups are provided below.

### Customer's children

- Increased financial resources (actual)
  - Savings from no longer having to buy kerosene and pay for kerosene related medical expenses redirected to children's needs such as nutrition and education (takes approximately 8-10 weeks to recoup initial outlay of the solar light)
- Improved education/knowledge (actual)
  - Younger children were found to sit and interact with older siblings whilst they studied
- Improved physical health (actual)
  - Reduced kerosene exposure leading to reduced risk of respiratory illness, burns and less eye strain
- Improved psychological health (actual)
  - Increased feelings of security and control over their environment after sunset
- Improved support (actual)
  - Parents are able to spend more time with their children discussing homework
- Improved home environment (actual and potential)
  - Reduction in the chance of household fires (compared to kerosene based lighting)
- Aspirations (potential)
  - Increased expectations for the future including continuing education due to improved performance and studying more
- Interactions (actual)
  - Increased risk of conflict with siblings because of light use
- Adaptability (actual)
  - Increased ability to assimilate in to the school environment by being more prepared

### Dealers' children

- Increased financial resources (actual)
  - Due to additional parental income that add to children wellbeing
- Improved entrepreneurial skills (potential)

- From witnessing their parents sell products
- Increased knowledge and interest in renewable energy (actual)
- Increased social capital (actual)
  - From parents' social network results in increased resources for children

### **Children in the broader community**

- Improved aspirations (actual and potential)
  - For the future resulting from young girls seeing female dealers running their own businesses and earning money
- Improved ambient air quality (actual)
  - Through reduced use of kerosene

The research by Smeet and Beckers (2013) involved 43 semi-structured interviews with students and teachers, and 319 surveys with children in public and private (excluding boarding) secondary in schools in Tanzania. The students' ages ranged from 12 to 22 years old. The impact relating to students is provided below.

- Study behaviour (actual)
  - Solar lights were shown to positively affect students study behaviour. Students were shown to study more often at night, had better concentration, enjoyed doing (and completing) their homework and had less physical symptoms such as sore eyes (statistically significant compared to using kerosene). A solar light was seen to give students control of one of the main challenges at home, which was no electricity and no money for kerosene
- Psychological wellbeing (actual)
  - Students did not worry about if and when they did their homework and also cited that it made them more motivated
- Socialising (actual)
  - Activities that solar lights are used for (other than study) included discussing with friends and leisure activities or playing

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