

ACCESS TO CLEAN LIGHTING AND ITS IMPACT ON CHILDREN: AN EXPLORATION OF SOLAR AID'S SUNNYMONEY

By Heather Esper, Ted London, and Yaquta Kanchwala

Solar-based lighting in off-grid and/or poorly electrified communities reduces the reliance on poor-quality, highly polluting and expensive kerosene-based lighting and other disposable alternatives such as candles and non-recyclable batteries. A solar-powered lamp when turned on produces no emissions, is a renewable and reliable source of energy and requires no overhead or underground electrical wiring. This case examines the impacts a social enterprise distributing solar lamps to the Base of the Pyramid (BoP)ⁱ has on children and how these impacts can be enhanced. SunnyMoney is an initiative of SolarAid, a non-profit organization that seeks to “eradicate kerosene lamps from Africa by 2020.”ⁱⁱ The initiative began in 2009 as “a business with a social goal”ⁱⁱⁱ, a self-sustaining enterprise to support SolarAid’s mission. SunnyMoney sells pico (or micro) solar products to residents of BoP communities with limited access to electricity in Kenya, Tanzania, Malawi, and Zambia, and markets the lamps through schools and existing entrepreneur networks.

We looked across SunnyMoney’s value chain in Kenya and Tanzania to assess the company’s impacts on children age eight and under. We assessed the impacts from reducing the use of kerosene lamps by using small household solar lamps (the S1 model by d.light) that cost an average of 10 USD per unit and typically provide three to four hours of clean, good quality light per night. We found that once a solar lamp is purchased, families begin to save money in the

ⁱ The BoP—estimated at approximately 4 billion people—is the socio-economic segment that primarily lives and operates micro-enterprises in the informal economy, and generally has an annual per capita income of less than 3,000 USD in purchasing power parity (PPP).



long term, by reducing kerosene costsⁱⁱ and kerosene-related medical expenses—enabling more financial resources to be channeled toward their children’s needs. We also found the increased ability for customers’ children to study longer hours and spend more time with parents and siblings on educational activities. These children also benefit from the reduced exposure to kerosene’s toxic fumes and reduced risk of burns. While the majority of impacts occur on customers’ children, children of SunnyMoney’s dealers benefit from the additional income earned by their parents, when directed toward their needs. In addition, children in the community benefit from the improved quality of ambient air and reduced emission of carbon dioxide, released when burning kerosene. Carbon dioxide, a greenhouse gas, is very likely to be the main cause of the current global warming trend, according to the Intergovernmental Panel for Climate Change (IPCC).ⁱⁱⁱ

ⁱⁱ A kerosene lamp producing 37 lumens for four hours per day will consume about three liters of kerosene per month (Rao, Stanford University). One liter of kerosene costs 1.01 USD (as of December 2012) in Kenya (not accounting price differential in rural and urban Kenya).

ⁱⁱⁱ As stated in the Intergovernmental Panel on Climate Change’s (IPCC) Synthesis Report: Climate Change 2007



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ABOUT THE SERIES

UNICEF states that poverty reduction should start with young children (UNICEF. 2000. Poverty Reduction Begins with Children). The first years of life have a large influence on an individual's long-term well-being. Poverty at an early age can cause lifelong damage to children's future and perpetuate the cycle of poverty across generations. Thus early childhood interventions offer an opportune time to influence the poverty cycle. The effects of poverty can be passed on to children through their parents; improving the well-being of parents therefore can also enhance the well-being of their children.

This series was funded by the Bernard van Leer Foundation, a private philanthropic organization focused on improving the lives of children from birth to age eight. The goal of these cases is to gain a greater understanding of the ways in which businesses in emerging markets impact young children's lives and the potential to optimize impact on children. We also hope that these case studies will influence development and impact investing leaders to include metrics related to young children in their measurement systems.

IN THIS SERIES

IMPROVED HOUSING AND ITS IMPACT ON CHILDREN: AN EXPLORATION OF CEMEX'S PATRIMONIO HOY

Patrimonio Hoy provides construction materials to low-income consumers in Mexico, Nicaragua, Costa Rica, Colombia and the Dominican Republic through a 70-week payment plan that allows its customers to build onto their current homes or build new homes room by room.

IMPROVED SANITATION AND ITS IMPACT ON CHILDREN: AN EXPLORATION OF SANERGY

Sanergy builds 250 USD modular sanitation facilities called Fresh Life Toilets (FLT) in Mukuru, a large slum in Nairobi, Kenya, and sells them to local entrepreneurs for about 588 USD. Franchisees receive business management and operations training and earn revenues by charging customers 0.04-0.06 USD per use.

DIVERSIFIED FARM INCOME, MARKET FACILITATION AND THEIR IMPACT ON CHILDREN: AN EXPLORATION OF HONEY CARE AFRICA

Honey Care Africa (HCA) of Kenya supplies smallholder farmers with beehives and harvest management services. HCA guarantees a market for the beekeeper's honey at fair trade prices, providing a steady source of income.

ACCESS TO CLEAN LIGHTING AND ITS IMPACT ON CHILDREN: AN EXPLORATION OF SOLARAID'S SUNNYMONEY

SunnyMoney sells pico-solar products to BoP communities with limited access to electricity in Tanzania, Malawi, Kenya, and Zambia. It markets the lamps through schools and existing entrepreneur networks.

IMPROVED INCOME STABILITY, TRAINING, MARKET FACILITATION AND THEIR IMPACT ON CHILDREN: AN EXPLORATION OF VILLA ANDINA

Villa Andina of Peru produces high-quality agro-industrial food products through its work with local smallholder farmers. The venture trains farmers in organic cultivation techniques and provides guaranteed payment for the crops produced.

IMPROVED HEALTH CARE AND ITS IMPACT ON CHILDREN: AN EXPLORATION OF PENDA HEALTH

Penda Health provides high-quality, evidence-based, standardized primary care, both curative and preventative, to low- and middle-income families in Kenya while also specializing in women's health care.

BUILDING A SCALABLE BUSINESS WITH SMALL-HOLDER FARMERS IN KENYA: HONEY CARE'S BEEKEEPING MODEL

This teaching case study examines Honey Care Africa's transition from obligating farmers to maintain their own hives to providing hive management services. Readers will explore strategies to reduce side-selling and opportunities to generate greater impacts on farmers' families, in particular young children. The case can be found on GloboLens.com.

Also included in the series is a summary article, Focusing on the Next Generation: An Exploration of Enterprise Poverty Impacts on Children, that aggregates findings across the above six ventures.

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EXECUTIVE SUMMARY

According to the World Bank, 1.4 billion people live without access to electricity, with nearly 590 million in Africa, over 400 million in India, and the remainder in other developing countries.³ Africa has the lowest electrification rate of all global regions i.e. 26% of households (and an even lower rate of 14.2% in rural sub-Saharan Africa⁴). Electrification is failing to keep up with the region's population growth. It is estimated that Africa's non-electrified population will grow from 110 to 120 million households (630 million people) by 2015. Additionally, 20 million households are considered under-electrified i.e. they have intermittent and low-quality electric grid supply.⁵

While those in the developed world take access to clean, efficient, safe, and reliable lighting for granted, life stops after dark for hundreds of millions in the developing world. This affects their ability to carry out basic human activities such as cooking and cleaning, and income-generating opportunities such as conducting business or working in factories after sunset. Without electricity, the poor cannot access modern hospital services, refrigeration for food and medicines, and after-school educational activities. For children, lack of lighting equates to inability to read, study, and an increased risk to go outside after dark.

Off-grid and under-electrified households use alternate sources of lighting such as kerosene lamps, candles, and/or disposable batteries in flashlights (also called torches). Across the African continent, an estimated 53% of off-grid households use kerosene-based lighting and spend \$4.4 billion a year on the fuel.^{6,7} Using poor quality lighting from kerosene lamps increase the risk of household fires, personal injuries such as burns and kerosene poisoning and, in the long term, the risk of chronic respiratory diseases due to harmful emissions.⁸ Additionally, kerosene emits approximately 2.5 kilograms of carbon dioxide (CO₂) per liter; and it is estimated that Africa's Base of the Pyramid's (BoP) use of kerosene-based lighting accounts for 20 million tons of CO₂ emission per year, further exacerbating the concentration of greenhouse gases (GHG) in the atmosphere.⁹ According to the Intergovernmental Panel for Climate Change (IPCC), "the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations".¹⁰

Alternate sources of lighting such as candlelight increases the risk of fires and personal burns and does not provide sufficient lighting to families. Disposable, non-rechargeable batteries to power torches, cumulatively drain household income over the long term, have a high risk of contaminating local water and soil resources with toxic heavy metals,¹¹ generate non-recyclable waste, and provide a poor amount of lighting.

Solar lamps provide a number of benefits over the alternatives discussed above: Once the solar lamp is paid for, families save money over the long term through reduced usage of kerosene, candles and/or disposable batteries. Clean and reliable solar lighting reduces the risk of fires, incidence of burns and respiratory illness in children and adults, and decreases expenditures on kerosene-related medical expenditures. When children gain additional hours of light and spend that time studying, they improve their grades and develop higher self-confidence, which plays a role in their desire to continue their education, seek higher-paying jobs, and develop higher expectations for the future. With availability of light, women can spend their daytime hours on income-generating activities and complete their household chores, like cooking and cleaning, after sunset. Reduced kerosene use also positively impacts the environment through reduced CO₂ emissions. But solar lights can be cost-prohibitive: according to studies conducted by Lighting Africa, a 20 USD off-grid lamp will have a payback period of 8.4 months under a kerosene rural^{iv} pricing scheme (i.e. 1.30 USD per liter) and 11.4 months under an urban pricing scheme (i.e. 0.96 USD per liter). Note the kerosene displacement rate^v is 60 milliliters per day in this scenario.¹²

iv Rural and urban pricing of kerosene differs due to the poverty penalty- the per unit cost of kerosene is higher when bought in smaller quantities.

v More expensive lamps have higher performance levels and/or a larger number of light points that result in greater levels of kerosene displacement.

We examined the impacts that solar lamps when introduced, have on children age eight and under by studying the influence of SunnyMoney. SunnyMoney is a market-based initiative of SolarAid, a non-profit organization that seeks to “eradicate kerosene lamps from Africa by 2020.”¹³ The initiative began in 2009 as “a business with a social goal”¹⁴, a self-sustaining, market-based enterprise to support SolarAid’s mission. SunnyMoney, headquartered in Nairobi, Kenya, sells pico (or micro) solar products (made by multiple manufacturers including India-based GreenLight Planet, US-based d.light, and Australia-based BareFoot Power) to residents of BoP communities with limited access to electricity in Kenya, Tanzania, Malawi, and Zambia. Since its inception, SunnyMoney has sold over 459,000 solar lights.¹⁵ SunnyMoney markets its products through multiple channels: in Tanzania, we studied the impacts of using the S1 (manufactured by d.light) on customers’ children, priced at an average 10 USD per unit and sold through their School Campaign. In Kenya, we studied the impacts on SunnyMoney’s dealers’ children.

At the beginning of 2013, d.light upgraded all their S-line products including the S1 studied in this case; as per a d.light employee: “functionally, the S2 [upgraded S1 product] is the same and looks 99% the same, the changes are mostly technical around the battery--much improved product lifetime. Actually, all our S-line products were upgraded, so the S10 is now S20 and S250 is now S300”.¹⁶

To gain an initial understanding of SunnyMoney’s influence on young children, we conducted a literature review and spoke with thought leaders about the types of impacts that occur on children as a result of gaining access to a clean, good-quality source of lighting. To gain a holistic sense of SunnyMoney’s impacts on children age eight and under, and to verify, enrich, and identify additional impacts, we conducted in-depth qualitative interviews and focus groups with key SunnyMoney stakeholders in Tanzania and Kenya. Both direct impacts on children as well as indirect impacts on children through their parents and the environment were assessed across the stakeholders (see **sidebar**).

We found that SunnyMoney has the greatest impacts on its customers’ children (presented below in **Table 1**) who use the S1 solar lamp and gain access to 3-4 hours of clean (no emissions produced), good-quality lighting output.

Stakeholders

Customers

SunnyMoney reaches BoP populations in Tanzania, Kenya, Malawi, and Zambia through its work with local schools and existing entrepreneurs. We studied SunnyMoney’s Tanzanian School Campaign to analyze impacts on customer’s children.

Dealers

SunnyMoney’s dealers are existing business owners, who often operate small shops in city centers in the regions the organization serves. We studied SunnyMoney’s Kenyan dealers to analyze impacts on their children.

Broader Community

Individuals who do not have any relationship with SunnyMoney besides living in areas that the venture operates in.

Table 1: Substantial Impact on Customers' Children

Economic Well-Being	Increases in Wealth: Once the lamp is purchased, increased savings from reduced kerosene expenditures and kerosene-related medical expenses can be redirected to children's needs such as nutrition and education.
Capability Well-Being	<p>Improved Education/Knowledge: The child's academic performance improves as s/he studies longer due to access to clean light. Improved school performance plays a strong role in the child's wish to remain in school and continue with his/her higher education.</p> <p>Improved Physical Health: Reduced exposure to kerosene-based lighting reduces the risk of respiratory illnesses and burns, and puts less strain on children's eyes.</p> <p>Improved Psychological Health: Children experience increased feelings of security and control over their environment after sunset as a result of the solar lamp.</p>
Relationship Well-Being	<p>Improved Support: Parents spend more time with their children discussing homework as a result of having access to clean light.</p> <p>Improved Home Environment: Solar lamps reduce the chance of household fires (as compared to kerosene-based lighting).</p>

The impacts on children in the 0-5 age group differ from those in the 6-8 age group. Impacts on younger children (ages 0-5) are mostly related to changes in their health as a result of improvements in home air quality as well as potential changes to their nutrition due to their parents' decreased spending on kerosene and medical bills. Older children (ages 6-8) appear to experience additional impacts resulting from an added 3-4 hours of clean, good quality light that can be dedicated to their studies.

In addition to its customer's children, SunnyMoney positively impacts its dealers' children and those in the broader community. We learned that the dealers' children benefit from the supplemental income their parents can contribute toward their immediate needs like food, clothing, books, school uniforms, and other necessities. SunnyMoney impacts the children of the broader community by improving the local ambient air quality through the reduction of kerosene use (reduction in released toxic fumes and CO₂).

Based on the likely outcomes SunnyMoney has on children across its value chain, we identify opportunities that SunnyMoney can explore to enhance, deepen, and expand its impacts on children age eight and under:

- SunnyMoney should explore methods to strengthen dealer networks and incentivize dealers to stock more SunnyMoney products.
- SunnyMoney should explore procedures to improve after-sale service to combat any negative perceptions of solar lamps and SunnyMoney as a company.
- SunnyMoney should explore approaches to strengthen ties between customers and SunnyMoney, and between suppliers and SunnyMoney through communication and strong feedback loops.
- SunnyMoney should explore including messaging on health and environmental benefits of using a solar lamp in its School Campaigns, in addition to the messages on savings and school performance improvements.
- SunnyMoney should explore techniques to improve the transfer of message delivered in School Campaigns from child to parent. The organization should also consider disseminating information directly to parents.

- **SunnyMoney should continue to explore new financing mechanisms for solar lamps to increase sales among the BoP.**
- **SunnyMoney should explore methods to pool resources within the solar lamp business community for operations, market creation, and advocacy.**

Beyond these key recommendations, we also offer guidance on conducting impact assessments in a systematic and manageable manner.

Note: Due to similarity in impacts across the six cases and in an attempt to be concise, we only include secondary research supporting and further exploring impacts in the first case study of this series— Patrimonio Hoy. Please also note that since these cases were developed over the course of 2012-2013, a number of our recommendations to enhance positive and mitigate negative impacts for the venture, have been implemented since we visited the venture. As such, please visit the enterprise's website for more information on their latest practice

COMPANY BACKGROUND

SOLARAID

SolarAid, a charity registered in the United Kingdom, was launched in 2006 by Jeremy Leggett, the founder and chairman of SolarCentury,^{vi} the UK's largest independent solar company. The charity was established through a SolarCentury fund that set aside 5% of the company's profits, and SolarCentury employees served as volunteers. In 2011, SolarAid set an ambitious goal to eradicate the use of kerosene lamps across the African continent by the end of 2020.

SolarAid began with funding large-scale installations of solar panels for buildings such as schools and hospitals through major donations from groups such as USAID, Vodafone, and others. Since 2006, it has installed macro solar products in 108 schools, 19 clinics, and eight community centers.¹⁷ It now focuses on pico-solar products. It also carries out market creation through consumer awareness and education activities. For example, Solar Roller, a mobile education center and solar cinema (in the form of a van), raises awareness of renewable energy in rural Kenya.¹⁸ The charity has now grown to more than 45 staff in addition to more than 100 volunteers.¹⁹ The organization's total income through fund-raising and trading activities was 4.2 million USD in 2011. The non-profit organization is seeking to grow its funding base through individual donations and social impact venture philanthropy.

The charity has won a number of awards for its work, including the Energy Globe Award for Sustainability, the Clinton Global Initiative pledge, the Environmentalist of the Year award from Archant London Environment Awards 2009, a Corporate Social Responsibility of the Year Award from Charitytimes 2009, the Vodafone World of Difference Award and most recently, the Google Impact Challenge Award in June 2013.²⁰

SUNNYMONEY

SunnyMoney, a social-enterprise initiative of SolarAid, began in 2007 as “a business with a social goal”²¹ or a self-sustaining, market-based enterprise, to support SolarAid's mission. SunnyMoney is a distributor and does not manufacture its own brand of solar products. Headquartered in Nairobi, Kenya, SunnyMoney sells pico (or micro) solar products to residents of BoP communities with limited access to electricity in Kenya, Tanzania, Malawi, and Zambia, directly or through partners (see Figure 1 for map of operations). As of June 4, 2012, SunnyMoney has sold over 459,000 solar lights.²²

SunnyMoney sells:

- Picosolar²³ products (15 watts and under, serving one household)
- Solar home systems²⁴ (SHS) products (between 10-20 watts, serving one household; the Barefoot Power 15 W is the biggest system in this range) and lamps that can be used in larger solar installations.^{vii}

Specifically, SunnyMoney's solar lamp products range from:

- The entry-level, pocket-sized, S1 (7-13 USD (average=10 USD); d.light) geared towards students. At the beginning of 2013, d.light upgraded all their S-line products including the S1 studied in this case; as per a d.Light employee: “functionally, the S2 [upgraded S1 product] is the same and looks 99% the same, the changes are mostly technical around the battery—much improved product lifetime. Actually, all our “S-line” products were upgraded, so the S10 is now S20 and S250 is now S300.”²⁵

vi Leggett founded SolarCentury—a company specializing in solar panels and photovoltaic systems—in 1998 after becoming increasingly concerned about climate change while working in the oil and gas industry during the 1980s.

vii Solar lamps are composed of a solar panel with a rechargeable battery (lithium ion, Ni-Cad, or lead acid) and high-efficiency light-emitting diodes (LEDs). The batteries need to be replaced every 1-5 years, depending on the product make.

- The mid-range (low) Firefly Mobile (20-21 USD; Barefoot Power) geared toward low-income households with mobile phones
- The mid-range (high) Sun King Pro (28-29 USD; GreenLight Planet) geared toward higher-income households and
- The upper- and macro-range lamps (100 and 225-325 USD respectively) for rural households, offices, classrooms, dormitories, and clinics.²⁶

All products meet the Lighting Africa's Minimum Quality Standards.²⁷

Some of the lamps have multiple brightness settings (e.g. high, medium, low, bed light on the S250²⁸), providing different hours of light on a full day's charge. Some like the Sun King Pro²⁹ have digital displays to inform the consumer of how much life is left in the battery, while others have smart indicators such as in the S10.³⁰ SunnyMoney lamps range from 1.5 watts to 15 watts. **Table 2** presents the variety of products SunnyMoney sells through its multiple channels in its four countries of operation.

Figure 1: SunnyMoney's Geographic Presence

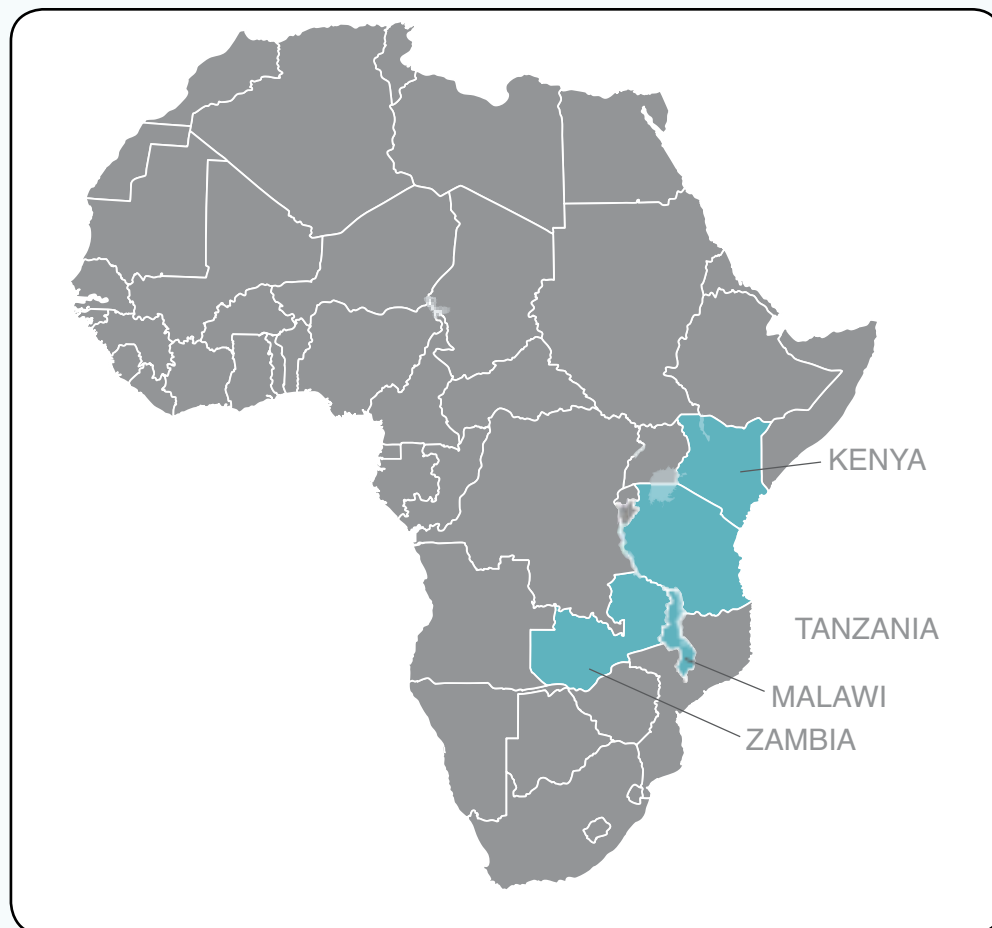





Table 2: Products Sold by SunnyMoney in Operating Countries^{31,32}

Product	Price Range (USD)	Category (Range)	Manufacturer	Kenya	Malawi	Tanzania	Zambia
 S1	7-13	Entry	d.light	X	X	X	X
 S10	10-11	Entry	d.Light	X		X	
 FireFly Mobile	20-21	Mid (low)	Barefoot Power	X	X		X
 Sun King Pro	28-29	Mid (high)	GreenLight Planet	X	X		X
 S250	50-51	Mid (high)	d.Light			X	
SL2	55-56	Mid (high)	SunLite	X			

Product	Price Range (USD)	Category (Range)	Manufacturer	Kenya	Malawi	Tanzania	Zambia
 <p>PPJ</p>	36-58	Mid (high)	Barefoot Power	X	X		X
 <p>PP5</p>	94-96	Upper	Barefoot Power	X	X		X
 <p>PP15</p>	220-325	Macro	Barefoot Power	X	X	X	X



Solar product display in the Nairobi office.

Although children are usually the main users of the small S1 lamp, parents also use SunnyMoney's solar lamps for ironing, cooking, farming, and walking outdoors at night. The majority of SunnyMoney's customers paid cash up-front from their personal savings. Households are proud of their solar lights and think of themselves as technologically advanced for using them.³³

SunnyMoney strongly supports the health and safety of its suppliers' workers and ensures a standard of working conditions in supplier factories by holding its manufacturers to a supplier 'Code of Ethics' (based on universally recognized human rights). This code states:

- No person younger than 16 should work in the factory
- No person in the factory is forced to work
- Working conditions comply with SA8000 (safety and health standards)
- Workers work a maximum of 48 hours per week
- At least minimum wages are paid (e.g. 93 USD per month in China)
- Non-discriminatory and non-abusive working environment

SunnyMoney management has attended conferences organized by Lighting Africa^{viii} and has expanded the venture's network through this initiative.

LIGHTING CONSTRAINTS

According to the World Bank, 1.4 billion people live without access to electricity, with nearly 590 million in Africa, over 400 million in India, and the remainder in other developing countries around the world. Africa has the lowest electrification rate of all global regions i.e. 26% of households (and an even lower 14.2% in rural sub-Saharan Africa).

Electrification is failing to keep up with the region's population growth and it is estimated that Africa's non-electrified population will grow to 630 million by 2015. Additionally, 20 million households (about 107 million persons) are considered under-electrified i.e. they have intermittent and low quality electric grid supply. **Table 3** highlights national rates of access to electricity in countries where SunnyMoney operates. The World Bank states "Africa's infrastructure is the most deficient and costly in the developing world"- including its power infrastructure which "remains skewed in favor of better-off households." While power tariffs in the developing world are between 0.04-0.08 USD per kilowatt-hour, in sub-Saharan Africa it is 0.13 USD making electric power extremely cost-prohibitive for those under the poverty line.³⁴

viii "Lighting Africa is a joint IFC and World Bank program that works towards improving access to better lighting in areas not yet connected to the electricity grid" (Lighting Africa - 2012)

Box 1: A Child's Perspective*

Four-year-old Baraka likes to sit at the kitchen table with his two brothers, ages six and eight, while they complete their homework. Although he is too young to go to school, he likes to draw while his brothers finish their math homework. The brothers always studied hard, but before they studied with the aid of a kerosene lamp, and their eyes, like Baraka's, became irritated with the smoke emitted from the lamp. As part of a SunnyMoney School Campaign, Baraka's parents recently purchased a solar lamp for the brothers. Their eyes no longer burn and water when they read, and they can focus longer on their studies. Baraka says he cannot wait for the day when he begins attending school, and studies with his brothers near the solar lamp.

** This fictional account is provided to represent a common SunnyMoney stakeholder situation. The narrative sketch is based on information collected during interviews and focus groups.*

Table 3: Electrification Rates in Countries of Operation

Countries	Access to Electricity in % (2009) ³⁵
Kenya	16.1
Malawi	13.9
Tanzania	9
Zambia	18.8

With high costs, poor quality infrastructure and lack of the electric grid in remote areas of rural sub-Saharan Africa, life stops after dark for these hundreds of millions, affecting their ability to carry out basic human activities such as cooking and cleaning, and income-generating opportunities such as conducting business or working in factories, after sunset.

Off-grid and under-electrified households use alternate sources of lighting such as kerosene lamps (also known as paraffin lamps), candles, and/or disposable batteries in flashlights (torches). Africa-wide, an estimated 53% of off-grid households use kerosene-based lighting and spend \$4.4 billion a year on the fuel.^{ix} In Tanzania³⁶ and Kenya^x, the majority of households use kerosene for lighting (on average, 2% of kerosene is used for cooking) which has many negative impacts explored in **Box 2**. Candlelight increases the risk of fires and personal burns and does not provide sufficient lighting to families. Disposable, non-rechargeable batteries to power torches, cumulatively drain income over the long term, have a high risk of contaminating local water and soil resources with toxic heavy metals,³⁷ generate non-recyclable waste, and provide a poor amount of lighting.

Box 2: Negative Impacts of Using Kerosene Lamps

Use of kerosene lamps in poorly ventilated houses are a serious cause for concern for the following reasons:

- The fumes, consisting of particulate matter that can penetrate deep into the lungs and lower respiratory tract, contain carbon dioxide, carbon monoxide, benzene and toluene.³⁸ In the short term the fumes can cause headaches and dizzy spells and in the long term, they can increase the risk of damage to the respiratory and nervous system and cause kidney damage and blood clots.³⁹
- Children frequently accidentally overturn kerosene lamps, causing serious spills and burns⁴⁰ on their body. They may also break the glass of the hot kerosene lamp and burn themselves when they touch the shards.⁴¹
- Kerosene is often stored in used soda or water bottles, making accidental ingestion of kerosene the main cause of childhood poisoning in the developing world.⁴²
- Kerosene use in the house increases the risk of household fires.
- Kerosene emits approximately 2.5 kilograms of carbon dioxide per liter, further exacerbating the concentration of greenhouse gases in the atmosphere.⁴³

ix Globally, 1.6 billion people use kerosene lamps and 38 billion USD is spent annually on fuel-based lighting, with 200 billion kilograms of soot and CO₂ emitted each year (Solar Aid, GreenLight Planet, d.light, IFC).

x As per SunnyMoney research, on average, greater than 90% of Kenyan household use kerosene for lighting and cooking

THE SUNNYMONEY BUSINESS MODEL

SunnyMoney has set up separate units in Tanzania, Kenya, Zambia, and Malawi, each of which function autonomously with their own financial reporting and five-year strategic plan. SunnyMoney sells products through multiple channels, including School Campaigns, dealer networks, and other organizations. We explore the School Campaigns in Tanzania and the dealer networks in Kenya.

- **School Campaigns:** Marketing staff meet with school headmasters to teach them about solar products and provide them with marketing materials that can be distributed to children during school assemblies. Children take home the flyer explaining the benefits of solar lamps to parents. Parents have two weeks to purchase the lamp at the school by sending the payment with their child.
- **Dealers:** SunnyMoney works with pre-existing business owners who operate kiosks and storefronts in city centers and small rural communities to market and sell its solar lights.

SCHOOL CAMPAIGNS

School Campaigns target children as the main beneficiaries of the S1 solar lamp and carry out consumer awareness through them. The time period from contact initiation to sale is approximately five weeks. In Tanzania, the S1 retails for 12,000-15,000 TZS (7-9 USD) and on an average costs 10 USD across other countries of operation. The campaigns are conducted as follows:

1. SunnyMoney partners with district education officers to request meetings with school headmasters individually or in a group; on meeting, SunnyMoney provides information about solar lamps to the headmasters.
2. Headmasters in turn share this information with their students at an after-school assembly. The message highlights costs savings from using solar lamps over kerosene-based lamps and improvement in school performance stemming from the ability to study longer hours with the solar lamp.
3. Headmasters give the children SunnyMoney flyers that contain the same information provided during the assembly.
4. Students are expected to take the flyers home, show them to their parents, and tell them of the benefits of the lamps (based on what they learned in school).
5. Students have two weeks to purchase the lamp and must pay the full amount to the school.
6. The headmaster collects the money and places the orders with SunnyMoney.
7. SunnyMoney then returns to the school with the solar lamp deliveries in about two weeks' time.

See **Figure 2** for an illustration of information and product delivery within the school campaign model. While the lamp is an expensive purchase for most families, SunnyMoney's marketing team convinces the

Box 3: A Child's Perspective*

Two-year-old Farisi's parents purchased a solar lamp through SunnyMoney about four months ago. Ida, her mother is using the light from the lamp to replace the kerosene lamp she used to light the home, to walk outdoors to the bathroom at night, and to take care of Farisi when she wakes in the middle of the night. Previously, Ida would fall asleep with the kerosene lamp near Farisi's crib. Now that her mother uses the solar lamp, Farisi's nose is no longer stuffy when she wakes in the morning, and both Farisi and Ida have fewer bouts of flu. The money that Ida saves from no longer having to buy a liter of kerosene per week is 2,000 TZS (1.27 USD). Ida is using these savings and the 20,000 TZS (12.68 USD) per year she saves on doctor visits related to using kerosene-based lighting, to buy more necessities for Farisi, including better food and clothing.

** This fictional account is provided to represent a common SunnyMoney stakeholder situation. The narrative sketch is based on information collected during interviews and focus groups.*

headmasters of its benefits for school children. The campaign earns credibility among potential customers when coming from a trusted source—the headmaster.

Sales figures for SunnyMoney Tanzania: in 2011, SunnyMoney generated 400,000 USD in revenue, and on Mafia Island alone, an estimated 57% of households now use at least one solar light. By September 2012, SunnyMoney had reached nearly 400,000 people and had sold 84,090 lights through its work with more than 1,500 schools in three regions of Tanzania—Kilimanjaro, Mafia, and Arusha. By May 2013, SunnyMoney Tanzania had reached over 1.28 million people and sold over 268,000 solar lights.⁴⁴

EXISTING ENTREPRENEUR DEALER NETWORKS

SunnyMoney recently transitioned its business model from training local entrepreneurs to sell solar lights to working with pre-existing business owners. When the initiative began, SunnyMoney accepted applications from potential entrepreneurs and trained these individuals to sell lamps from door-to-door. SunnyMoney found that training individuals with little to no business experience was challenging and turnover was high. We studied SunnyMoney's existing entrepreneur dealer network and its impacts in Kenya—SunnyMoney staff members either deliver the stock to the dealer's shop or dealers pick up stock from SunnyMoney's head office.

Organization Structure

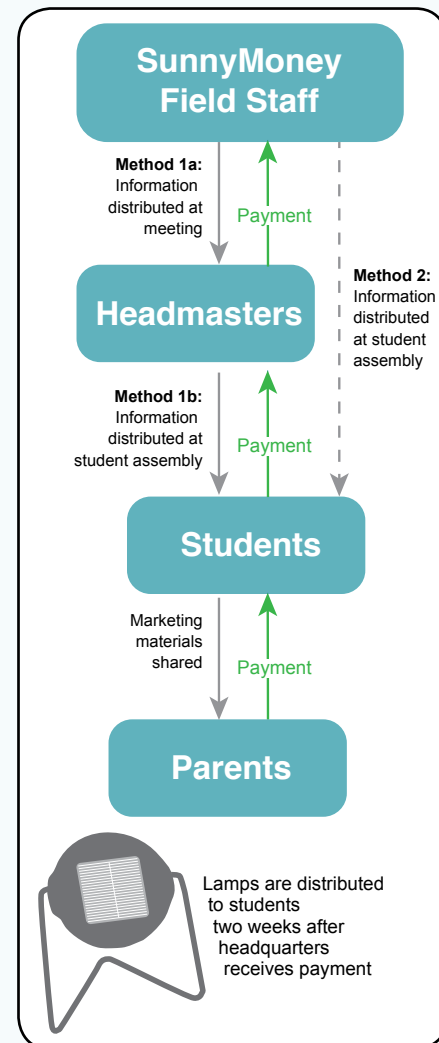
STAFF

SunnyMoney's senior management team, led by a managing director is located in Nairobi, Kenya. As of October 18, 2012,⁴⁵ SunnyMoney had the following numbers of staff members: Kenya, 10; Malawi, 6; Tanzania, 13; and Zambia, 7, with a common structure across country offices. Project officers (junior staff) report to a field manager (mid-level staff) who, along with finance and administrative staff, report to an Operations Director. The Director is the country's program head and reports to the senior management team. Currently, no staff member belongs to the BoP.

COMPETITION

SunnyMoney welcomes solar and other alternative energy competitors because they help in achieving the organization's mission to eradicate the use of kerosene lamps in Africa by end of 2020. The venture competes with other micro-solar (small domestic lights) product sellers such as Highedge Solar Tanzania Ltd., ARTI Energy and ARTI Ebergery Kunured (Tanzania), Solanterns (Kenya), Sollatek (multi-country), and Solar Energy for Africa Ltd. (East Africa). Detailed information on the listed competitors can be found in **Appendix A**.

Figure 2: SunnyMoney School Campaign Model



Box 4: Portrait of SunnyMoney's BoP Market

Across East Africa, the majority of households live with no access to electricity or are under-electrified (poor quality electric supply). In Kenya, 89% of the urban population and 94%⁴⁶ of the rural population relies on kerosene for lighting. Kenyans use an average of three⁴⁷ kerosene lamps to light their homes. According to research carried out by the Lighting Africa initiative, 73.5% Kenyans use kerosene as their primary lighting source and 20.8% use it as their secondary lighting source.⁴⁸ The same research quotes the monthly expenditure on kerosene in 2005-2006 at 165 KES (1.95 USD) per month. In Tanzania, 85% of the population has no access to electricity⁴⁹ and most such households use kerosene to light their homes.⁵⁰ The market research carried out by Lighting Africa also found that the median Kenyan household spent 35 KES (0.41 USD) per month on dry-cell batteries, some of which were used to power torches for secondary lighting needs.⁵¹

East African households spend about 15-30%⁵² of their income on kerosene. Rural populations in Kenya and Tanzania pay a poverty penalty of 46% and 23% respectively on the fuel i.e. in Kenya, kerosene in villages' costs 46% higher than in pump stations in urban areas because kerosene sold in smaller quantities costs more.

It is estimated that one⁵³ solar lamp replaces the regular use of 1.5 kerosene lamps. Households that SunnyMoney have sold to and interviewed, use, an average two kerosene lamps regularly. Hence a total of two solar lamps are required to replace all kerosene lamps in this average household. Using the average price of an S1 solar lamp (10 USD), a household must spend 20 USD to replace all kerosene lamps with solar-based lighting -- which can be cost-prohibitive. In Kenya and Tanzania, 43.4%⁵⁴ and 33.4%⁵⁵ of the population, respectively, lives below the national poverty line (in general, this equate to living on less than 1.25 USD/day).

In an impact research study conducted by SolarAid in Tanzania, 64% respondents main source of household income was farming, 26% were teachers, and 11% were traders. In a similar study conducted by SolarAid in Kenya, 33% of respondents main source of household income was from farming, 32% from teaching, and 20% from trading.

Kerosene's total replacement in households is a daunting task, as kerosene use is a cultural habit that will take much effort in three directions to break: education about negative impacts of kerosene, awareness of positive benefits of clean renewable energy, and new financing options to include the very poor who are most in need of such solutions. In addition to cultural use, studies have shown that the poor are suspicious of new solar products, as in the past many macro-installations were left in disrepair and disuse. Some worry that their lights will be stolen when left in the open (the sun's energy recharges the batteries through a solar PV panel), though we did not find this in our field research. As such, households continue to use kerosene either as a backup or use solar products to increase lighting in the household without eliminating a kerosene lamp.⁵⁶

Studies conducted by SolarAid in Kenya and Tanzania in 2012 found the average reduction in kerosene spending since buying a SunnyMoney solar product was 8,865 TZS in Tanzania or 830 KES in Kenya. The monthly income saved from this reduction in kerosene use was 9% in both Tanzania and Kenya. 45% of respondents interviewed in Tanzania by SolarAid said that they spent their savings on food, 23% on school costs and 14% on farming inputs. In Kenya, 34% of respondents spent their kerosene savings on investing in their business or farming and 32% spent it on food.⁵⁷ In a SunnyMoney study conducted in Malawi and from our own field research, it was found that men were the main decision-makers on purchasing the lights, though in some households a joint decision was made (specifically, in Malawi, SunnyMoney found that 79.1% of the time, men were the purchaser of the solar product; 13.5% were female; no data available on the remaining 7.4%; no data available on who is using the product).

FOCUSING ON IMPACTS ON CHILDREN UNDER EIGHT

FRAMEWORK AND METHODOLOGY

The BoP impact assessment framework (BoP IAF) provides a structured approach to gaining a holistic understanding of an enterprise's impacts on key BoP stakeholders. It assesses how BoP stakeholders are impacted across three areas of well-being: economic, capability, and relationship. We customized the BoP IAF to analyze SunnyMoney's potential impacts on children across stakeholders engaged with SunnyMoney, including customer's children, dealer's children, and children in the broader community.

We also adapted the framework to explore both direct and indirect impacts on these children (see **Figure 3**). Direct impacts are those impacts that directly result from SunnyMoney on children, and indirect impacts are those impacts that occur on children as a result of a direct impact from SunnyMoney on their caregivers, another adult or the environment.

Figure 3: Direct and Indirect Impacts on Children



The customized set of potential impacts we explore across the BoP IAF's three areas of well-being include:

- **Economic Well-being:** These are mainly impacts that result from changes in a caregiver's wealth (income and savings) and economic stability (expenditures and employment) that create changes in assets and resources provided to children.
- **Capability Well-being:** These impacts affect children directly as well as indirectly through direct impacts on their caregivers. Impacts within this area include changes in the child's physical health, psychological health, leisure time, aspirations, skills, and education and knowledge.
- **Relationship Well-being:** These impacts affect children both directly and indirectly through direct impacts on their caregivers. The impacts include changes in the types of interactions and support children receive from adults and other children in the community as well as changes to their social networks. They also include changes in the home and local environments.

To gain an initial understanding of SunnyMoney's influence on young children, we conducted a literature review and spoke with thought leaders about the types of impacts that occur on children as a result of gaining access to a clean, good-quality source of lighting. To gain a holistic sense of SunnyMoney's impacts on children age eight and under, and to verify, enrich, and identify additional impacts, we conducted in-depth qualitative interviews and focus groups with key SunnyMoney stakeholders in Tanzania and Kenya.

Interviews were conducted with people directly impacted by the venture —such as SunnyMoney's customers and dealers —as well as headmasters and teachers at schools. Interviews were also conducted with SunnyMoney employees at local offices and headquarters in Nairobi. We also spoke with people aware of the venture but who had not been impacted by it, such as non-participants and external organizations that had the experience of working with children in the 0-8 age group. The interviews were semi-structured conversations that comprised of a standardized set of open-ended questions that allowed us to ask follow-up questions to elicit more detail.

We concluded the interview with: “is there anything else related to this topic that you have not shared with us yet?” This encouraged interviewees (see **Table 4** for list of respondents) to share additional information with us. We also incorporated insights from earlier interviews into later interviews in order to develop a more refined understanding of impacts. Each interviewee received a small thank-you gift for their time.^{xi}

Table 4: Description of Primary Interview Respondents

Type of Respondent	Number of Individuals
Customers	15 ^a
Non-customer	22 ^b
Dealers	6 ^c
External parties including headmasters, teachers, and doctors	29 ^d

^a Includes ten interviews with parents who chose to buy a solar lamp from SunnyMoney and one focus group composed of men that chose to buy a solar lamp from SunnyMoney.

^b Includes five interviews with parents who chose not to buy solar lamps from SunnyMoney and four focus groups of parents who chose not to buy solar lamps from SunnyMoney.

^c Includes three interviews with non-SunnyMoney dealers in Tanzania who sold solar lights and three interviews with SunnyMoney dealers in Kenya.

^d Includes an interview with the district education officer, an interview with a headmaster, five focus groups with teachers and headmasters, and one interview with a clinic worker.



Child drew a picture of a sun with a solar light, a boy studying with solar light and a mother cooking using solar light.



Child drew a picture of a boy studying with solar light, a mother cooking with solar light and a house with a solar light inside.

^{xi} Before the visit, we asked SunnyMoney staff what would be culturally acceptable gifts. They agreed it would be best to give staff and external stakeholders a metal pen with a WDI logo and all other stakeholders, a plastic pen with a WDI logo.



Child drew a picture of a boy studying with solar light and a mother cooking with solar light.



Children learning about how the S1 works from a SunnyMoney representative.

Methodological Limitations

It is important to note that our evaluation of SunnyMoney's impacts on our target population is qualitative rather than quantitative; i.e., our findings are interpreted from the qualitative evidence we collected. Therefore, our findings consist of likely impacts of SunnyMoney on the children of its customers, dealers, and members of the wider community.

The methodology used in this study does not allow us to substantiate the impacts beyond attributing them to the respondents. Some of our findings may also suffer from recall inaccuracy, since we did not measure all impacts at the exact time of occurrence. We informed SunnyMoney of the different types of stakeholders we would like to interview and relied on them to select interviewees; as a result, our sampling may be biased toward those who had time or felt strongly about sharing information about SunnyMoney.



Children with S1 lamps.

This study methodology was adapted from a well-developed approach that has been implemented in Africa, Asia, and Latin America. The adapted methodology was designed to present findings with the objective of demonstrating the value of collecting such impact data in more rigorous ways over time. The Capturing Impacts section demonstrates how to measure the most substantial impacts within the Impact Findings section rigorously in order to quantify them.



Market at Hai Town, area of data collection.

IMPACT FINDINGS

The degree to which SunnyMoney impacts children differs based on their parents' relationship with the venture. Among our study's target group, we found the greatest impacts occur on SunnyMoney's customers' children. Children of staff and those in the broader community are also discussed in the following section. **Table 5** summarizes direct and indirect impacts on the children of all SunnyMoney stakeholders that we observed on our field visit. Impacts in bold font are explored in more detail in the section immediately below, while details of non-bolded impacts can be found in **Appendix B and C**.

Table 5: Summary of Impacts on Children Age Eight and Under Across SunnyMoney's Stakeholders

	Economic Well-Being	Capability Well-Being	Relationship Well-Being
Customers' Children	<p>Wealth</p> <ul style="list-style-type: none"> Increased financial resources available for child's well-being through parents' increased savings due to reduced expense on kerosene-based lighting (Indirect) Increased financial resources available for child's well-being due to parents' decreased spending on medical expenses related to kerosene use (Indirect) 	<p>Physical Health</p> <ul style="list-style-type: none"> Reduced risk of respiratory illness and burns and less strain on eyes due to reduced exposure to kerosene-based lighting (Direct) <p>Psychological Health</p> <ul style="list-style-type: none"> Increased feelings of security and control over their environment as a result of introducing a solar lamp in their home (Direct) <p>Education/Knowledge</p> <ul style="list-style-type: none"> Improved school performance due to ability to study longer hours (or do homework) by using a solar lamp (Direct) <p>Aspirations</p> <ul style="list-style-type: none"> Increased expectations of the future including the wish to continue their education due to improved school performance from studying longer hours (Direct) 	<p>Interactions</p> <ul style="list-style-type: none"> Increased risk of conflict between siblings over the use of the solar lamp (Direct) <p>Support</p> <ul style="list-style-type: none"> Parents spend increased amount of time with children to discuss their homework due to additional hours of light provided by the solar lamp (Direct) Children receive more support from their parents when their parents experience less tension and stress as a result of reduced kerosene-related medical issues and expenses (Indirect) <p>Adaptability in School</p> <ul style="list-style-type: none"> Increased ability to assimilate into the school environment by being prepared for class and performing more confidently, all facilitated by studying longer hours due to the use of a solar lamp (Direct) <p>Home Environment</p> <ul style="list-style-type: none"> Reduced threat of household fire from reduced use of kerosene (Direct)
Dealers' Children	<p>Wealth</p> <ul style="list-style-type: none"> Increased financial resources available for child's well-being due to increases in parental income as they add solar products to their shops 	<p>Education/Knowledge</p> <ul style="list-style-type: none"> Improved entrepreneurial skills by observing the increased business activity as their parents add solar products to their shops (Direct) Increased knowledge and interest in renewable energy (Direct) 	<p>Support</p> <ul style="list-style-type: none"> Increased social capital from parents' increased social network results in increased resources for children (Indirect)
Children in the Broader Community		<p>Aspirations</p> <ul style="list-style-type: none"> Improved aspirations for the future as young girls see female dealers earning an income and managing a shop (Direct) 	<p>Local Environment</p> <ul style="list-style-type: none"> Improved ambient air quality through reduced kerosene fumes and carbon dioxide emissions (aggregated through the community) from reduced kerosene use in the community (Direct)

Note: Impacts that are likely to have the largest impact on children are bolded. Bolded impacts are explained in more detail in the following sections whereas explanations of non-bolded impacts can be found in Appendices B and C.

Impacts on the Customers' Children

It is important to note that kerosene is not completely replaced in many SunnyMoney households. Many families still buy kerosene for additional lighting, or as backup lighting, or, in some cases, for cooking. Some families allow the solar lamp to be used only for studying, and use kerosene lamps for lighting when their younger children sleep at night. One respondent, for example, said that his family uses kerosene for cooking and during the night when his wife and their 9-month-old infant sleep. The solar lamp he purchased through SunnyMoney is only used by his other children when they study.⁵⁸

ECONOMIC WELL-BEING

Indirect Impacts

Wealth: Increased financial resources available for child's well-being through parents' increased savings due to reduced expense on kerosene-based lighting

Customers' children are indirectly impacted by their parents' increase in wealth after a solar lamp purchase through savings on kerosene. A district education officer in Hai Town told us that consumers often redirect their savings on kerosene to food, books, and school uniforms, among other necessities for children. The savings are especially significant for families in BoP communities who earn just 1-3 USD a day. Many of SunnyMoney's customers cannot afford to provide their children with even basic necessities, such as three meals a day.⁵⁹

According to data collected by SolarAid in November 2012 in Tanzania and Kenya, it takes approximately 10 weeks in Tanzania/8 weeks in Kenya to recover the price paid for one S1 light through kerosene savings. SolarAid's impact research found the average household saves 9% of their monthly income with the purchase of just one S1. With a three-year lifespan, the S1 provides customers with a product lifetime savings of nearly 312,000 TZS (USD 191) in Tanzania and ~30,000 KES (USD 352).⁶⁰ It should be noted that customers often buy just one solar lamp to begin with. As they purchase additional solar lamps to achieve the same amount of lumens (amount of light), it could negatively affect their financial resources in the short term.

A SunnyMoney customer we spoke with in Nkokashu used to consume two liters of kerosene a week, but after the purchase of a solar lamp only consumes one liter a week, generating a household savings of 2,000 TZS (1.27 USD) per liter a week. He said that he uses the savings to buy milk and other essential items for his children.⁶¹ Another customer told us that before her solar lamp purchase, she was unable to provide enough meals each day for her children, but with her savings on kerosene, she can now do so.⁶² Another customer in Kiseseni would buy five liters of kerosene a week but now buys only one liter a week after her solar lamp purchase. She uses the money she saves to buy books and fruit for her children.⁶³ Another customer told us that her kerosene savings allow her to buy enough soap for her children to bathe and to wash their clothes.⁶⁴ A phone survey conducted by SolarAid of 85 customers in Tanzania found that 45% of respondents spent their kerosene savings on food, 23% on school costs, and 14% on farming input. In Kenya, 34% of 66 customers interviewed spent their kerosene savings on investing in their business or farming and 32% spent it on food.

Wealth: Increased financial resources available for child's well-being due to parents' decreased spending on medical expenses related to kerosene use

During our interviews and focus groups, we found that customers' children benefit from their parents' reduced expenditures on healthcare issues related to kerosene. One of the customers we interviewed indicated that her daughter frequently had a stuffy or bloody nose and flu-like symptoms from the kerosene fumes. She would take her daughter to the hospital about two to three times a month at a cost of 3,000 TZS or 1.90 USD per visit.

Many customers said that after purchasing a lamp through SunnyMoney they are able to channel their savings into essential items for their children. One customer indicated that her daughter is sick less often, and the 20,000 TZS (12.68 USD) she used to spend on medical bills is now being spent on her

child's nutritional needs. Another customer said that he is using his savings on medical bills to increase the amount of meat in his children's diet. The spending on nutrition for children in the 0-8 age group is particularly significant as under-nutrition in young children can interrupt behavioral and cognitive development, educability, reproductive health, and future work productivity.⁶⁵

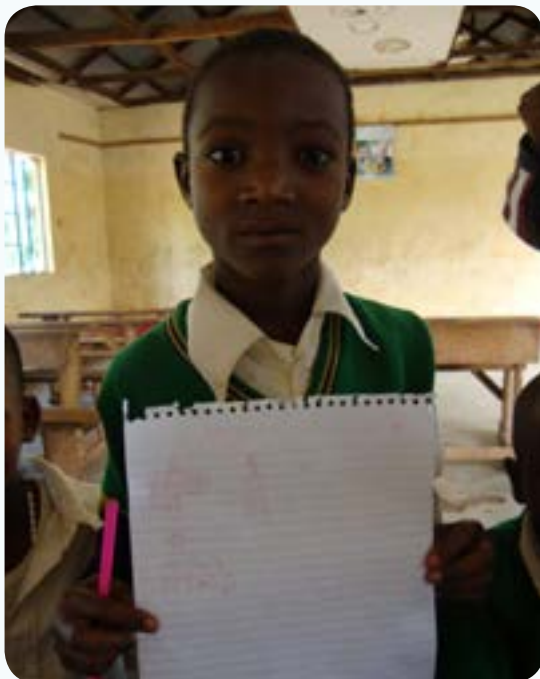
CAPABILITY WELL-BEING

Direct Impacts

Physical Health: Reduced risk of respiratory illness and burns and less strain on eyes due to reduced exposure to kerosene-based lighting

The heavy smoke emitted from kerosene lamps caused what a focus group in Narumu called the flu.⁶⁶ Symptoms include a stuffy or runny nose and coughing. One of the customers we spoke with indicated that his wife uses a kerosene lamp while breastfeeding their infant, and the infant often becomes sick with these symptoms.⁶⁷ One eight-year-old said that she "hates the smell of kerosene burning" and that it makes the air heavy.⁶⁸ Children of SunnyMoney's customers notice improved respiratory health from reducing kerosene use, as well as reduced incidence of burns and eye irritation from the smoke. One customer also said that her children are happy because the light from the solar lamp is much brighter and does not irritate their eyes.⁶⁹

During our conversations, we found that the youngest children (ages 0-5) are the most vulnerable to the effects of kerosene use. They appear to get more headaches and report more problems with eye irritation than children ages 6-8.⁷⁰ This may be due to the time children in this age group spend sleeping near a kerosene lamp.



Child drew a picture of a mother cooking under a solar lamp and a boy studying with a solar lamp at his side.



Child drew a boy studying and a mother cooking with the help of a solar lamp.

Psychological Health: Increased feelings of security and control over their environment as a result of introducing a solar lamp in their home

Children have a heightened sense of security when they are able to use a solar lamp after dark. The lamp reduces their fear of a starting a fire, a common occurrence with kerosene lamps, and gives them the ability to see in the dark.⁷¹ Before the lamps were purchased, many children went to sleep soon after

sunset; the solar lamps provide them with choices and the ability to conduct activities soon after sunset. Instead of going to bed, the children are able to spend more time playing, reading, or completing their studies. With access to a clean, renewable source of energy, the children also experience increased feelings of self-efficacy⁷² as they begin to exert more control over their environment. We found that children experience a new sense of freedom with the presence of a solar lamp at their side- they can walk more confidently in the dark and run errands for their parents. One mother told us that she sends her child to the local village shop after sunset because her son willingly goes with the solar lamp at his side. We also observed children's enjoyment by watching how carefully they cared for their lamp.



Child drew a boy studying and a mother cooking with the help of a solar lamp.



Child drew a boy studying and a mother cooking with the help of a solar lamp.

Education/Knowledge: Improved school performance due to ability to study longer hours (or do homework) by using a solar lamp

Most of SunnyMoney's customers reported that their children performed better in school after the purchase of a solar lamp.⁷³ The lamp provides three to four hours of clean, good-quality light every night when charged. Compared to kerosene lighting, solar lamps do not cause eye irritation.⁷⁴ The solar lamps also appear to improve children's motivation for studying.⁷⁵

According to research by SolarAid, 84% of Mafia Island headmasters reported an improvement in academic performance and exam results in students who had purchased a light.⁷⁶ Of students surveyed, 97% reported an increase in study hours per day, 57% studied 2-3 hours more than usual, and 21% studied an additional 3-4 hours.⁷⁷ Consumer data collected by SunnyMoney in 2011 showed that 66% of customers said that their child's school performance had improved a little, and 33% reported that their child's school performance had improved significantly since purchasing a solar lamp through the initiative. The parents and students we spoke with in Tanzania confirmed these findings, indicating that the solar lamp increases child motivation, the time spent studying, and classroom performance. One parent mentioned that the kerosene smoke affected how long their child could study and the child's ability to see the blackboard at school the next day.⁷⁸

In many families with more than one child, parents told us that their children share the solar lamp by gathering around a table to work on their homework. One parent said that even his young children who do not have homework sit at the table with their older siblings and count numbers or draw.⁷⁹ The youngest children in the 0-5 age group seem to be curious about the light and spend much of their time turning it on and off and taking the lamp from room to room. Some families said they prioritize their older children's use of the lamp for their studies.⁸⁰ In these households, the older children sometimes feel like they own the lamp.⁸¹ We also heard from families who said that they allow their younger children to use the lamp first because they prefer having their smallest children use a safe solar lamp rather than kerosene lamps while they are awake.⁸²

RELATIONSHIP WELL-BEING

Direct Impacts

Support: Parents spend increased amount of time with children to discuss their homework due to additional hours of light provided by the solar lamp

Many people simply went to bed after sunset prior to purchase of a solar lamp through SunnyMoney. Introduction of a solar lamp in their homes provides parents with additional time to discuss schoolwork with their children.⁸³ One mother told us that she frequently spends about two to three hours at the kitchen table with her children each night, helping them with their homework.⁸⁴ This type of time investment in children is thought to be critical to the development of human capital, and often provides a mechanism through which economic status can be transferred from generation to generation.⁸⁵

Home Environment: Reduced threat of household fire from reduced use of kerosene

Children of SunnyMoney customers benefit from reduced threat of fire in the home. For example, an eight-year-old child indicated that he is less afraid that there will be a fire in his home now that he has a solar lamp.⁸⁶ Children frequently sleep with the light and use it when they go to the toilet at night because they are not afraid of getting burned or setting something on fire.⁸⁷ Books, papers, and homes are less likely to burn when children fall asleep studying by the solar lamp.⁸⁸ The lamp is safer compared to candles and kerosene lamps for mothers and infants. Many of the mothers we spoke with said they prefer to use the solar lamp to calm their infants when they awake in the middle of the night.⁸⁹

Impacts on the Dealers' Children

ECONOMIC WELL-BEING

Indirect Impacts

Wealth: Increased financial resources available for child's well-being due to increases in parental income as they add solar products to their shops

SunnyMoney plays a critical role in creating conditions to earn additional income for families by providing entrepreneurs with the means to build on their existing business efforts. One Kenyan SunnyMoney dealer we spoke with buys SunnyMoney products before taking a bus back to Kajiado, about 100 kilometers or

Box 5: A Child's Perspective*

Eight-year-old Anisa's parents were not able to afford a solar lamp through SunnyMoney. Her parents would like to purchase the light, but the money must be spent on basic necessities. The family typically lives on about 212 KES (2.50 USD) a day. The money is spent on rent, nutrition for the children, clothing, and kerosene for heating and cooking. The family spends about 159.30 KES (about 1.85 USD) a week on three liters of kerosene for lighting, and would like to replace its kerosene light source with solar to eliminate the expense. Anisa wishes there was another way for her parents to purchase solar lamps through SunnyMoney.

* This fictional account is provided to represent a common SunnyMoney stakeholder situation. The narrative sketch is based on information collected during interviews and focus groups.

a two-hour ride from his home. He said he regularly buys the products as inventory for his brother's shop, and plans to build his own shop where he will sell the products when he has saved enough money. He and his brother have been stocking the solar products for about six months now, and 10-15% of their revenue comes from SunnyMoney products.⁹⁰ Another Kenyan SunnyMoney dealer said that the solar products increased his income by 10%. A portion of this additional income goes to savings, and the remainder is spent on food, school supplies, and clothing for his children, ages six and six months.⁹¹

This impact appears to increase in children age eight and under when the entrepreneur is a woman. When women become economically independent and have higher decision-making power, more money is channeled into resources for children. Evidence from Brazil, China, India, South Africa, and the UK demonstrates that when women have more control over household income—either through their own earnings or through cash transfers—children benefit from the mother's increased spending on food and education.⁹²

Impact on Children in the Broader Community

CAPABILITY WELL-BEING

Direct Impacts

Aspirations: Improved aspirations as young girls see female dealers earning an income and managing a shop

The role that SunnyMoney's female dealers play is critical. These women act as role models for girls and young women in the community. They create strong impressions on these young girls and positively impact their self-confidence, school achievement, and aspirations for the future.⁹³

RELATIONSHIP WELL-BEING

Direct Impacts

Local Environment: Improved ambient air quality through reduced kerosene fumes and carbon dioxide emissions (aggregated through the community) from reduced kerosene use in the community

With reduced kerosene use for lighting, the collective reductions in toxic fumes improve the ambient air quality for all residents of a community including young children. In addition, the collective efforts in reducing carbon dioxide emissions can have a mitigating effect on warming the earth's atmosphere. According to the Intergovernmental Panel for Climate Change (IPCC), "the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations".⁹⁴

Box 6: An Exploration of Individuals Who Choose Not to Buy SunnyMoney's Solar Lamps

From our interviews, we found the following reasons why certain individuals do not purchase solar lamps sold through SunnyMoney:

- **Price is the major barrier to a solar lamp purchase:** The purchase rate at the schools we visited in Tanzania was in the 13%-39% range. One of the non-customers^{xii} we spoke with said that she would like to purchase a solar lamp, but could not save enough money to do so.^{xiii} She typically uses one liter of kerosene a week at a cost of 2,400 TZS (1.52 USD), and consumption increases during the rainy season when she uses kerosene for cooking.
- **Ineffective message delivery from child to parent in the school campaign model:** Many parents do not truly understand the benefits of solar lamps and cannot conduct a cost-benefit analysis accurately when the message delivered by their children focuses on better exam preparation and cost savings on kerosene. Additionally, if parents are illiterate they cannot read the SunnyMoney flyers sent home from school.
- **Lack of trust for a foreign product and a new organization selling items in the community:** Respondents want others to try the lights first. If the experience proves beneficial for those families, they would then consider purchasing the solar lamp. In fact, SunnyMoney sales are about 10% higher in the second and third rollouts at the same school when compared to sales in the first rollout.

xii The interviewee's main source of income was from rain-dependent farming activities. Her output of maize, sunflower, beans and other vegetables had suffered due to a lack of rain, forcing her and her family to buy food from the market and survive on two meals a day.

xiii SunnyMoney is currently trialing rent-to-own, pay as you go, and installment payments to make the solar lights more accessible for people of this profile.

OPPORTUNITIES FOR GREATER IMPACT

Through the course of our interviews we found that SunnyMoney has a broad range of impacts on our target population; gaining access to clean lighting substantially improves the lives of children in the 0-8 age category. But we believe SunnyMoney has opportunities to further amplify its positive impacts, mitigate negative impacts, increase penetration into its existing markets, and expand into new regions. Each of our suggestions can generate more business for SunnyMoney, but depend on the resources the BoP venture has at its disposal. **Tables 6-9** presents potential ways SunnyMoney can enhance, deepen, and expand its impacts. Prioritized recommendations are bolded.

ENHANCE POSITIVE IMPACTS

Table 6: Opportunities to Enhance Positive Impacts

Opportunity	Potential Response
Dealer network	Explore methods to strengthen the dealer network and incentivize dealers to stock more SunnyMoney products
Demand for solar products	Explore methods to introduce other solar lamps in addition to the S1 in School Campaigns to create awareness and more demand
SunnyMoney sale-force	Conduct research on how to improve the effectiveness of the sales team when reaching out to dealers and headmasters

Prioritized recommendations are bolded.

- **Explore methods to strengthen the dealer network and incentivize dealers to stock more SunnyMoney products**

SunnyMoney should explore new methods to incentivize their current dealers to stock more solar products. Allowing dealers to stock their shops with a full range of solar products will maximize customer choice and excite both customers and dealers about solar products. SunnyMoney could also explore providing free trials to the dealers themselves, so they can experience the benefits of a solar lamp first-hand and effectively communicate and convince potential customers to purchase the product. Additionally, SunnyMoney should explore providing the dealers with more solar-product specific training such as solar lamp demonstrations, training on how to identify a customer's willingness to pay and preferences to enable dealers to market the solar products more effectively, and training on how to identify counterfeit products.

SunnyMoney sells its solar products at a discounted rate in schools. SunnyMoney should offer the same price range they offer through the School Campaigns to their dealers so that they are not competing with SunnyMoney. SunnyMoney should also explore ways to identify and direct persons with no children to buy solar lamps from dealers versus from the schools, to increase traffic in their dealer shops.

SunnyMoney should explore methods to attract entrepreneurs who sell radios, transmitters, mobiles, and other electronic products, as they generally have a better understanding of the technical aspects of electronics. They can be trained quickly on solar products and will be able to provide better after-sale service to customers.

SunnyMoney should also explore ways to share best practices and learnings among its entrepreneurs through regular meetings (e.g. quarterly) and regular communications (e.g. a phone call on a bi-weekly basis to understand the issues the entrepreneurs face). SunnyMoney can also attempt to connect entrepreneurs through such meetings and make a stronger business community to combat anti-competitive practices and increase sales of SunnyMoney products. SunnyMoney should aim to support the entrepreneurs in their network in as many ways as resources permit to create strong relationships and trust.

- **Explore methods to introduce other solar lamps in addition to the S1 in School Campaigns to create awareness and more demand**

SunnyMoney should introduce all types of solar products in their School Campaigns and have child-friendly, age-appropriate messaging for each pico product to improve awareness of the solar lamp market and enable higher reduction in kerosene use at home through the purchase of bigger lamps (bigger than S1).

- **Conduct research on how to improve the effectiveness of the sales team when reaching out to dealers and headmasters**

SunnyMoney should consider conducting research on how to increase the effectiveness of their sales team in recruiting dealers and headmasters. Research can be conducted on how technology can be used to make the sales team more efficient e.g. Customer Relationship Management (CRM) and sales force management software, how announcements of new products and schemes can be made via mobile software, etc. Research should also be conducted on how to improve the professional relationship and trust between the sales agent and the dealer/ headmaster e.g. new modules that could be included in sales trainings. Another area of research could include examining incentives to encourage dealers to stock and sell SunnyMoney products e.g. promotions to dealers, prizes on meeting sales targets, reduction of any unnecessary reporting requirements, etc.

REDUCE NEGATIVE IMPACTS

Table 7: Opportunities to Decrease Negative Impacts

Opportunity	Potential Response
After-sale service and support	Explore procedures to improve after-sale service to combat any negative perceptions of solar lamps and SunnyMoney as a company
Reputation and brand control	Explore approaches to strengthen ties between customers and SunnyMoney, and between suppliers and SunnyMoney through communication and feedback

Prioritized recommendations are bolded.

- **Explore procedures to improve after-sale service to combat any negative perceptions of solar lamps and SunnyMoney as a company**

SunnyMoney should explore methods on how to improve after-sale service delivery to customers. Examples include identifying and supporting technical persons (e.g. electrician, mobile repairer) in the community who can fix simple electronic issues and earn extra income. Another method is to employ a technical handyman in the second and subsequent rollouts of the school campaigns at the school to fix broken solar lamps where possible. SunnyMoney should also explore delivering demonstrations on how to best use the lamps to parents through head teachers or dealers to ensure customers treat the lamps in the best manner possible and avoid unnecessary wear and tear (both while using the lamp and while charging the batteries in the sun). After-sale service and preventing need for repairs are essential to combat negative perceptions of a new foreign product in a community and increase acceptance of solar lights. This is also essential to avoid negative perceptions of SunnyMoney, the School Campaigns, and the dealers selling the SunnyMoney products.

For solar lamps that need to be replaced, SunnyMoney could create a program for immediate on-the-spot replacement, to avoid service disruption to both customers and dealers i.e. the wait time to get the replacement from supplier should be absorbed by SunnyMoney. SunnyMoney should put in place an error-free, minimum-delay process to replace lamps with the supplier.

- **Explore approaches to strengthen ties between customers and SunnyMoney, and between suppliers and SunnyMoney through communication and feedback**

SunnyMoney should explore methods to ensure customers understand the venture's role in the solar lamp supply chain- as only a distributor that carries several products from different suppliers. This is to

ensure that if customers receive faulty products from one supplier, they do not associate the faults with SunnyMoney and continue to buy an alternate supplier's lamp from SunnyMoney itself. Additionally, SunnyMoney should source consumer feedback regarding products and communicate this in a timely fashion to suppliers.

SunnyMoney should also explore how to strengthen its due diligence process before entering into a professional relationship with a supplier. SunnyMoney should leverage its Lighting Africa relationship to strengthen this process and get a clearer idea of the suppliers' playing field. Transparent and open communication must be the norm rather than the exception and this should be made part of the organization's code of ethics.

INCREASE PENETRATION INTO CURRENT MARKETS

Table 8: Opportunities to Increase Market Penetration

Opportunity	Potential Response
School campaign messaging	Explore including messaging on health and environmental benefits of using a solar lamp in School Campaigns in addition to cost savings and improved school performance
Information dissemination about solar lights	Explore techniques to improve transfer of message delivered in School Campaigns from child to parent. Explore methods to disseminate renewable energy information directly to parents
Trust of new foreign products among BoP community members	Explore methods to popularize solar lamps among trusted community leaders to encourage parents to be more willing to purchase foreign products

Prioritized recommendations are bolded.

- **Explore including messaging on health and environmental benefits of using a solar lamp in School Campaigns in addition to cost savings and improved school performance**

Current School Campaign marketing focuses on the cost savings and the potential to improve school performance as benefits of solar lamps. SunnyMoney should explore the changes in demand by expanding this messaging (in a child-friendly, age-appropriate manner) to include the health and environmental benefits of solar lamps. To formulate messages that can connect with and impress children, SunnyMoney should explore partnerships with an educational institution (or NGO) that specializes in working with young children.

We also recommend increasing awareness of the negative impacts of long-term kerosene emission inhalation among parents as well as children. Studies show that reaching young children with environmental messages allows early adoption of environmentally responsible behaviors that have the potential to make a large impact over a lifetime. The initiative can also work with other renewable energy providers, community organizations, government, and NGOs to increase public awareness of the harmful effects of kerosene lighting and the environmental impacts of clean, renewable sources of energy.⁹⁵ SunnyMoney should continue to explore how it can have an effective partnership with the Ministry of Energy and reach out to the Ministry of Health to partner with community health workers (CHWs) to help spread awareness and education on the negative impacts of kerosene use in households. CHWs are trusted sources in the community and may have greater reach and influence in convincing families of the dangers of long-term kerosene use.

- **Explore techniques to improve transfer of message delivered in School Campaigns from child to parent. Explore methods to disseminate renewable energy information directly to parents**

We consider the transfer of information on solar lamps from child to parent to be a key part of the School Campaign model. We strongly recommend that SunnyMoney explore methods to ensure that the full message is being delivered. Younger children often have a difficult time relaying the message to their parents and many parents buy only one S1 lamp when they may need more to fully replace kerosene use for lighting. SunnyMoney can test differing message delivery styles to discern which is

most effective, not only to the child during assembly but also in conveying full transfer of information from child to parent.

SunnyMoney does encourage teachers to set up community/parent meetings so they can give the message verbally. SunnyMoney can explore other methods of reaching parents directly especially in cases where parents are illiterate and cannot read the marketing materials sent back home with the child. Possibilities include dramas at school where parents are invited to see their children perform and discussions with community health workers.

- **Explore methods to popularize solar lamps among trusted community leaders to encourage parents to be more willing to purchase foreign products**

SunnyMoney should explore methods to convince influential community leaders and trusted community members of the benefits of solar lamps as well as the negative impacts of kerosene use. We hypothesize that this will have a ripple effect in increasing demand of solar lamps among parents in the BoP, who are generally skeptical of foreign products. One such option is to give community leaders and trusted persons—e.g. village elders, district officers, community health workers, agriculture extension workers, headmasters, and nurses—solar lamps on a trial basis and ask them to share their experiences in village town halls, and when they go to other community members' homes. Parents and children can also be invited to visit such people's homes to experience the impacts first-hand.

During interviews and focus groups, many stakeholders mentioned that they learned most about solar lamps from neighbors who had purchased one through SunnyMoney. Based on this finding, we suggest SunnyMoney ask headmasters to call on children whose parents had purchased the S1 lamp in the first rollout to discuss their experience with the lamp during school assembly. SunnyMoney should also ask headmasters to encourage parents, who have bought the solar lamp, to discuss its use with their extended family and friends. Other methods include using the lamps in school so that children understand how they work and explain the benefits to their parents.

EXPAND TO NEW POPULATIONS AND MARKETS

Table 9: Opportunities to Expand to New Populations and New Markets

Opportunity	Potential Response
Financing options	Continue to explore new financing mechanisms to increase sales
Younger children	Explore expanding the School Campaigns to preschoolers with targeted messaging
Marketing and sales events during harvest season	Explore rollout of School Campaigns during the harvest seasons when families have cash in hand
Best practices of successful NGOs' commercial initiatives	Explore best practices on funding and financing from other NGOs that have a market-based, for-profit initiative
Trade associations	Explore methods to pool resources within the solar lamp business community for operations, market creation and advocacy

Prioritized recommendations are bolded.

- **Continue to explore new financing mechanisms to increase sales**

We applaud SunnyMoney's efforts in finding new ways to offer its products to poorer segments of the BoP. We recommend that the venture continue to explore piloting rent-to-buy and pay-as-you-go models to attract new customers from poorer segments of the BoP and also enable current customers to purchase more solar lamps to completely eliminate kerosene lamps in the household. We also suggest exploring partnerships with microfinance institutions and village loan and savings schemes (VSLA). If the latter do not exist, we recommend SunnyMoney introduce the concept in a village and use it as a financing tool for solar lamps.

- **Explore expanding the School Campaigns to even younger children with targeted messaging**

We recommend that in the future, SunnyMoney explore working with even younger children than whom they normally target (we expect that the earlier the entry of a solar lamp in a home, the longer the positive impacts can accrue over time). The School Campaign will need to be adapted since very young children may be unable to pass on the message to their parents (as in the current business model). SunnyMoney would benefit from consulting an expert for advice on how to effectively do this.

- **Explore rollout of School Campaigns during the harvest seasons when families have cash in hand**

In our interviews, some respondents told us that they do not purchase the S1 lamps because when SunnyMoney comes to their child's school, they do not have any cash in hand at that moment.⁹⁶ To sidestep this issue, we recommend SunnyMoney roll out its School Campaigns during the harvest season when parents have cash in hand from their farming activities.

- **Explore best practices on funding and financing from other NGOs that have a market-based, for-profit initiative**

SunnyMoney can explore the funding and financing strategies of other successful non-profits that have launched commercial ventures e.g. SIDAI and its commercial venture FarmAfrica in order to identify best practices as SunnyMoney expands to new markets.

- **Explore methods to pool resources within the solar lamp business community for operations, market creation and advocacy**

Because SunnyMoney's mission is to eliminate kerosene use by 2020, it welcomes competitors to increase the spread of solar lamps and demand of such. SunnyMoney should hence explore developing a trade association of suppliers and distributors in areas of operation and in potential expansion territories to pool resources for market creation and operation. Such an association could also discuss common issues they face due to the external environment in which they operate, share best practices, and advocate for business-enabling policies at the regional and national levels. SunnyMoney could take the lead in creating such an association and hand over control to a non-biased, non-operating actor. An example of a successful association is the cook-stove trade association in Laos spearheaded by GERES.

CAPTURING IMPACT

In this section, we outline at a high level how SunnyMoney can quantify a set of impacts identified in the Impact Findings section and move toward regularly measuring its outcomes on its stakeholders and their children age eight and under. We suggest that SunnyMoney consider conducting its own study or commission a study from an outside source (preferred method) to learn more about its impacts. By conducting a thorough assessment of impacts, SunnyMoney can:

- **Assess opportunities to enhance value to its stakeholders**
- **Create additional revenue-generating models to better meet the needs of stakeholders and seek partnerships to facilitate them**
- **Demonstrate the success of its business model to external stakeholders**

MOVING TOWARD A SYSTEMATIC IMPACT ASSESSMENT

We recommend that SunnyMoney systematically measure its impacts on its stakeholders' children in the 0-8 age category. This will allow SunnyMoney to gain a more nuanced understanding of the needs of young children as well as how these needs change over time. Rather than focus on measuring the impact it has on all its stakeholders' children, we recommend that SunnyMoney start by first measuring its impacts on its customers' children. Once SunnyMoney develops a regular system to capture this, the BoP venture can, in a targeted manner, measure its impacts on children of their dealers and those in the broader community.

In order to capture SunnyMoney's impacts on children in a manageable way, we suggest that the company develop a short, mostly quantitative survey of core impact areas (such as impacts bolded in **Table 5**) affecting children age eight and under. The survey should be distributed to new customers at three key intervals: 1) at purchase, 2) six months after purchase, and 3) one year after purchase at the respondent's home. Recording GPS coordinates will help interviewers to find a respondent's home at later data collection points.

We recommend that the survey be administered by interviewers rather than filled out by customers. This will help to ensure respondents fully understand the questions and do not leave questions blank. We also recommend that SunnyMoney hire a third party to conduct the interviews to reduce response bias. A less expensive alternative would be to have SunnyMoney conduct the surveys itself. If SunnyMoney chooses the latter option, we recommend that it still commission an independent assessment every few years to ensure objectivity of the findings. Regardless of who conducts the surveys, SunnyMoney should hold a brief workshop to ensure that the interviewers understand the purpose of each question.

Based on the likely direct and indirect impacts we found in the field on the majority of customers' children, we identified core impact areas for SunnyMoney to consider measuring using subjective questions, many of which can be quantified using Likert scales of 1-5 (see **Appendix D**). Since the impacts are likely to vary by the child's age, we specify which questions should be asked according to age group. The survey should begin with a question about the number of children in the home and their age so the interviewer knows which questions are appropriate. At the end of the survey, the interviewer should ask an open-ended question to capture any other differences parents have noticed in their children. The questions in **Appendix D** are suggestions, and should be pre-tested with customers for adaptation to the local context.

We suggest that SunnyMoney continue to use the BoP IAF to systematically capture its impacts on customers. The tool will provide a structure through which SunnyMoney can categorize and track new findings derived from its surveys. SunnyMoney may also find the tool helpful if the organization decides to

capture impact data on its dealers' children and children in the broader community in the 0-8 age group. A benefit of using the BoP IAF is its flexibility— SunnyMoney can customize the tool to its needs, which will allow the organization to measure its impacts in a manageable way.

CONCLUSION

SunnyMoney is a market-based initiative of SolarAid, a non-profit organization that seeks to “eradicate the kerosene lantern from Africa by the end of this decade.”⁹⁷ SunnyMoney, headquartered in Nairobi, Kenya, sells a wide range of solar products (made by multiple manufacturers including India-based GreenLight Planet, US-based d.light, and Australia-based BareFoot Power) to residents of BoP communities with limited access to electricity in Kenya, Tanzania, Malawi, and Zambia. Since its inception, SunnyMoney has sold over 459,000 solar lights.⁹⁸ SunnyMoney markets its products through multiple channels. In Tanzania, we studied the impacts of using the S1 (manufactured by d.light) on customers’ children, priced at an average 10 USD per unit and sold through their School Campaign. In Kenya, we studied the impacts on SunnyMoney’s dealers’ children.

Clean (no emissions) and good quality lighting output from a solar lamp has the potential to positively impact the lives of children. Our research indicates that once the lamp is purchased, increased savings from reduced kerosene expenditures and kerosene-related medical expenses can be redirected to children’s needs such as nutrition and education. They also benefit from the ability to study longer hours due to the three to four hours of clean light they receive from a solar lamp, from the improved quality of air in the house and reduced threat of fire, and from the improved feelings of security and control over their environment after sunset.

In addition to its customers’ children, SunnyMoney positively impacts its dealers’ children and children in the broader community. We learned that dealers’ children benefit from the supplemental income their parents contribute toward their immediate needs like food, clothing, books, school uniforms, and other necessities. SunnyMoney impacts the children of the broader community by improving the local ambient air quality through the reduction of kerosene use (reduction in released toxic fumes and CO₂).

Based on the likely outcomes SunnyMoney has on children, we identify opportunities that SunnyMoney can explore to enhance, deepen, and expand its impacts on children age eight and under:

- **SunnyMoney should explore methods to strengthen dealer networks and incentivize dealers to stock more SunnyMoney products.**
- **SunnyMoney should explore procedures to improve after-sale service to combat any negative perceptions of solar lamps and SunnyMoney as a company.**
- **SunnyMoney should explore approaches to strengthen ties between customers and SunnyMoney, and between suppliers and SunnyMoney through communication and strong feedback loops.**
- **SunnyMoney should explore including messaging on health and environmental benefits of using a solar lamp to School Campaigns, in addition to the cost savings and school performance improvements.**
- **SunnyMoney should explore techniques to improve the transfer of message delivered in School Campaigns from child to parent. The organization should also consider disseminating information directly to parents.**
- **SunnyMoney should continue to explore new financing mechanisms for solar lamps to increase sales among the BoP.**
- **SunnyMoney should explore methods to pool resources within the solar lamp business community for operations, market creation, and advocacy.**

We also provide methods and questions that SunnyMoney can use to measure its impact on children regularly. Together these suggestions can help SunnyMoney improve its operations to better meet the needs of children.

APPENDICES

APPENDIX A: COMPETITORS

Highedge Solar Tanzania Ltd.

Arusha, Tanzania-based Highedge Solar Tanzania Ltd. provides solar panels, inverters, solar water heaters, wind generators, solar water pumps, batteries, solar batteries, solar lights, and solar charge controllers in Tanzania. The company serves residents who are not connected to the grid, are seeking to reduce their electricity consumption costs, want power backup systems, and/or seek to protect their existing electrical equipment against power surges. Highedge also installs solar systems for businesses and NGOs.⁹⁹

ARTI Energy and ARTI Energy Limited

ARTI Energy is a collaboration between Appropriate Rural Technology Institute Tanzania (ARTI-TZ) and ARTI Energy Ltd. ARTI-TZ is a Tanzanian-registered non-profit organization established in 2007 with the mission of serving Tanzania through the dissemination and application of scientific knowledge and sustainable technologies for energy production, environmental protection, employment, and income-generating opportunities. ARTI Energy Ltd. is a commercial enterprise established to identify quality renewable energy products and market them to consumers. The organization provides low-cost solar units, large solar system installation, and training while establishing community-based enterprises.

Solanterns

Solanterns is a Kenyan initiative of Renewable Energy Ventures Ltd., a renewable energy and energy efficiency project developer and advisor. The organization provides solar lanterns that retail for 2,500 KES (25 USD) with a battery life of three years, allowing Kenyans to pay 833 KES a year for lighting compared to 3,650 KES per year when using kerosene lanterns. The initiative seeks to accelerate the adoption of solar lanterns to replace kerosene lamps and help low-income households prevent fires and respiratory illnesses while decreasing their lighting costs.¹⁰⁰

Sollatek

Founded in 1983, UK-based Sollatek Ltd. serves developing markets that have erratic and unreliable power supply. Sollatek manufactures specialist products to protect consumer and industrial electrical and electronic equipment. The company has offices and an active distribution network in 30 countries around the world, and provides six small solar light products in addition to telcom, installation, battery, voltage protection, and refrigeration control in each of SunnyMoney's markets.¹⁰¹

Solar Energy For Africa Ltd.

Solar Energy For Africa Ltd. is a Kampala, Uganda-based private company dealing in the procurement, selling, installation, maintenance, and service of all types of solar energy/power systems, equipment, and appliances in East Africa. The company specializes in solar photovoltaic systems, and plays a leading role in the development of the solar industry in Uganda. The company also distributes small solar lights in East Africa.¹⁰²

APPENDIX B: ADDITIONAL IMPACTS ON CUSTOMERS' CHILDREN

Impacts that occur on customers' children that are not bolded in **Table 5** are explored here:

CAPABILITY WELL-BEING

Direct Impacts

Aspirations: Increased expectation of the future including the wish to continue education due to improved school performance from studying longer hours

Due to the ability to study longer hours, children develop improved aspirations for their future. With improved grades, they wish to continue their education and also dream of better jobs. The solar lamps are marketed toward Standard 7 children, the year students must pass a central exam to move on to secondary school; improving their performance in this crucial year encourages students to continue with their education. One parent indicated that his child's expectations have changed since getting the solar lamp—he is now thinking about going to secondary school.¹⁰³

RELATIONSHIP WELL-BEING

Direct Impacts

Interactions: Increased risk of conflict between siblings over the use of the solar lamp

Many siblings have no trouble sharing the solar lamps.¹⁰⁴ However, in some cases, children appear to experience increased conflict with their siblings over use of the solar lamp during study time. For example, one customer's 14-year-old son was the only child in the household who was allowed to use the solar lamp, while the younger girls had to use a kerosene lamp. The three sisters, ages 12, 10, and five, became upset because they were not allowed to use the new lamp and so threw the lamp and broke it.¹⁰⁵

Adaptability in School: Increased ability to assimilate into the school environment by being prepared for class and performing more confidently, all facilitated by studying longer hours due to the use of a solar lamp

Access to clean and good quality light after dark allows children to prepare for school work, and develop higher levels of self-confidence about the quality of their work. Children who are prepared raise their hand in class more often and develop higher levels of self-efficacy in their ability to communicate about course concepts with peers and teachers.

Indirect Impacts

Support: Children receive more support from their parents when their parents experience less tension and stress as a result of decreased medical issues and expenses

As parents begin to have fewer kerosene-related health issues and medical expenses due to use of solar lamps, they experience less stress in their lives, which improves interactions with their children. They also have more energy to attend to their children's needs.

APPENDIX C: ADDITIONAL IMPACTS ON DEALERS' CHILDREN

Impacts that occur on dealers' children that are not bolded in **Table 5** are explored here:

CAPABILITY WELL-BEING

Direct Impacts

Education/Knowledge: Improved entrepreneurial skills by observing the increased business activity as their parents add solar products to their shops

Entrepreneurs who are part of the SunnyMoney network cultivate additional business skills and talent through their interactions with SunnyMoney. Their children observe their parents' work and can model their parents' entrepreneurial mindset. Role modeling is a critical factor in successful intergenerational transfer of entrepreneurial talent and ambition.

Education/Knowledge: Increased knowledge and interest in renewable energy

The children of SunnyMoney's dealers are impacted by their parents' increased interest in renewable solar energy and protecting the environment for generations to come. As their parents' views about kerosene change, children's views change as well.

RELATIONSHIP IMPACTS

Indirect Impacts

Support: Increased social capital from parents' increased social network results in increased resources for children

SunnyMoney dealers meet a number of people within the communities they serve, expanding their social networks. An increase in the number and often quality of social relationships can provide a support mechanism for parents, which can increase access to additional resources available within those networks for their children. The expansion can provide children with additional models of positive social interactions and access to other supportive adults. This network can provide parents with support in times of crises and allow them to reach out to others for help.¹⁰⁶

APPENDIX D: ADDITIONAL IMPACT ASSESSMENT SUGGESTIONS

These questions provide a starting set that we recommend SunnyMoney use to begin regularly capturing its impacts on customers' families. The questions illustrate how SunnyMoney could quantitatively measure some of its key impacts on children. These questions have not been tested and should be reviewed for reliability and for adaption to local context.

The surveys should be structured to ensure comparability across respondents. Therefore all surveys should include the same questions, so changes in customers' children's lives can be compared and measured over time. However, impacts will likely vary based on the age of the child. Therefore we suggest that the surveys clearly mark questions intended for older children and use skip patterns to only ask questions that apply based on the child's age (see **Table 10**). The survey should begin with a question about the number of children in the house and their ages so the interviewer knows which questions are appropriate.

Table 10: Suggested Impacts to Measure and Potential Questions

	Impact	Potential Question	Question Type
Economic Well-Being	Assets	What job and other sources of income does the male head of household have?	
		What job and other sources of income does the female head of household have?	
		What is your average weekly income? Please include all sources of income.	
		Please answer the question using the scale based on how true the following statement is: My household income is stable. <i>Scale: 1=Strongly agree, 2=Agree, 3=Neither agree or disagree, 4=Disagree, and 5=Strongly disagree</i>	
		How many loans do you currently have open? Please share the amount and when you estimate they will be paid off.	
		On average, how much money are you saving per week?	
		In an average week, how much money do you spend on your child? How much of that is health- related expenditures?	Ask caregiver about both younger and older children; ask pregnant women
		Over the past week, to what extent were you able to meet your child's clothing needs?* <i>Scale: 1=Not at all, 2=A little, 3=A moderate amount, 4=Very much, and 5=An extreme amount</i> *This question can be repeated to ask about other material needs a child has such as school supplies and fees.	Ask caregiver about both younger and older children

	Impact	Potential Question	Question Type
Capability Well-Being	Physical Health	How many times has your child gone to the doctor in the last week? The last month?	Ask caregiver about both younger and older children; ask pregnant women.
		How many times did your child have a cough or cold in the last month?	Ask caregiver about both younger and older children
		How many times has your child missed school due to health reasons in the last month?	Ask caregiver about older children
		Please answer the question using the scale based on how true the following statement is: The quantity of food my child is getting is sufficient. <i>Scale: 1=Strongly agree, 2=Agree, 3=Neither agree or disagree, 4=Disagree, and 5=Strongly disagree</i>	Ask caregiver about both younger and older children; ask pregnant women.
		Please answer the question using the scale based on how true the following statement is: The quality of food my child is getting is sufficient. <i>Scale: 1=Strongly agree, 2=Agree, 3=Neither agree or disagree, 4=Disagree, and 5=Strongly disagree</i>	Ask caregiver about both younger and older children; ask pregnant women.
	Psychological Health	Please answer the question using the scale based on how true the following statement is: My child has high self-efficacy (or feel that they can accomplish tasks). <i>Scale: 1=Not at all, 2=A little, 3=A moderate amount, 4=Very much, and 5=An extreme amount</i>	Ask caregiver about older children
		Please answer the question using the scale based on how true the following statement is: My child's sense of security is strong. <i>Scale: 1=Strongly agree, 2=Agree, 3=Neither agree or disagree, 4=Disagree, and 5=Strongly disagree</i>	Ask caregiver about older children
	Education	How much, if at all, has your child's studying time increased? <i>Scale: 1=Not at all, 2=A little, 3=A moderate amount, 4=Very much, and 5=An extreme amount</i>	Ask caregiver about older children
		How much, if at all, have your child's grades improved at school? <i>Scale: 1=Not at all, 2=A little, 3=A moderate amount, 4=Very much, and 5=An extreme amount</i>	Ask caregiver about older children
		How much, if at all, has your child's understanding of the importance of conserving the environment changed? <i>Scale: 1=Not at all, 2=A little, 3=A moderate amount, 4=Very much, and 5=An extreme amount</i>	Ask caregiver about both younger and older children
	Quality of Home Environment	Please answer the question using the scale based on how true the following statement is: My house is safe for my child/children. <i>Scale: 1=Strongly agree, 2=Agree, 3=Neither agree or disagree, 4=Disagree, and 5=Strongly disagree</i>	Ask caregiver about both younger and older children
		Please answer the question using the scale based on how true the following statement is: The air quality in my home is good. <i>Scale: 1=Strongly agree, 2=Agree, 3=Neither agree or disagree, 4=Disagree, and 5=Strongly disagree</i>	
		Please answer the question using the scale based on how true the following statement is: The risk of fires in my home is low. <i>Scale: 1=Strongly agree, 2=Agree, 3=Neither agree or disagree, 4=Disagree, and 5=Strongly disagree</i>	

	Impact	Potential Question	Question Type
Capability Well-Being	Support	<p>Please answer the question using the scale based on how true the following statement is: My child has developed a closer relationship with family members.</p> <p><i>Scale: 1=Strongly agree, 2=Agree, 3=Neither agree or disagree, 4=Disagree, and 5=Strongly disagree</i></p>	Ask caregiver about both younger and older children
		<p>Please answer the question using the scale based on how true the following statement is: I feel like I spend enough time with my children.</p> <p><i>Scale: 1=Strongly agree, 2=Agree, 3=Neither agree or disagree, 4=Disagree, and 5=Strongly disagree</i></p>	Ask caregiver about both younger and older children

During the survey, the interviewer should observe each child's appearance and behavior, if present. At the end of the survey, the interviewer should ask an open-ended question to capture any other differences the parents may have noticed in their children. The above questions are suggested questions and should be pre-tested with customers to adapt them to the local context.

SunnyMoney could also consider working with local clinics to collect and share health data on children age eight and under. This would require the doctor asking whether the family uses solar lighting and getting parents' approval to share the health data of their child with SunnyMoney.

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