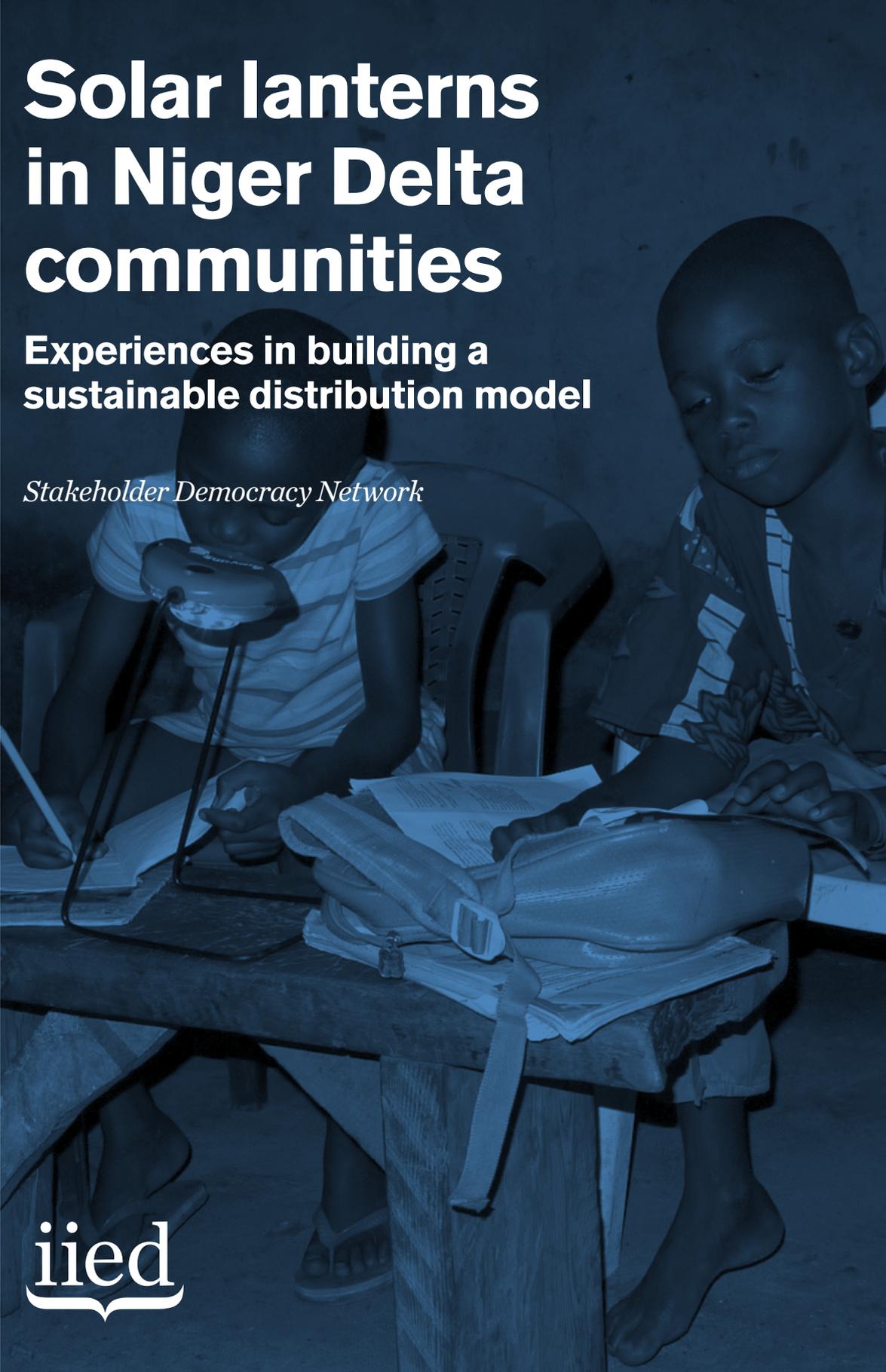


Solar lanterns in Niger Delta communities

**Experiences in building a
sustainable distribution model**

Stakeholder Democracy Network



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About the author

Stakeholder Democracy Network (SDN) supports the efforts of those affected by extractive industries and weak governance through rights based community empowerment. We strive to protect human rights and demand responsive governance. We have an array of experience including mediating complex local conflicts, introducing solar power to the Niger Delta, supporting displaced communities, community mapping and strengthening governance structures and policy.

The SUNGAS project

The SUNGAS project aims to catalyse development of Nigeria's natural gas and renewable energy markets through innovation, demonstration, policy dialogue and advocacy. Small demonstration projects for both renewables and gas-to-power will show that community-based energy facilities are technically viable, financially sustainable, and can ensure better access to modern energy services for rural communities. The project is funded by the European Union and is being implemented by the International Institute for Environment and Development (IIED), the Niger Delta Wetlands Centre (NDWC), the Living Earth Foundation (LEF) and Stakeholder Democracy Network (SDN).

The European Union

The European Union is made up of 28 Member States who have decided to gradually link together their know-how, resources and destinies. Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development whilst maintaining cultural diversity, tolerance and individual freedoms. The European Union is committed to sharing its achievements and its values with countries and peoples beyond its borders.

For further information on the work of the European Union see <http://ec.europa.eu/world/>.

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Acronyms

APC	All Progressive Congress
CAFOD	Catholic Agency for Overseas Development
CDC	Community Development Committee
CSO	civil society organisation
CSR	corporate social responsibility
ECN	Energy Commission of Nigeria
EDM	energy delivery model
EIA	Environment Information Administration
FDI	foreign direct investment
FGD	focus group discussion
FGN	Federal Government of Nigeria
IIED	International Institute for Environment and Development
LGA	local government area
MW	megawatt
N	Nigerian naira
NEPA	National Electric Power Authority
NERC	Nigerian Electricity Regulatory Commission
NGO	non-governmental organisation
PDP	People's Democratic Party
PHCN	Power Holding Company of Nigeria
PHED	Port Harcourt Electricity Distribution Company
REA	Rural Electrification Agency
REMP	Renewable Energy Master Plan
REFIT	renewable energy feed-in tariff
SDN	Stakeholder Democracy Network
SMEs	small and medium-sized enterprises
SUNGAS	Sustainable Utilisation of Nigeria's Gas and Renewable Energy Resources
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

The Niger Delta region fuels Nigeria's economy, accounting for 95 per cent of Nigeria's export earnings and over 80 per cent of the federal government's revenue – and yet remains one of the poorest parts of the country (Francis *et al.*, 2012). Its considerable potential for socio-economic development has been hampered by a lack of access to modern energy services, despite rich energy resources and well-educated populations. Renewable energy has become a competitive option, due to the current high costs and unreliability of electricity access. While there is potential for decentralised and renewable energy supply to the Niger Delta's rural and peri-urban communities, according to a recent World Bank analysis (*ibid*), this needs to be recognised and translated into investment and implementation.

Since there is not enough on-grid power to meet demand, off-grid generation is used to make up the shortfall. An estimated 60 per cent of all current generation comes from off-grid sources. The primary form is 'self-generation' by individual households or businesses using diesel and petrol generators. This can cost between three and 20 times more than power supplied by the national grid, depending on the tariff.

The SUNGAS Project (Sustainable Utilisation of Nigeria's Gas and Renewable Energy Resources) is a European Commission funded project to develop community-based energy initiatives in the Niger Delta using renewable energy resources. One component of SUNGAS

is the Sustainability and Market Development project, carried out by the Stakeholder Democracy Network (SDN), which aims to catalyse market development by demonstrating and selling small solar lanterns as a commercial and sustainable business model. This solar portable lighting project is committed to generating conditions for the successful market growth of a diverse range of solar lighting options, free of distorting subsidies, to suit relevant community needs and income levels.

Using the 'energy delivery model' approach

This case study aim's to review and evaluate the impact of SDN's solar lantern distribution model at a community level. It identifies what SDN staff have learnt through distributing solar lanterns to four rural and urban communities in Rivers State, Nigeria, in order to critique the approach and consider how to implement the model more effectively, as well as analysing its potential to scale up in the region. To this end, SDN applied the 'energy delivery model' (EDM) framework offered by the International Institute of Environment and Development (IIED) and the Catholic Agency For Overseas Development (CAFOD) to help design pro-poor energy delivery.

The EDM approach presents a participatory framework to enhance the delivery of energy projects that work for people living in poverty, while building an evidence base for more

informed decision-making and advocacy. Its two tools – the Delivery Model Map and the Delivery Model Canvas – can be used to help design delivery in a holistic and participatory way, responding to the underlying factors that maintain demand for energy services in that specific context. Instead of assuming that cost is the sole barrier, the model encourages exploration of the broader socio-cultural, economic, political and geographical factors that have created the current energy gap and seeks solutions where previous interventions have failed. The results of applying this framework inform SDN's strategy to expand the small solar lighting model into rural areas.

Fieldwork designed using EDM principles consisted of survey questionnaires, key informant interviews and focus group discussions with questions adapted to the Niger Delta context. This yielded valuable lessons on both the process side of how the solar lantern distribution model would likely operate in target communities, and its outcomes in the target communities.

Findings for the solar lantern model

The results of applying the EDM framework and related fieldwork helped in analysing the current distribution of solar portable lighting, which operates as a 'NGO (non-governmental organisation) model'. Figure 1 illustrates this structure, from the donor through to end users. A regional distributor sources resources from the stock house and makes them available for community distributors to sell locally, with the revenue generated circulating throughout. However, the maintenance of the stock house relies on a donor and a supplier. In its current form, the model is therefore not self-sustaining in that it requires the NGO as a key actor as well as donor funds to help with start-up.

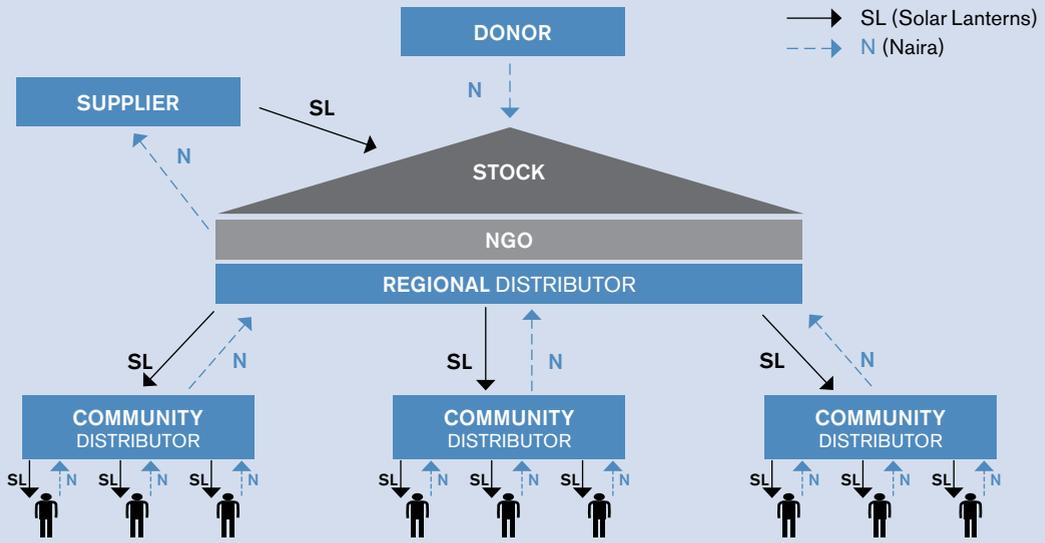
The lessons from examining the process aspects of the model included: the need for more effective ways to reach end users of the lanterns, especially in rural communities, such as word-of-mouth marketing, pidgin slogans on the radio, informal networks of communication, women acting as advertiser 'champions'; and the need for seizing opportunities to introduce products, and flexible repayment plans for periods when income is high – for example during harvest.

One particularly interesting finding – which emerged from SDN-run 'town hall' style sensitisation meetings on solar lanterns – was poor capacity and knowledge among community members. When asked about targeting market women as ambassadors for the products, 80 per cent of respondents felt that strategic 'knowledge workshops' aimed at market women, as central to the home and domestic sphere, could increase community-wide understanding of and buy-in to the products.

This finding has helped identify market women's groups as potential 'mouthpieces' for renewable energies, by demonstrating the product at home and on market stalls. This could both generate momentum around the product and support women's livelihood empowerment. Capacity building exercises and skills acquisition around solar could further work to support women's rights. The 'value' of the solar lantern is determined by its importance, worth, or use for the user. So the focus in the formative stages of the business model is to introduce the product and communicate its 'value'.

Lessons on outcomes for communities included the positive impact on education when children use solar lanterns to study after dark, and on health and the environment when they are used as an alternative to noisy, polluting diesel generators or kerosene lanterns.

Figure 1. 'NGO model' used by SDN for lantern distribution



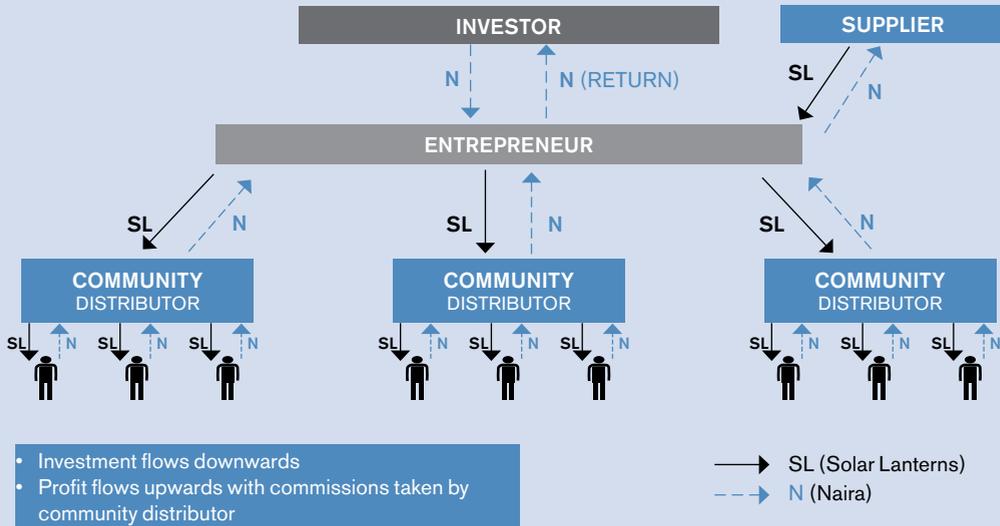
A viable business model for solar lanterns in the Niger Delta

Based on the field research, it appears that lantern distribution could have sufficient profit margins to operate as a viable business model. This scenario was modelled based on assumptions drawn from the research, such as the following: an initial investment of stock being required to begin business; products sold at full market price; the sale of only Sun King Pro and Schneider products (tested extensively with the customer-base); and finance agreements being available to customers with a 40 per cent initial payment. Small-scale businesses would act as distributors – working with existing suppliers as they would not want the risk of importing products. Large-scale suppliers are already set up for imports and can manage customs and import risk; beyond a certain size this would also bring economies of scale.

The resulting proposed 'sustainable' business model (Figure 2) brings together this research analysis, which was conducted across social, cultural, economic, and supply-chain factors within the energy delivery model framework. The main departure from the current model is the introduction of local privatisation. Rather than relying on a donor to keep stock afloat, individuals are given assistance to source investment and a supply of products, which they can then sell directly to community distributors.

With this model, the financial benefits accrued through transactions will go directly to those engaged in the procurement and distribution of the products. What is more, this business structure potentially gives local community-based entrepreneurs a far wider reach than an NGO could aspire to, resulting in wider awareness, dissemination, and uptake. It is anticipated that the model will ultimately be

Figure 2. Proposed sustainable business model for lantern distribution



sustainable, as the dependence on donor and NGO has been removed.

However, SDN argues that the NGO and sustainable business phases are mutually reliant. In other words, it is a two-phase model, where the NGO phase is as important as the sustainable business model phase. The NGO role is essential for starting up: to initially manage stock, build on 'networks of trust' in the community, and support the community-based entrepreneur with financial reporting prior to transitioning to the 'investor-based' structure.

Business-based approaches are flexible and can respond to demand, and a community's ability to pay – but in many cases they do not respond to broader customer needs where energy is only one piece of the puzzle. What is more, a free-market approach alone is often not sufficient. Local capacity is key to realising benefits of new opportunities and remains an area that requires more extensive support than the private sector can or is willing to provide.

Distribution and sales of solutions are quick and easy wins under the correct market conditions. Building these conditions in the first place can require 'pre-market' participation of other actors such as government – and as we have seen in this example, NGOs.

It is also the case that selling products in a market place has directly quantifiable outcomes which play better to the strengths of businesses. Larger and more complex questions such as how to build resilience to climate change are more likely to be of interest to development agencies, governments and NGOs, rather than the private sector. The participation of these public and NGO organisations may help to better steer markets in directions that begin to address these more complex questions – and, as has been discussed in the solar lantern model, foster 'pre-market' conditions to allow for a private sector model which delivers more appropriate and better quality products to poor users in the Delta.

Alternatives, parallels, and scaling up

In the Niger Delta, Solar Sisters and Green Village are experimenting with micro-grid models. To scale up the solar lantern distribution model, a potential technical partnership with Green Village could look to serve off-grid communities in the Delta and Bayelsa State. Installing larger solar panel installations, with costs shared across communities, could meet rural people's energy requirements, make renewable energy accessible and create job opportunities through the installation, maintenance and payment processes.

SDN's activities in testing and deploying the solar lantern model thus far have focused on four communities which, although a mixture of urban and rural, are relatively accessible. One possible rural area to pilot remote rural solar lighting models is Nembe Island, Bayelsa State. SDN has already worked in Nembe - alongside the United States Bureau of Conflict and Stabilization Operations, when Nembe communities participated in a 13-part documentary series to promote non-violent civic activism in the Delta called *Dawn in the Creeks*.¹ This existing relationship could be a starting point.

Better understanding the socio-cultural context and wider enabling environment will be key in remote rural areas. Entering into riverine, off-grid and isolated communities requires dedicated and sustained engagement with the

community. An inception phase is pivotal in order to understand and respect local decision-making structures; community hierarchies must be adhered to. A crucial first step in our programme would be to conduct a baseline feasibility study, without provoking hostility, in order to understand informal money flows and disposable income. The greatest challenge in potentially hostile villages is safety. This perhaps emphasises the need for the two-phase model where an NGO is the lead organisation during the first phase – perhaps in this case with a longer transition and/or further ongoing community engagement support to ensure sustainable operation of the energy delivery model in these challenging contexts.

The emergence of competing products of varying power has the potential to provide meaningful gains for differentiated individual demand. The challenge is to make packages relevant and visible to household needs, incomes and aspirations. This cannot be done without consumer and distributor awareness about the value of these new products in meeting different energy needs. Consumer (and distributor) education should therefore be incorporated into any renewable energy strategy. As seen in this study, there can be a role for NGOs in helping understand this value based on locally specific needs, in raising awareness through brokering trusted relationships, and building the capacity of local distribution networks.

¹ See www.dawninthecreeks.tv

1 Introduction

In Nigeria's Niger Delta, 46.2 per cent of the population that are connected to the grid receive less than two hours of electricity supply daily (Oyebamiji and Kigbara, 2011). The picture on reliability is similar across many areas of Nigeria, where national electricity demand is estimated to be between 20,000 and 60,000 MW while actual power generation fluctuates from 1,500MW – 4,000MW. Fed through a failing national grid, supply is erratic and unreliable. The result is widespread dependence on kerosene, diesel and wood for expensive, poor quality, and polluting off-grid electricity generation. Although there are plans being put in place to improve the grid and generation capacity, these will take decades – and so far have been focused on building infrastructure for central generation. Greater investment in decentralised electricity generation would benefit the country.

Localised markets for renewable energy products in Nigeria are sporadic and under-developed. In the Niger Delta, there are a number of high profile examples, such as solar street lighting, that have failed – and a multitude of unregulated solar products in the local informal markets which are of poor quality and stop working shortly after purchase. This end-user 'experience', combined with the often cloudy weather and misinformation disseminated by the likes of the diesel generator industry, has led to impressions that solar 'doesn't work' in the Niger Delta.

To start to change perceptions, provide positive demonstration of renewable energy at work, and foster reliable local renewable energy markets, the Stakeholder Democracy Network (SDN) is working to develop community-based

sustainable energy initiatives in the Niger Delta. Amongst a number of projects, it has initiated a portable solar lantern project as part of the SUNGAS (Sustainable Utilisation of Nigeria's Gas and Renewable Energy Resources) project, funded by the European Commission. The aims are to test out sustainable supply models, build informed demand, and with this bring potential to catalyse the development of renewable energy markets and sustainable community-based energy facilities beyond the project target community. While small, the SDN business modelling for the project shows that the fundamentals of a profitable enterprise exists, revealing an opportunity for a self-sustaining and scalable solution to bring safe and reliable lighting solutions to local communities.

The first phase of the portable solar lighting initiative has already been completed. Activities included testing for interest in different types of portable solar lanterns based on certain end-user needs and preferences, and establishing a supply chain and distribution network to a number of target communities. Given the negative views of these types of products, the approach involved a model focused on building trust and awareness with the target communities – detailed further in Section 2. This paper reviews and analyses the impact of the first phase, through the lens of the 'energy delivery model' (EDM) framework – a pro-poor approach to designing energy delivery created by the International Institute for Environment and Development (IIED) and the Catholic Agency for Overseas Development (CAFOD). We applied and adapted the EDM tools in order to identify what SDN has learnt in distributing solar

lanterns to rural and urban communities in Rivers State, and to assess the potential to improve and scale up the model regionally as part of a second phase – both by becoming more self-sustaining and by reaching more communities, especially in rural areas.

The paper is structured as follows: **Section 2** describes SDN's current solar lantern distribution model; **Section 3** introduces the energy delivery model (EDM) framework, and SDN's objectives in using it; **Sections 4** and **5** show how the SDN and stakeholders applied the framework to the lantern

distribution model at a participatory workshop; and **Section 6** describes how the EDM questions were adapted to the local context in preparing fieldwork.

Sections 7 and **8** present fieldwork findings on the lantern distribution process, and propose a sustainable business model; **Section 9** presents the fieldwork findings on community outcomes; **Section 10** discusses a strategy for expanding into rural communities; and **Section 11** proposes the next steps for solar lantern distribution and renewable energy in the Niger Delta.

Access to power in Nigeria

The Federal Government of Nigeria (FGN) estimates that roughly 60 per cent of Nigerians – more than 80 million people – have no access to electricity (Vision 20:2020). Even without taking into account the needs of industry, demand appears to be overwhelming: conservative estimates put overall demand for electricity at 20,000–60,000MW. Yet, current generating capacity is limited to 5,000MW, and actual power generation is 1,500MW–4,000MW – a mere five to ten per cent of demand.

The Council for Renewable Energy in Nigeria (CREN) states that erratic power supplies cripple development in the Delta, with power outages causing a loss of 126 billion Nigerian naira (N) annually (CREN, 2009). It blames an “erratic” supply on “faulty transmission and distribution lines”. In 2007, it was estimated that 20 per cent of all electricity generated by the Power Holding Company of Nigeria (PHCN) was lost through transmission and distribution before reaching customers – losing around US\$600m a year (Lawal, 2007).

SDN's own research, described later in this report, assessed residents' access to power in Rivers State, Nigeria in 2014. The following findings are taken from this research.

“We are connected to the grid, however electricity supply is infrequent and sporadic. Majority of citizen use generator and fuel for their households and businesses” – Ezekiel, Rumunduru.

Supporting CREN's findings, respondents to SDN's survey stated that in 2014 Mgouba Community in Rivers State experienced five consecutive months without any electricity. Yet the company responsible, Port Harcourt Electricity Distribution Company (PHED), continues to estimate and increase electricity bills. Community residents have refused to pay due to the lack of service, and the majority of the community are still in debt to PHED.

“The money I spend to keep my business moving is more than my profit. I spend N15,000 weekly to buy diesel and also pay my workers every month. In February, PHCN brought a bill of N31,850. What for? Surprisingly last Saturday, they brought light that was not up to 15 minutes. To be frank, the light situation is not worth discussing because the more you are discussing it the more you will be hurt” – Enwerem Sandra, Ena Classic Beauty Hall, Mgbuoba.

Across the urban sites of Rumukwache, Rumunduru and Mgbuoba, 96.7 per cent of respondents are connected to PHED's electricity supply, known colloquially as 'NEPA' (National Electric Power Authority). However, 63.3 per cent of these are dissatisfied with their electricity supply, frequently referring to the output as 'sporadic' and 'epileptic'. Of those interviewed by SDN in urban and semi-urban areas, 60 per cent state that electricity bills do not match their consumption.

“When I used to keep tabs last year, the nature of electricity supply was sporadic, sometimes an hour a day and other times 15 hours a day but since this year 2014 the supply has never been more than two hour for any day we get supply” – Christerbel Abel, Mgbuoba.

“We always have sporadic power supply, I use kerosene for my local lantern and gas for cooking, I refill my gas cylinder for N4,000 every month” – Julie, Mgbuoba Community.

In light of PHED's failure to deliver reliable power, solar energy is seen as a 'less stressful' alternative by urban communities in the SDN study. Residents are able to operate it autonomously, benefitting from the light source immediately. However, cost implications continue to deter users.

As our field research in Mgbuoba Community attests, this unreliable energy supply costs N1,000 per month for 53.3 per cent of residents in low to middle-income semi-urban communities in Rivers State.² Due to the saturation of urban housing areas, the PHED output struggles to serve the mounting energy needs of over-populated communities and the growing middle class's appliances and computer-charging facilities. Currently, grid electricity is cheaper (N6 per kilowatt hour), but its reputation for being 'sporadic' and 'erratic' means expensively fuelled generators (at N35 per kWh) have become the main source of power for many urban and rural areas. Ninety per cent of citizens interviewed across the four communities supplement their electricity supply with a generator set.

“I work in a car body shop – we spray paint cars. We are actively not connected to the grid at work due to irregularity of light supply, it is better for us that way. Combining fuel expenses and bills for power we never get will be too expensive. We solely depend on generator” – Resident, Rumunduru.

2 SUNGAS stands for 'Sustainable Utilisation of Nigeria's Gas and Renewable Energy Resources'.

2

SDN's solar lantern pilot project

The Stakeholder Democracy Network (SDN) exists to support the efforts of those affected by extractive industries and weak governance in Nigeria's Niger Delta region, through rights-based community empowerment. SDN's model of community empowerment, backed by research and advocacy, aims to help communities and civil society to communicate a shared vision and negotiate with other stakeholders, to get a better deal from the investments and operations that affect their lives, livelihoods and environment. As part of achieving these goals, SDN has a strong interest in sustainable energy services that work for local people.

SDN's portable solar lighting project fits these goals. As mentioned above, Niger Delta communities depend on noisy, expensive diesel generators to supplement an unreliable and often non-existent supply of electricity from the grid. During 2013 and 2014, as part of the SUNGAS project, SDN purchased and distributed a diverse and sustainable supply of solar lanterns and solar base-stations in selected community groups and enterprises. In phase one, the aim was to trial a variety of portable solar lighting products with communities, build up a sustainable supply and distribution model for a subset of these, and change target community mindsets on the viability of solar technology for lighting - thereby reducing dependence on diesel generators and kerosene-based lighting.

The core principles of the portable solar lighting initiative, in line with SUNGAS objectives, include ensuring the model is sustainable

and has potential for replication. The theory of change is to generate conditions for successful market growth, free of distorting subsidies, with a diverse range of solar lighting options to suit relevant community needs and income levels. If successful in our pilot communities in the Niger Delta, a key priority for the project is to share lessons with other civil society and development organisations, in order, potentially, to replicate the solar distribution model at national level.

To start this process of creating the right conditions for growth, SDN decided that trust-building and awareness raising were key factors to embed into the model - so as to overcome the negative perceptions of solar in the Niger Delta. The phase 1 model is described below, along with initial sales figures for the various products deployed. Section 3 goes on to describe the analysis of the phase 1 model for impacts and potential improvement.

2.1 The 'phase 1' distribution model

The aim of the phase one pilot was to sell individual renewable lighting products directly into communities through local entrepreneurs, thereby creating a model of distribution in urban and suburban communities in Port Harcourt and the surrounding area. To achieve this goal, SDN employed the services of a known local marketing distributor, Hamisu Usman, to leverage existing relationships in core communities and build a distribution network across various parts of Port Harcourt and surrounding communities.

At the outset, SDN identified a range of tested solar products that are known to be durable and relatively affordable. Other factors considered in choosing the range of solar lanterns were availability, provision of after-sales support, results of product focus groups of individuals (including SDN staff) who had purchased and used the solar lanterns during the initial product outlay, and cost of distribution and storage. The products were sourced from suppliers in Nigeria in order to support medium-size enterprises to develop and meet burgeoning community demand for solar lanterns. The lanterns are from recognised manufacturers Sun King Pro, Schneider, and Waka Waka; two products from each manufacturer giving a range of six lanterns in total. (See Annex 1 for more details on the product specifications.)

In this initial model, SDN brokered relationships with the suppliers and sourced the products from them, to pass on to the regional distribution agent, which were then in turn sold locally by community level agents. Importantly, the local community agents were trusted within their communities – being a combination of community-based groups (such as women's groups) and local entrepreneurs.

Having selected the products, SDN set an attractive 'sustainable' or affordable retail price, which was lower than the steep price charged by the few local retailers who sold the product: cost price plus a mark-up to cover the cost of distribution, storage and marketing. No subsidies were included so as not to distort the product's true market value and to encourage private sector investment. The marketing distributor then began to implement and manage distribution. He identified individuals and groups of entrepreneurs in urban and semi-urban communities selected by SDN in Rivers State in order to better meet the decentralised energy needs of vulnerable groups. The distributor sold the products at a wholesale fixed rate; the entrepreneurs in turn sell on to locals at a suitable retail price, which is not predetermined

by SDN. Initially, distribution started in these communities selected by SDN and around Port Harcourt, but has since expanded to other areas like Yenagoa, Kaduna and Lagos through direct sales by the marketing distributor to entrepreneurs from these places.

The marketing distributor also devised and agreed terms of reference for the entrepreneur groups and individuals, outlining requirements for the process of selling and monitoring of solar products sales. It was within the purview of the marketing distributor to supply solar lanterns to trusted small-scale community-level entrepreneurs on credit – not collecting cash up front, but within a predetermined time frame which ranged from 15 to 30 days depending on the volume of stock and rate of sales. The marketing distributor ensured all outstanding payments were made before new stock was supplied to local entrepreneurs.

The distributor also helped the SDN/SUNGAS team to carry out a sensitisation programme in each pilot community on the benefits of solar energy and the objectives of the lantern distribution project. Solar lights were also strategically placed in visible places, such as kiosks or areas with good customer footfall. The distributor assesses each community's sales volume and decides how to promote interest and participation in the entrepreneur scheme. He also provides a monthly progress and sales report on the status of the project.

The current structure of our solar lantern distribution model, from the donor through to end users, can be described as an 'NGO' (non-governmental organisation) model (see Figure 4). The marketing distributor regularly sources solar products from the stock house and makes them accessible for community distributors to sell locally, with the revenue generated circulating throughout. However, maintaining the stock house currently relies on a donor (SUNGAS, funded by the European Commission) and a supplier, as well as input from SDN employees as trusted and influential

members of the church and community. (SDN staff purposefully placed ourselves within the model as 'trust champions' to improve our understanding of supplying portable lighting.)

2.2 Demand, pricing and customers

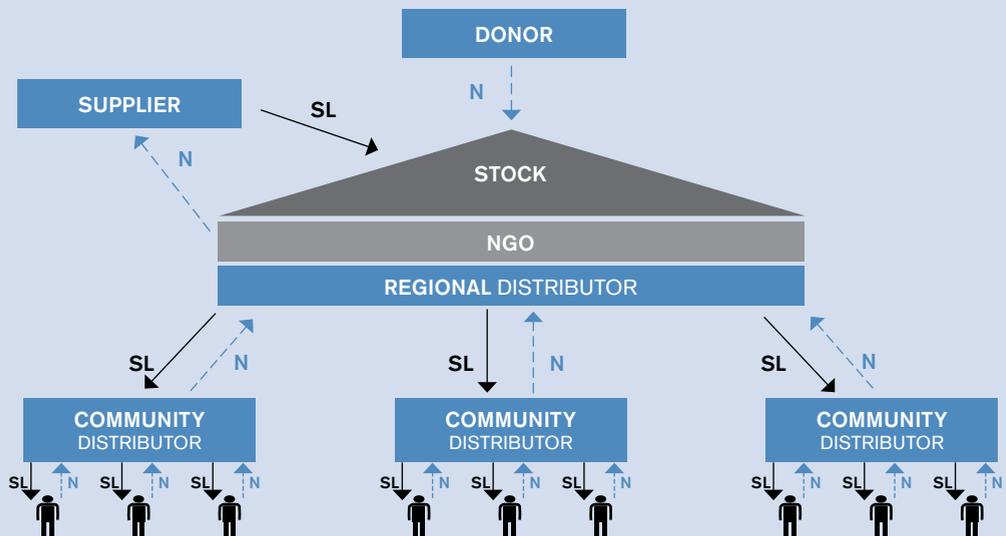
SDN's solar lantern distribution model is based on the theory of 'free market catalysis'. Prices of solar products are determined by existing market and distribution variables, such as the cost of transportation, distribution and payment to intermediaries, and without distorting subsidies; this is done in order to 'catalyse' the local market for small solar products. The demand, price and financing options, and customers for the solar products in the lantern pilot project are described below.

2.2.1 Demand for solar products

See more detailed sales records in Annex 5.

As shown in Figure 3 and Table 1, the Sun King Pro was the most popular product across the customer base in the selected communities. The Sun King Pro price of N5,500 was affordable both for customers on low incomes (those earning less than N70,000 per month) and those on middle incomes (over N70,000 per month). The product was perceived as cost effective, quiet (as it does not need to be powered by a noisy diesel generator), portable and functional. In the middle-income bracket – and what Figure 2 does not show – was the popularity of the Schneider. Sales were low due to the price, set at N13,000, but it was nevertheless seen as a premium product that provided increased power and functionality. There were some problems with

Figure 4. SDN's current solar lantern distribution model



Note: N – Nigerian naira; SL – solar lanterns

Figure 3. Sales analysis, December 2013 – March 2014

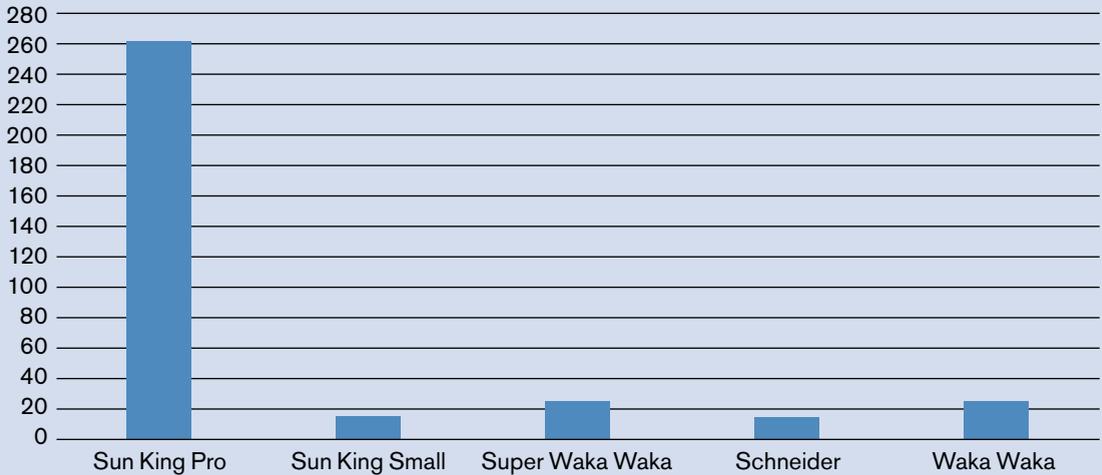


Table 1. Sales analysis and price variance of solar lanterns

TOTAL SALES SUMMARY DECEMBER 2013–MARCH 2014				
PRODUCT	QUANTITY(S) SOLD	SET PRICE (N)	AVERAGE PRICE (N)	% VARIANCE ON PRICE
Sun King Pro	262	5,500	5,340	3%
Sun King Small	16	2,500	2,378	5%
Super Waka Waka	25	9,000	8,500	6%
Schneider	16	13,500	11,750	13%
Waka Waka	25	3,000	3,031	-1%
Total	344			

the batteries; but this did not deter customers, as the marketing distributor was able to return them to the supplier and exchange them for new batteries.

Table 2 shows the variance between the set price and the actual price charged to customers. SDN set the price by adding together the supply

cost and a mark-up that reflected a position between market rate and cost price, to cover distribution and storage costs. The variance in price shows the flexibility offered to customers as the marketing distributor negotiated around the set price, without going below cost price and incurring a loss. This is the benefit of setting prices below the market rate in an unsubsidised

market: if the lantern distribution model proves successful, then entrepreneurs can begin selling at market prices and have sufficient profit margins to adopt this as a viable business model. More details on sales can be found in Annex 5; the business model is discussed further in Section 8.

2.2.2 Price and financing

Analysing the financing options for customers is important when catalysing a free-market approach. This includes asking questions on whether lines of credit are required to be able to afford products, and where they may come from. Cultural and trust issues may also play a role when asking questions such as: are customers willing to enter into finance arrangements with distributors?

Our initial strategy was to sell at full price with no financing agreement. The outcome was low

sales, with customers questioning the price of an unknown product and weighing it up against their income. We then trialled a simple finance agreement allowing customers to make payments across a specified period after one initial down payment. Once customers were made aware of the benefits of the products they were willing to explore this financing option.

The financing arrangement often depended on the financial situation of the customer; but in general it was a payment plan over a maximum of two months, with one initial payment followed by an instalment at the end of the same month and the final instalment payable at the end of the second month.

It was evident that if customers were given the option of entering into a payment plan, charging interest was culturally acceptable; even expected. Often the interest payment was not defined as a percentage, but a fixed

Table 2. Average down payment as a percentage of total price

QUARTER TOTAL	NAIRA	% OF TOTAL PRICE
Down payments	736,900	41%
Balance paid by instalments	1,071,800	59%
Total	1,808,700	100%

Table 3. Income from resale of solar lanterns

	DECEMBER (N)	JANUARY (N)	FEBRUARY (N)	MARCH (N)
Total product sales	958,400	217,300	253,600	379,400
Paid	573,200	43,000	46,600	74,100
Outstanding	385,200	174,300	207,000	305,300
	% outstanding	25%	23%	24%

charge of between N500 and N1,000. For example, on a payment plan the Sun King Pro would cost the customer N6,000: N5,500 plus N500 interest. This approach slightly increased uptake and sales of the products. The average down payment was 40 per cent of the total product price, showing the willingness of some customers to secure the product and enter into a short-term finance agreement (see Table 2). However, sales inertia remained, since the products were still relatively unknown.

Finally, we initiated a bulk discount approach to encourage those wishing to re-sell lanterns themselves, further spreading solar lanterns across communities. In addition, shorter-term financing agreements were made with one group of vendors, the Port Harcourt Energy Distributor collectors, who collect payments for PHED power within each community. They are known as 'NEPA collectors' (NEPA, an abbreviation for the Nigerian Energy Power Authority, is the colloquial term Nigerians use to refer to electricity). Through their work, the collectors are fully aware of cost and price sensitivities in the local area, and have strong and trusted community relationships to facilitate finance agreements. They therefore make ideal and well-informed sales people.

As Table 2 shows, there were few defaults on the payment plans. There is a culture of 'handshake agreements' to repay debt which meant that most customers honoured their payment plans and paid for their products in full. For those who did not meet payment deadlines, the distributor would reschedule the agreement, to ensure that the terms could be met by the customer. This proved successful. As mentioned above, the Schneider model batteries were a common problem. If a faulty product was brought back to the distributor

the financing agreement would be put on hold while the product was exchanged for a new one with the supplier. Once the product was re-issued, the finance plan would resume until fully repaid. This highlighted the importance of understanding suppliers' terms and conditions to ensure that any problems could be rectified; and the importance of the customer–distributor relationship for building customer trust and ensuring that their needs can be addressed, and to encourage repayments.

2.2.3 Customers

Most customers bought the lanterns for business and home use, taking advantage of the products' portability. Customers had an 'instant' mindset in making purchases, tending not to shop around for other available small solar products but opting for solar lanterns 'on the spot'. This was arguably due to word of mouth referrals and a growing trust in solar technology, as people saw solar products demonstrated by their neighbours. ('Word of mouth' marketing is discussed further in Section 7.) The decision to purchase also depended on whether the customer's income was received daily, weekly or monthly. Those earning daily would make instant decisions, whereas those earning more stable monthly salaries would take the risk of choosing higher cost products, trusting their monthly income to cover repayments if entering into a finance agreement. Financing was by far the preferred option for low-income customers, as it allowed them to purchase products that they could not usually afford. Those on daily trading wages, despite the greater risk, entered into financing agreements on the basis, most likely, of knowing what their daily earnings had been historically and what a safe level of risk it would be.

2.3 Community-based entrepreneurs

The solar lantern distribution model supports economic empowerment through two pathways: financial savings for small business ventures using the lanterns; and profits for the community-based entrepreneurs selling them.

Savings for businesses

Using solar lanterns has a number of benefits for small and medium-sized enterprises (SMEs) and informal businesses. They include:

- more time to pursue other activities
- less money spent on electricity bills
- ability to read and study at night

- ability to undertake income-generating activities at night
- new jobs and areas of employment
- increased communications and access to information (mobile phone chargers, radios).

Profits for entrepreneurs

According to a 2009 study, gas and small solar technologies could create over 600,000 new jobs in the short to medium term (ICEED, 2009). On a small scale, our field research appears to confirm those findings. SDN's solar lantern distribution model targeted small-scale business entrepreneurs in focus communities to act as ambassadors for the products, using their influence and existing channels of retail and communication within their areas to indirectly and directly promote solar lanterns.

Box 1. Christerbel in Mgbuoba Community

Name: Christerbel Osun Abel

Age: 47

Gender: Male

Profession: Primary School Director

Education: Phd School Management

Savings

"Savings I made from use of solar lanterns enabled me to purchase a set of festival drums for the school, costing N45,000.

I rent out the drum set for N15,000 per time for festivals, street parties and weddings, which in turn generates income for my family and school. The savings will be put towards buying a photocopying machine for the students and my solar-powered night school. I have already made my money back on the initial payment for the festival set."

Profits

- Acting as a sub-distributor to Hamisu Usman, SDN's Market distributor, Abel sells Sun King and Sun King Pro products to the local community.
- Abel currently sells at cost in order to build client base and reputation, supporting his status as an influential member of the community.

"The Schneider lantern output is multi-functional – it has a compatible port with my fan. I use it to charge my radio and mobile phones."

Following increased sales, Abel intends to 'bulk buy' the product and sell it on a commission basis with Hamisu Usman.

"I could stock the lanterns in my school storage space and act like a middleman between the community and the marketer. I would prefer to pay in monthly instalments."

Box 2. Ezekiel in Rumunduru Community

Name: Ezekiel Anunonso

Age: 25-34

Gender: Male

Education: Secondary school

Private sector employee: Spray paints cars at a small shop in Rukpakulosi Community

Profits

- Ezekiel is SDN's sole business contact in Rumunduru Community. He has collected over 20 lanterns from Hamisu; 5 Sun King, 4 Schneider, 11 Waka Waka and 2 Super Waka Waka.
- Ezekiel's relationship with the Market Distributor is informal. He collects batches of product on request by customers.

- He sells the lanterns as additional products in his small kiosk, operated by two attendants who receive a monthly salary.
- Customers pay in instalments over a two-month period on receiving the product.
- Ezekiel reported that some customers have taken lanterns but haven't paid all or part of the money for almost 5 months and counting.

"I purchased a selection of 20 lanterns in batch and sold them at my shop with an increase of N200 per product and I prefer my customers to pay upfront" – Ezekiel.

Solar lanterns have enabled small-scale entrepreneurs to:

- diversify their income
- add to the community economy
- acquire business skills
- demonstrate effective entrepreneurship
- incentivise the community to take up the product
- circulate renewable, environmentally friendly light sources
- support the cycle of development.

Testimonials from entrepreneurs suggest that these two pathways are reliable and mutually reinforcing. Boxes 1, 2 and 3 describe the experience of entrepreneurs from three communities where the pilot project operates: Mgbuoba, Rumunduru and Rumukwache.

In summary, the community-based entrepreneurs who are involved in the lantern distribution project can be described as follows:

- In each community, the small-scale business entrepreneurs selling solar lanterns have multiple jobs and income streams.
- These micro entrepreneurs were selected by SDN because they are regarded as influential and trusted members of the community.
- Sales currently earn minimal profit in order to gain support from neighbours at this early stage.
- Financial savings are the primary selling angle; environmental concerns are secondary.
- Small-scale business entrepreneurs tend to be male; this potentially represents a bias from the market distributor or SDN-led sensitisations.

Box 3. Amos in Rumukwache Community

Name: Amos Adebayo

Age: 29

Gender: Male

Education: Secondary school

Profession: Health worker and small business operator (chemist)



Savings

Amos lives in a 30-block compound in Rumukwache. Although connected to the national grid, he complains of “unsteady light [...] Sometimes they may give you light once or twice in a month.” Amos takes part in a bulk billing system through his landlord’s meter. He explains:

“I have a meter, it is connected to my landlord’s house and I do pay my bills. We have about thirty rooms in the yard. We do contribute N500 to N1,000 per month for NEPA. All the thirty rooms contribute this amount to pay our NEPA bills. I spend about N4,500 monthly on fuel for my personal generator.”

Amos’ energy profile is representative of participants in SDN’s distribution model in Rumukwache. Since using the Sun King Pro, Amos states that he has, “No use for candle or kerosene lamp. What I use is the solar lantern and generator. I do buy fuel every day because of the nature of my work.”

Using the Sun King Pro Lantern to supplement generator use, Amos saves N3,500 per

month. “The rent for my drug shop is N60,000 per year while my compound is N42,000 per year,” explains Amos. Yearly energy saving fund the chemist’s housing. Solar savings further generates income for the health work, enabling Amos to widen his drug store stock, meeting Rumukwache residents’ need for a broad spectrum of antibiotics, vitamin supplements and pain killers. Again, “Savings gained from use of solar lanterns enabled me to buy more drugs in my shop.”

Profits

Using his network as health worker and chemist located on Rumukwache’s main road, Amos sells the Schneider, Sun King Pro, Sun King Small and Wakka Wakka lanterns.

SDN project staff supply Amos’ stock. Amos is yet to develop a relationship with Market distributor Hamisu Usman and relies on direct contact with SDN employees.

“I collect the packs from Samuel on credit and sell to customers on instalments.”

Customers pay in instalments on an ad hoc basis; this can be unreliable and problematic for Amos.

“Some paid N2,000 or N2,500 and refuse to pay the balance. Sometimes I used to go after them to demand the money. Another strategy is that if somebody owes N3,000 for the solar, I will keep the money and the light until the person pay up. Some of them take two weeks.”

Amos works on a not-for-profit basis as the project is in its early stages. He is currently building momentum and a client base.

“The products I sold is on non-profit basis. But the last pack I collected, they said there is going to be commission. I have not made any money from the sales but I have made good impact and recommendation from people. I have good reputation among community people and I am satisfied about that.”

- No credit or bank loan scheme exists; there is no culture of 'bulk buying' or saving. This hindered SDN's exploration of more robust credit schemes to boost the solar lantern distribution model.
- There is no fixed way of operating across communities. The market distributor and sub-distributors' relationships and operational process depend on community context, consumer interest and entrepreneurs' motivation.

2.4 The NGO model

In its current form, the model is not self-sustaining as such – it requires the NGO. The premise is that the NGO model is essential for start-up; to initially manage stock, build

from networks of trust in the community and support the community-based entrepreneur with financial reporting. However, SDN are now focused on moving into the second phase of the project: making the business model self-sustaining, allowing SDN to withdraw to a background, facilitating role. How could the 'affordable' NGO model described above transition into an entrepreneurial, scalable business model, with products being sold at market prices? This is one objective of our case study, to evaluate this model and look at how it might be modified in a second phase. It is also a reason for engaging with the 'energy delivery model' approach, introduced in the next section, as part of our evaluation and forward planning methodology.

3

Approach to evaluation

In order to gather detailed data and provide a considered evaluation of our solar lantern distribution project, the SDN project team opted to apply a framework for designing pro-poor energy delivery created by the International Institute for Environment and Development (IIED) and the Catholic Agency for Overseas Development (CAFOD): the energy delivery model (EDM) framework. By applying the framework, SDN was able to evaluate the design, delivery and results of our introduction of ‘small solar’ to four communities in Rivers State. The objectives of evaluating our lantern distribution model were:

- To generate **operational lessons, or how best the model can function, and community outcome-based lessons.**
- **To understand the ‘positive human development’ impact (Bellanca and Garside, 2013) of SDN’s model: how the distribution of solar lights creates health, education and livelihood benefits in our target communities**
- **To learn** if and how we could replicate and adapt our distribution network in rural communities in the Niger Delta by reviewing end user needs and expectations in a rural context
- To evaluate how the model could best transition from the current NGO model to a viable, self-sustaining business model.

This section introduces the EDM framework, why we felt it an appropriate approach for our context, and a step-by-step methodology of how we applied it.

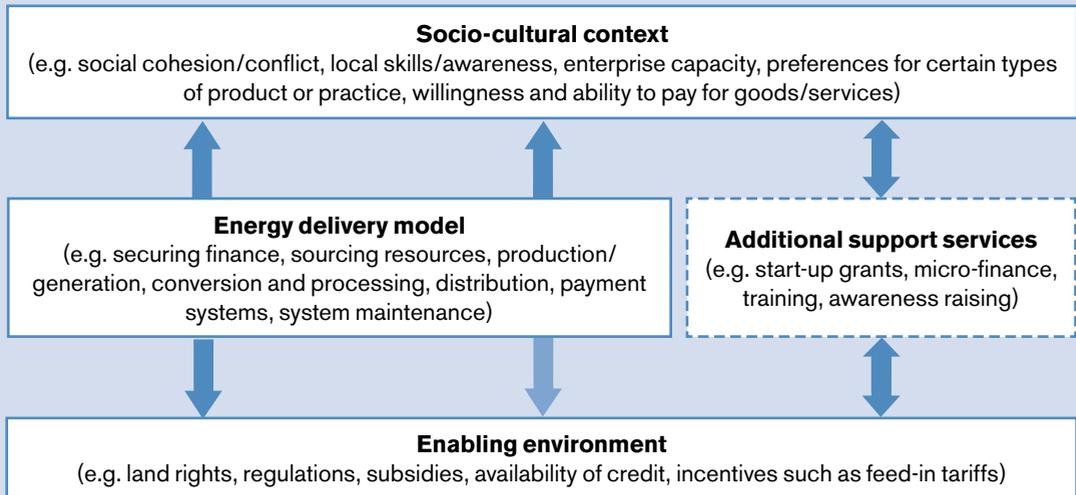
3.1 What is the ‘energy delivery model’ approach?

“An energy delivery model (EDM) is the combination of the technology, finance, management activities, policy support, legal arrangements and relationship types required to supply energy to a group of people or end users (in this context, to groups of people living in poverty)” (Bellanca and Garside, 2013: 9).

In our understanding, the CAFOD/IIED energy delivery model (EDM) approach presents a participatory framework to enhance the delivery of energy projects that work for people living in poverty, while building an evidence base for more informed decision-making and advocacy. The two tools – the Delivery Model Map and the Delivery Model Canvas – can be used to design delivery in a holistic and participatory way that responds to the underlying factors that are maintaining the demand for energy services in that specific context. The framework can be used either to create an energy delivery service from scratch, or – as in this case – to apply its guiding principles as a retrospective lens on our current energy delivery model.

Figure 5 shows the four building blocks of the energy delivery model system and how they relate to one another.

Figure 5. Map of the pro-poor energy delivery system



Source: Wilson et al., 2012, p.9.

The four building blocks, as described by Bellanca and Garside (2013), are:

- **The delivery model** – the set of activities and group of actors that are necessary to deliver the service(s)
- **The enabling environment** – the external environment (eg, formal government or public policies) that influences and enables the delivery model
- **The socio-cultural context** – the wider socio-cultural context in which the activities and the actors who carry them out are embedded
- **Supporting services** – any external support that the delivery model might need due to weaknesses in the enabling environment or a need to adapt to specific circumstances of the socio-cultural context (eg social funds, loans or externally supported technical training).

The energy delivery system recognises that energy services often require multiple organisations and/or individuals to deliver them (rather than one single business) – each with their own incentives to participate or not. The success of the ‘energy delivery model’ relies on these actors working together, and doing so in a particular local context to deliver to particular users. The authors encourage a more systematic understanding of this context, and adapting of the energy delivery model so that it can best operate within it. The end goal is energy services that are likely to be more sustainable.

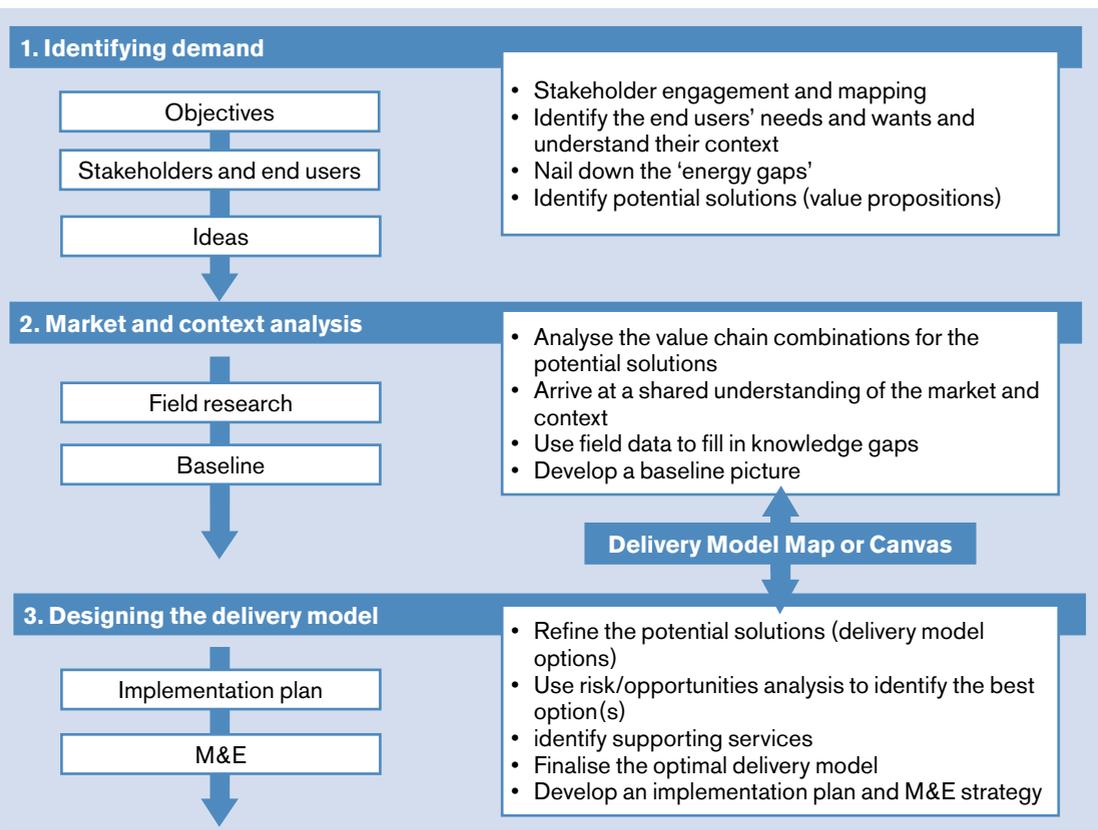
To design a new energy delivery model (or analysing an existing one), Bellanca and Garside (2013) encourage a three-phase approach with a number of steps within each: identifying demand, analysing the market and context, and designing the delivery model itself (see figure 6). They encourage this approach to be participatory, involving all stakeholders as

far as possible. A central ethos of the approach is end-user impacts (needs), which are defined in the delivery model value proposition. The approach also provides two visualisation tools to help stakeholders analyse the market and context, ideally in a workshop environment – the Delivery Model Map (Figure 7) and the Delivery Model Canvas (Figure 8).

The Delivery Model Map builds on the ‘enabling environment’, ‘socio-cultural context’ and ‘supporting services’ shown in Figure 5 with a set of non-definitive examples of what issues to

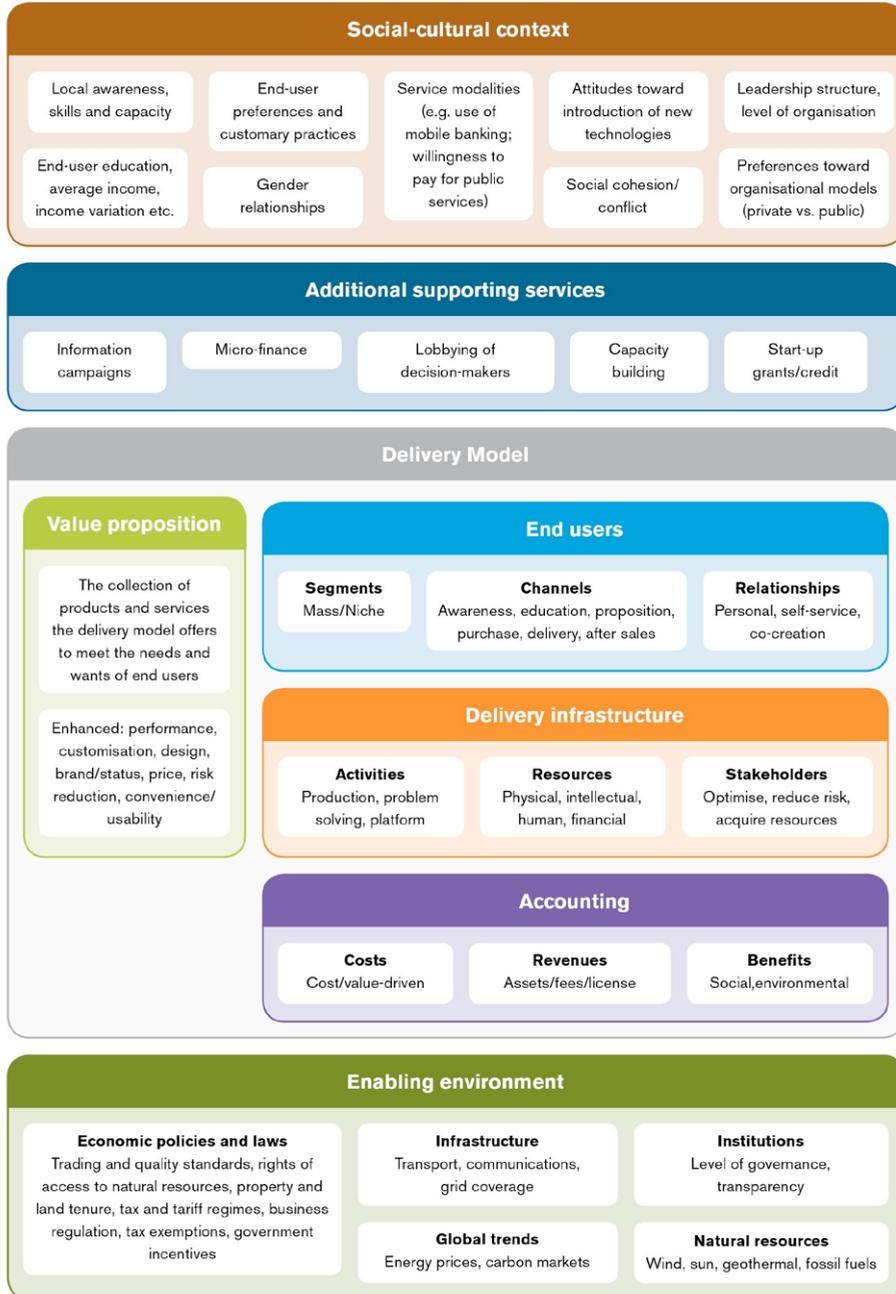
consider when designing the delivery model. In particular, the ‘enabling environment’ category contains broader thematic areas: economic policies and laws, infrastructure, global trends, institutions and natural resources; while the ‘socio-cultural context’ category covers issues such as: end-user preferences and norms; gender relations; and levels of social cohesion, education, and awareness. Each of the categories has a number of probing questions intended to promote discussion and further analysis.

Figure 6. A pro-poor approach to designing energy delivery models in three phases



Source: Bellanca and Garside, 2013.

Figure 7. The Delivery Model Map



Source: Bellanca and Garside, 2013.

Figure 8. The Delivery Model Canvas

<p>Delivery infrastructure</p> <p>Key stakeholders (partners, suppliers, enablers, institutions) Who are our key stakeholders? Which key resources are we acquiring from them? Which key activities do they perform? What do they expect from us? How is value shared through the delivery chain, including with end users? How does the value proposition fit with public policies and government strategies?</p> <p>MOTIVATIONS FOR PARTNERSHIPS: Optimisation and economy Reduction of risk and uncertainty Acquisition of particular resources and activities</p> <p>TYPES OF STAKEHOLDERS: Partners, suppliers, enablers (permission, endorsement, credibility, visibility), institutions (government and local authorities), end users</p>	<p>Key activities What key activities do our value propositions, distribution channels, end-user relationships and revenue streams require? Which activities are contributing the most towards the value proposition? Which activities would improve the value proposition but are not essential? <i>Are any of the activities disrupting existing businesses and power relations? Is there potential for conflict?</i></p> <p>CATEGORIES: Production, problem-solving, platform/network ASSESSMENT: Impact on livelihoods, conflict mitigation strategy</p> <p>Key resources What key resources do our value propositions, distribution channels, end-user relationships, revenue streams and partnership relationships require? <i>Are all resources within reach? Which supporting services might be added?</i></p> <p>TYPES OF RESOURCES: Physical, intellectual, human, financial</p> <p>TYPES OF ENABLING FACTORS: Natural resources, global trends, institutional structures (their transparency and strength), economic policies, laws and implementation strategies, state of infrastructure</p>	<p>Value proposition What value do we deliver to the end user? Which one of our end user's problems are we helping to solve? What bundles of products and services are we offering to each end-user segment? Which end-user needs are we satisfying? What social and/or environmental problems are we solving? How is the broader community benefiting?</p> <p>TYPES: Quantitative, qualitative (includes positive socio-environmental impacts)</p>	<p>End users</p> <p>End-users relationship What type of relationship does each of our end-user segments expect us to establish and maintain with them? <i>Do end users expect services to be delivered by the public or private sector?</i> What kind of organisation is this? EXAMPLES: Personal assistance, dedicated personal assistance, self-service, automated services, communities, co-creation ORGANISATIONAL STYLES: Privately owned business, governmental agency, cooperative, intermediate agent (international NGO, local NGO, church)</p> <p>Channels Through which channels do our end-user segments want to be reached? How are we integrating them with end-user routines and preferences? <i>Are there informal channels and how do they interact with the delivery chain?</i></p> <p>TYPES: Own channels, partner channels CHANNEL PHASES: Awareness, evaluation, purchase, delivery, after-sales</p>	<p>End-users segments For whom are we creating value? Who are our most important end users? <i>Are there local norms, behaviours, attitudes toward innovation and risk that could affect the value proposition?</i> <i>Are there preferences and customary practices that could affect the value proposition?</i> How are gender relationships affecting the value proposition? EXAMPLES: Mass market, niche market, segmented, diversified, multi-sided platform</p>
<p>Cost structure What are the most important costs inherent in our delivery model? Which key resources are the most expensive? Which key activities are the most expensive?</p> <p>CLASSES OF BUSINESS STRUCTURES: Cost-driven, value-driven</p> <p>CHARACTERISTICS OF COST STRUCTURES: Fixed costs, variable costs, economies of scale, economies of scope</p>	<p>Other costs/benefits What are the most important social and environmental costs inherent in our delivery model? What are the benefits?</p> <p>TYPES: Social, environmental</p>	<p>Revenue stream Where will the revenue streams come from? Can end users pay? Entirely or partially? How much does each revenue stream contribute to overall revenues? <i>Are there available subsidies/incentives from donor/government programmes?</i> Can civil society offer in-kind resources (human, physical, financial)? Can the end users offer in-kind resources (human, physical)?</p> <p>TYPES: Asset sale, usage fee, subscription fees, lending/renting/leasing, licensing, brokerage fees, advertising, grants / subsidies, in-kind means: fixed (list price, product feature-dependent, end-user segment-dependent, volume-dependent), dynamic (negotiation, yield management, real-time market)</p>		

Source: Bellanca and Garside, 2013

There are four elements grouped under the 'Delivery Model' that are adapted for a development context from a business tool, Osterwalder's Business Model Canvas:

- **Value Proposition:** the collection of products and services offered to meet end users' needs and wants
- **End Users:** those receiving the products and services
- **Delivery Infrastructure: the activities, resources and stakeholders needed to deliver the products and services**
- **Accounting:** the costs, revenues and benefits associated with the model.

Using the map allows stakeholders to establish what these elements are in their own context, and it is complemented by the Delivery Model Canvas (Figure 8). Questions are provided for each of the elements to help foster discussion and open up the analysis. The Delivery Model Canvas reflects the overall pro-poor approach to designing delivery models by explicitly integrating developmental and environmental sustainability benefits into it; for example the 'value proposition' includes positive socio-environmental impacts as well as economic revenues. A specific 'socio-environmental benefits' element has also been added to the accounting building block to measure non-monetary targets. Moreover, each block includes new elements aimed at capturing the 'triple bottom line' of social entrepreneurship.

The 3-phase EDM approach supports the following key principles:

- encourages dialogue and understanding
- aims to more systematically examine the social, financial, and environmental sustainability
- is a guideline process, aimed at being adapted to context
- does not replace practitioner experience

- builds on existing tools and encourages integrating local techniques
- is a work in progress and needs to learn from real-world application (Bellanca and Garside, 2013).

3.1.1 Why choose the EDM approach?

We felt that the EDM framework and approach could be a very useful way of assessing our current model and challenging our assumptions. For instance, instead of assuming that cost is the sole barrier, the model encourages the exploration of the broader socio-cultural, economic, political and geographical factors influencing the existence of the current energy gap, and seeking solutions where previous interventions have failed.

A people-centred approach is at its core, with various project stakeholders integrated into all stages and activities. Participatory analysis can generate immediate feedback on project activities from participants, with immediate validation. Including stakeholders in this consultative process gives an added insight that could enrich overall understanding of the context, and inform the direction of engagement in an iterative process.

This flexibility allows the delivery of projects to not only be attentive to the existing context, but to adapt to reflect the reality on the ground throughout the life-cycle of the project. It is envisaged that taking this approach will inform a true account of end-users' needs and wants for the specific intervention.

This is an encouraging departure from projects that are driven by institutional dogma rather than dealing with demand. Instead, the delivery of energy is not the end-goal; it is the provision of a 'social lubricant' that can enable communities to carry out activities to realise their own developmental goals.

What is more, the model accounts for often-overlooked and complex context-specific challenges related to questions of affordability,

scalability, and capacity gaps while successfully delivering energy services to people living in poverty through 'bottom-up energy solutions' in line with UN's Sustainable Energy For All initiative.

A malleable approach that involves local communities in the life-cycle of a project will increase the capacity of those communities to run its implementation, and ultimately the sustainability of ongoing activities and the legacy of the project following withdrawal of support from the funding agency. This is the ultimate goal of any development project.

The authors describe the model as a 'work in progress' which needs to learn from real-world application (Bellanca and Garside, 2013). Part of the objective of this study is therefore to test it on the ground in the Niger Delta.

One particular focus will be the operation of the market mechanism that relies on actors within the market chain to incentivise individuals' participation. This is particularly challenging given the lack of financial and policy incentives or a market for renewable products.

By using the delivery model's tools as a lens on our current approach, we hoped to challenge our existing knowledge base and analyse data in light of the sociocultural and political context, in order to improve the reach of our distribution of solar lanterns and strategies in ways which improve community understanding. We also hoped to test the assumption that the SDN model is replicable and scalable in any context. Lessons from tailored questions on issues that arise in this particular Nigerian context can assist with the participatory design process.

3.2 Step-by-step methodology

As a first step of the process and to familiarise themselves with the tools, the SDN staff team decided to analyse the broader 'enabling environment' and the socio-cultural context with respect to their potential impacts on a

solar portable lighting model - using the themes identified in the EDM framework as prompts for discussion. This fed into later participatory dialogue, and is described in Section 4.

Next, we held a participatory workshop in Port Harcourt with other civil society organisations and community members to carry out the following activities:

- a. Stakeholder mapping to identify existing and potential stakeholders that could influence the success/failure of a solar lighting model
- b. Identifying the value proposition – what is our solar lantern project really trying to deliver, and to whom?
- c. Reflecting on gaps identified in the solar lighting model using the EDM approach
- d. Reflecting on issues created by the language of the EDM approach and adapting it to the Delta context
- e. Designing field research to explore issues raised by the EDM tools in rural and urban communities
- f. Noting the challenges and limitations of implementing the solar lighting model.

The results of the Port Harcourt workshop are covered in Sections 5 and 6.

We then carried out the planned fieldwork in SDN's four focus communities: the peri-urban communities Mgbuoba, Rumunduru and Rumukwach on the outskirts of Port Harcourt, and the rural community Odouha, all in Rivers State in the Niger Delta (see Annex 3 for a profile of each community). **Field research took the form of** three focus group discussions, 20 'key informant' interviews and a survey questionnaire with 40 respondents. It focused on the lantern distribution process; outcomes in the communities; and impacts on environment and society. The results of the fieldwork are described in Sections 7 to 9.

4

Exploring the enabling environment and socio-cultural context for solar lantern distribution in the Niger Delta

The EDM guidelines call for an examination of the context in which the project will be implemented. Failure to do so will reduce the likelihood of adoption, absorption, and sustainability of use for the technologies introduced. Moreover, previous projects that have imposed themselves as blueprint replication of services on communities rather than responding to demand have proved counterproductive. SDN decided to look at these aspects as a first-step exercise in getting familiar with the EDM approach and tools.

Using the EDM conceptual framework, SDN looked at the socio-cultural context and 'enabling environment' (see Figure 5 in the previous section): "the institutional structures and public policies, the existing transport and communications infrastructure, the local capacities and the wider socio-cultural context" in which our core communities live (Bellanca and Garside, 2013: 9). We did this in order to analyse two spheres of learning – *process and community outcomes* – to improve our lantern distribution model. 'Process' learning describes the planning processes and functions that make our model work; 'outcome' based learning refers to the impact of our model at community level and its latent effect on social, economic and environmental issues in the target areas.

4.1 Enabling environment

The 'enabling environment' is considered to be the external environment (such as formal government or public policies) that influences and enables the delivery model (Bellanca and Garside, 2013). We examined what is currently being done in Nigeria to expand renewable energy use, including implications for solar portable lighting, and what are the barriers to success.

Government policies and initiatives operate at multiple levels and involve multiple actors. At the international level, the Federal Government of Nigeria (FGN) is a signatory to various agreements that allow it to access financial and technical assistance towards tackling climate change and promoting renewable energy, such as the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, Power Africa, and the World Bank's Clean Technology Fund.

At the domestic level, the FGN has set ambitious targets for renewable energy to be achieved through various internal agencies and commissions, some inevitably more successful than others as they compete for influence in Nigeria's highly politicised energy sector. The overarching target is to achieve 20 per cent renewable energy usage by 2020.

Tasked with the overall planning and coordination of national policies for the sector, the Energy Commission of Nigeria (ECN) has the mandate to expand access to electricity, especially to rural and remote areas. The ECN launched the National Energy Policy in 2003, which contains some limited provisions for the optimum utilisation of conventional and renewable resources.

Two years later, with support from the United Nations Development Programme (UNDP), the Commission expanded on this objective and developed the national Renewable Energy Master Plan (REMP). Here the ECN articulated its national vision for renewable energy for the first time, outlining the key functions of solar exploitation in achieving accelerated national development. The REMP includes a comprehensive framework with policies, legal instruments, technologies, manpower, infrastructure and markets to facilitate the development of the sector.

Although this is the most comprehensive strategy developed thus far for Nigeria, it has never been endorsed by the Federal Executive Council, nor has it been passed into law by the National Assembly. As such, Nigeria currently lacks an overall strategic direction for national investments in renewable energy.

Barriers

Without the support of a solid national economic policy to facilitate renewable energy initiatives, there is little incentive for private investment in the sector. Consequently, levels of competition are poor, good quality installers and vendors are often very hard to find, and the overall cost per unit of renewable energy in Nigeria (US\$0.26–0.50 per kilowatt hour - kWh) remains markedly higher than that of grid electricity (US\$0.10–0.15/kWh).

Research in other countries suggests that the main deterrent to transitioning from existing to renewable energy is the high initial capital cost that must be made upfront. While commercial loans are available in Nigeria, interest rates start in the region of 25 per cent per year, and are accompanied by stiff guarantee requirements, making this an unattractive option for most Nigerians.

To address this barrier, the Nigeria Electricity Regulatory Commission (NERC) launched the renewable energy 'feed-in-tariffs' (REFiTs) in June 2012. The vision is that subsidies will incentivise investment in renewable energy generation – from individual homes and communities to big companies – by guaranteeing to buy and pay for all the electricity produced. This is hoped to increase uptake and stimulate the development of a competitive market that can eventually function without the need for subsidies.

However, while feed-in tariffs may have been successful in other countries, a system of payment through electricity generation relies on grid access. This is not an option for the 15.3 million Nigerians without access to the grid, and even for those who are connected, the erratic supply limits the initiative's effectiveness. As a result, there have been very few participants in the scheme so far. It is also not relevant for the portable solar lighting model, given that these lights are not designed for grid connection.

The FGN's overall energy strategy has since shifted towards increased privatisation of the energy sector, to reduce the role of government from operation and ownership to regulator. New policies have allowed US\$2 billion worth of investment through purchasing power plants. Since 2013, system-wide generation has increased by roughly 1,000 megawatts as a result.

Nigeria is the largest recipient of foreign direct investment (FDI) in Africa, receiving US\$8.9bn or 20 per cent of total FDI to Africa in 2011 (AfDB, 2013). A recent survey by the World Bank, however, cited access to power as the top constraint to business and growth in Nigeria (*Foreign Affairs*, 2014). This is one factor explaining Nigeria's ranking of 131 out of 185 countries (World Bank, 2013). Investment is therefore restricted to resource exploration and primary services, and wider economic growth through agglomeration is unlikely until the electricity supply and infrastructure are improved.

As of 2014, Nigeria was ranked 152 out of 186 in the UN Human Development Index, and is not on track to meet most of the Millennium Development Goals by 2015 (Federal Government of Nigeria, 2015). Again, improved energy supply and access is the crosscutting key to realising all development targets; so demand for energy is high.

4.2 Socio-cultural context

Guided by the EDM framework, SDN next looked at the wider social factors that shape a community's demand for power.

Access to energy differs significantly between rural and urban areas. The US Environment Information Administration (EIA) estimates that while urban areas worldwide have an electricity access rate of 62 per cent, the figure for rural areas is only 18 per cent. Access is worsened by inefficiency. Nigeria has one of the least energy-efficient economies in the world, ranking 21 out of 186 globally for energy inefficiency (Climate Investment Funds, 2010).

The EDM framework explains that demand for power determines the scope and design of a pro-poor energy delivery model. Intangible factors such as citizens' willingness and ability to pay, social tensions and cultural preferences

can further determine community demand. The EDM framework defines these factors that determine the way people live and work together as the 'socio-cultural context', meaning the "norms and behaviours of potential end users of the energy services" (Bellanca and Garside, 2013: 11).

We understand the socio-cultural context to also extend to the decision-making processes and customs embedded within community culture. Understanding measurable socio-cultural factors in which our model operates, such as the "level of individual and community education; the level of average income and income variation and the level of interacting with the private and public sector" (ibid: 11) can impact community ownership, expectations and level of participation in the intervention.

4.2.1 Willingness to pay

How is citizens' willingness to pay for solar lanterns shaped by the socio-cultural context of the Niger Delta?

Underdevelopment and poverty

Nigeria is one of the most unequal countries in the world. Despite the rhetoric about growth in some sectors of the economy, 61 per cent of Nigerians survive on less than US\$1 a day. The proportion of Nigerian citizens living in absolute poverty has grown from 6.2 per cent in 1980 to 38.7 per cent in 2010. This stands in stark contrast to the country's GDP growth over recent years: in that same period, Nigeria's GDP grew more than 120 per cent, from US\$87.8 bn to US\$193.7 bn, according to the World Bank. The World Bank estimates that Nigeria will miss most of its Millennium Development Goals targets, failing to tap into the potential of many millions of Nigerians.

The Niger Delta, which accounts for 95 per cent of the country's export earnings, remains one of the poorest parts of the country.

Underdevelopment and poverty in the region are caused by a mutually reinforcing mix of political, social, economic and cultural processes that disempower the local population. According to a UNDP report, “the Niger Delta is a region suffering from administrative neglect, crumbling social infrastructure and services, high unemployment, social deprivation, abject poverty, filth and squalor, and endemic conflict” (UNDP, 2006). It is also a region where stark inequalities are more visible than anywhere else in Nigeria and where social indicators are significantly worse than the national average (Bellanca and Garside, 2013, p. 11). This economic hardship and limited access to power impacts communities’ ability to participate in our portable solar lighting project.

Informal culture of buying and lending

Our field research identified a culture of monetary exchange in Rivers State as it found that customers are willing to enter into financial arrangements. A culture of ‘handshake agreements to repay debt’, as seen in Section 2, meant that most customers honoured their payment plans. Informal networks of trust, and a community mentality, function in most areas. These are important factors to keep in mind when considering improvements for the model. Section 5 expands on community groups’ willingness and ability to pay for solar lanterns, community networks, cultural preferences and the role of women.

4.2.2 Social cohesion and conflict

Intra-community conflicts

The unwillingness and inability of government to meet the basic socio-political and economic needs of Niger Delta citizens fuels popular discontent and cycles of violent conflict. An SDN analysis of electrification in Bayelsa in 2012 found that collaborating on solutions to improve energy supply in target communities reduced the level of community frustration and tendency to violence.

The Niger Delta came to the attention of the world during its 2005–2009 militancy crisis. This conflict reduced oil production by two thirds costing Nigeria over US\$15 billion a year in lost revenue. While news headlines were filled with weekly kidnappings, pipeline attacks and militarisation of the region, the challenges of poor governance, limited service delivery, environmental devastation and lack of power went unreported. Newsworthy violence also turned attention away from the low-intensity inter- and intra-community conflicts over oil-related contracts, political contracts and political control.

These underlying issues driving conflict and tensions in the region remain, and there are regular examples of intra-community violence over the spoils of contracts from oil majors and the government. These dynamics are exacerbated by the absence of the state and functional service delivery, reinforcing people’s short-term focus as they fight for survival. Moreover, traditional livelihoods are impacted by the widespread environmental devastation caused by oil spills, resulting from oil majors’ equipment failure and third party sabotage for oil theft. Inter and intra-community conflict drivers can impact the success of our energy delivery model, due to mistrust within the pilot communities and negative perceptions of external for-profit enterprises.

Unemployment

The three peri-urban focus communities are located on the outskirts of Port Harcourt, Rivers State. Port Harcourt became the operational base for multinational petro-businesses from 1950. The oil boom led to a rapid influx of migrants in search of job opportunities. Reliable data on Mgbuoba, Rumunduru and Rumukwache’s economies are limited. However, interviews indicated that the communities house civil servants, academics, fishermen, fisherwomen and construction workers, much like the varied districts of Port Harcourt.

The Niger Delta has a destabilising legacy of unemployment and underemployment among a rapidly growing young population. Lack of jobs limit young peoples' possibilities for moving out of poverty, creating incentives for criminal and illegal activities and helping to drive and sustain high levels of violence and criminality throughout the Delta region. The lack of adequate statistics does not hide the very high unemployment rate, especially in rural areas where violence is endemic, and its contribution to economically desperate options such as illegal oil refining.

Status of women in the family and community

There are very few viable options for establishing sustainable businesses in communities.

Conditions for setting up local businesses are generally difficult due to the lack of supporting infrastructure, such as a reliable power supply, safe and potable drinking water, functional public transport, effective communication systems, and healthcare and educational facilities. Markets provide some opportunities for self-employment, especially for women, who contribute to their families' income through small-scale trade, fishing and farming.

Decision making at the community level is still very much viewed as 'men's business', and women continue to be excluded from the civic and religious forums where decisions are made. Women themselves lack the confidence and support necessary to challenge the patriarchal culture. The majority of men in the communities believe that the role of women in society should be confined to domestic activities, and do not expect women to have positions of community leadership. While women frequently assume the role of breadwinner for their families, a lack of education and livelihood skills, as well as poor access to micro-credit facilities and discriminatory traditional practices, make them more economically vulnerable. Early marriage

and pregnancy can further reduce the economic independence of women and increase their vulnerability. However, women are key at markets and should be incentivised to take part in income generation and electrification activities.

Key stakeholders for our energy delivery model are women within the domestic sphere, market zones and schools. Understanding the needs of these key 'end users' would enable the SDN team to retrospectively map prospective beneficiaries of the solar products, to understand spaces where the lanterns would function and identify potential points with high footfall in each focus community to install demonstration lanterns.

State government accountability and essential services

Although there have been improvements in some areas, the lack of basic quality provision of functioning services in health, education, power and water in many communities remains a justified source of grievance with government. The need for improved responsiveness and performance from government both at state and local level remains obvious, and while elections have an important role to play, it is vital that more sustained engagement is maintained.

4.2.3 Energy usage behaviour in urban communities

Energy usage behaviours differ across Rivers State according to population size, state of development, and citizens' divergent needs. Greater energy output is required for business growth in urban centres than it is for farming communities, such as Oduoha, where the economy is based predominantly on agriculture. One respondent to our survey (see Section 6) in peri-urban Rumunduru Community, an electrical repairer, describes the frustrations of an inadequate power supply:

"I am a resident and business operator in Rumunduru community, servicing and repairing fridges and A/C [air conditioning]. I am not happy about the light situation in this community because without light my business cannot thrive. Light is not steady and unpredictable. Sometimes, I don't meet customers' demand as a result of power failure. I spent a lot fuelling my generator and this is eating deep into my savings. I will like to join campaign for steady light in Rumunduru community and will like to pay more for steady light" – Moses Benson, Rumunduru.

The responsibility of energy supply and generation, 'PHCN or government', is an issue brought up by all interviewees. Issues of trust and responsibility of local government versus the private sector will be detailed further in Section 7.

"I will like PHCN or government to come to our aid because the situation is getting out of hand. You cannot operate a computer business without stable power. What we realise is not up to what we expend on fuelling and maintenance of generator and other equipment. I will like to pay more for steady light because it saves cost than purchase of fuel for generator use" – Amos Victor, Rumunduru.

In response to poor PHED power supply and over-dependency on generator sets, urban communities diversify their energy sources:

"For over one month there is no light in this part of Mgbuoba. As electronic repairers, we cannot operate without light. We need constant and stable light for our business to thrive. In order to keep our business going, we are going to device alternative measure of buying solar panel and inverter. One of the panels will cost N40,000 but the inverter is costly. It is very durable and effective. Unlike generator, solar neither makes noise nor smoke" – Onyebuchi, Mgbuoba Community.

Onyebuchi and Victor's testimonials attest that supporting small-scale business ventures requires 'stable power'. Similarly to Amos Victor, Mgbuoba residents can "spend up to N5,000 monthly on electricity bills. The electricity supplied is used to power my household appliances, for light and water pump for borehole." (Andrew Olamuyiwa) Energy usage behaviour differs considerably across the commercial centre of each community depending on income and size of compound. Commonly, gas stoves, kerosene lanterns, and battery-powered torches supplement infrequent 'NEPA' lights. The solar products distributed by SDN do not attempt to fulfil urban communities' requirements, but do reduce dependency on fuel-powered generators.

Amos Victor's decision to invest in solar power for his business illustrates contrary patterns of energy use across Rivers State, highlighting the notion that a strategy to penetrate urban community with solar products will be strategically different from a strategy for off-grid rural communities. As the Delivery Model Map demonstrates, principles of a well-designed pro-poor energy delivery model are capable of meeting the energy needs and wants of end users (Bellanca and Garside, 2013).

The energy norms and behaviours of urban residents can be summarised by one Mgbuoba resident:

"In the domestic setting people use kerosene stoves, firewood for cooking, coal iron to straighten clothes. In the school setting power supply is used to power light, fan, radio, television, phone charge and printers. In the market stalls candles, battery lamps and gen [generator] sets are used for lighting, chilling drinks and sustaining frozen foods" – Rita, Mgbuoba.

5

Identifying our stakeholders and ‘value proposition’

Having analysed the socio-cultural context and enabling environment, we planned (as the authors of the EDM approach encourage) to adapt the approach and tools to suit our purpose and context. Following the EDM guiding principles, we initially mapped the key stakeholders and beneficiaries, prior to identifying our value proposition – see the first phase in Figure 6, Section 3. In order to understand the EDM framework and its tools, the SDN team facilitated a workshop in Port Harcourt to interrogate the existing objectives of our solar lantern delivery model and retrospectively analyse the ‘solutions’ we offer.

The IIED/CAFOD pro-poor energy delivery system is framed by an understanding of “the context in which the activities and the actors who carry them out are embedded” (Bellanca and Garside, 2013: 10) and the formal government or public policies that shape the external environment.

By using the Delivery Model Map (see Figure 7, Section 3) as a lens to analyse the impact of our energy delivery model, SDN hopes to understand what aspects apply to the economies of the Niger Delta and the people of Rivers State. The intersection between solar technology, management and finance is a key component of our model. However, we understood that we were yet to formally identify how these elements affect the end users or communities we are working in.

5.1 Stakeholder mapping

The EDM approach encourages “dialogue and understanding”, starting with mapping who the stakeholders are as a first step (see Identifying Demand in Figure 6, Section 3). In order to cement our shared understanding of the solar market and its context in Rivers State, the SDN team met with members of the Electricity Committee of Mgbuoba. Together we charted our experiences to date of implementing the solar lantern distribution model, and the challenges for communities with varied economic status. We also reviewed our baseline study on energy use in the Niger Delta, *Energy use and usage perceptions in the Niger Delta* (Oyebamiji and Kigbara, 2011) and mapped the interest and influence of key stakeholders.

This stakeholder mapping exercise shaped our methodology. Through identifying broad participants we were able to adapt the Delivery Model Canvas (Figure 8) questions for target stakeholder groups. Mgbuoba community members and SDN staff identified the following stakeholders as key to the effective implementation and monitoring of the portable lighting project:

“Families, especially women. Low-income earners would buy the idea of using a solar lantern rather than spend so much money or fuel to power a small generator used for only light purposes” – Rita, Mgbuoba Community.

“The generator manufacturers and salesmen would have really low interest because, the more stable the light, the less the patronage for their business” – Joe, Mgbuoba.



SDN workshop with members of the Electricity Committee of Mgbuoba

Table 4 gives a more comprehensive list of identified stakeholders and their area of influence of interest (both positive and negative) with respect to the success/failure of the solar portable lighting model.

The mapping exercise also highlighted five influential factors specific to the Rivers State context:

- The role of oil and gas companies in energy access
- the low-carbon agenda and renewable energy access
- the challenges of community-based projects: willingness to pay; governance; expectations
- energy access and conflict
- advocacy and awareness raising.

SDN and the participants found this exercise useful in identifying stakeholders that might be interested in the solar lantern model and discussing why. This included not only the

supply chain players in the current model, but also organisations with potential interest in supporting this type of business in communities – such as corporate social responsibility within an international oil company.

5.2 The value proposition

Having mapped the key stakeholders and benefactors, the next step of the energy delivery model process was to establish our ‘value proposition’: the “collection of products and services the delivery model offers to meet the needs and wants of end users” (see the Delivery Model Map in Figure 7).

We agreed that our value proposition is effectively described by SDN’s ‘theory of change’:

“By making solar products affordable and accessible to urban and semi-urban communities in Rivers State, we will be able to reduce the amount people spend on energy and power supplies, candles, kerosene and

Table 4. Stakeholder map: interest and influence on the lantern distribution model

CATEGORY	STAKEHOLDER	INFLUENCE/INTEREST
Community decision makers	Community development committee (CDC), council of chief and elders, paramount ruler	SDN depends on the influence and support of the CDC to approve the distribution of solar lanterns in communities
Community-based organisations (CBOs)	Youths, women, age grade associations, faith-based organisations	SDN relies on CBOs for effective distribution of the solar lanterns. CBO groups are 'end users' and demonstrators with community-specific, strategic, marketing channels
Suppliers	Creeds Energy and Schneider	There is a relationship of mutual benefit between SDN and solar supplier Creeds Energy. Creeds supports availability, choice of product and after-sales care for SDN and Hamisu Usman, SDN's Market distributor. Interest lies in widening reach of sales and selling solutions
Distribution company	Port Harcourt Electricity Development Company (PHED) ³	PHED distributes on-grid electricity in four states – Rivers, Cross River, Akwa-Ibom and Bayelsa. The national enabling environment has been slow to evolve, and more effective alignment of communities and investors with national utility requirements and energy policy needs to be fast-tracked
Energy regulator	Nigerian Electricity Regulatory Commission (NERC)	Policies made by this body and its electricity distribution can either truncate or improve the use or sustainability of the project
Generator manufacturers	Generator manufacturers	The effective distribution and popularity of solar lanterns negatively impacts the use and perception of generators
Government policies/ regulations	Customs	Customs and import taxation can either disrupt or encourage solar lantern imports
Alternative distributors/ retailers	Illegal oil refiners and black market retailers	Artisanal oil refineries and black market fuel distribution would negatively influence the outcome of the portable lighting model, according to Mgbuoba voices. Notably, participants in the mapping exercise state that the proximity of rural communities to artisanal oil refining camps gives them access to ad hoc refined fuel for generators and commonly supplied kerosene without charge. The team needs to consider the change in 'enabling environment' when entering rural or riverine communities

³ See www.phed.com.ng/about_us

CATEGORY	STAKEHOLDER	INFLUENCE/INTEREST
Alternative distributors/retailers	Candle and battery retailers	The distribution of solar lanterns arguably limits or deters sales of torchlight batteries, rechargeable lanterns and candles
Corporate social responsibility (CSR) initiatives: extractive industry	International oil companies (IOCs)	Potential for CSR involvement to support social and environmental outreach. IOCs play a significant role in providing off-grid power to communities within the Niger Delta. As part of CSR programmes, IOCs have often provided free off-grid power to communities by providing generators, building dedicated gas turbines, selling discounted solar lamps, or connecting communities to their own power plants' distribution networks
State and local government authority	Rivers State Government	Assumed concern with community productivity, standards of living and security

fuel. Increased citizen access to solar works toward improving the environment and local economies through savings. Costs formerly associated with the aforementioned non-renewable energy sources can be reallocated within the family, contributing to improvements in the domestic and social sphere. Access to solar light further affects end user-education and energy literacy in the region" – Olumide, SDN Senior Project Officer, 2014.

Forced to reflect on our 'theory of change' to dictate the priorities of our model, our team understood the assumptions we have to challenge in the course of applying the Delivery Model Canvas.

5.2.1 Challenging our value proposition

SDN's solar lantern distribution model:

- **Depends on the SDN project staff's direct contact with communities;** in its current phase, it could not exist independently of NGO intervention. This highlights the need to strengthen the capacity of community-

based entrepreneurs to ensure the sustainability of the project, independent of the NGO body

- **Depends on international manufacturers and local suppliers**
- **Depends on networks of community trust to support an informal 'pay-back scheme'** to enable the varied products to be affordable for the community. Our value proposition therefore relies on trust and informal relationships within community groups. In the Niger Delta context, **we recognise this as an important lesson in 'what works'. In order to strengthen our model we want to 'evolve' the trust and build it into a formal and scalable hub for the area**
- **Affects local battery, candle retailers and black market fuel distributors.** However, retailers also offer existing commercial channels that could further stock and distribute the lanterns.

These are useful observations as we consider how the model can be improved.

6

Adapting the energy delivery model framework to the Delta context

The EDM approach encourages adapting its key questions, describing itself as a ‘work in progress’ that must be tested and adapted in specific real-world contexts. The SDN team therefore understood the need to dismantle and adapt the Delivery Model Map and Canvas for the Niger Delta context, so as to systematically analyse the social and environmental impacts of our lantern distribution model, marketing strategy, channels of communication and the experience and understanding of the end user.

At the Port Harcourt workshop for SDN staff, other CSOs and Mgbuoba community members, we attempted to demystify the development language and technical vocabulary tied to the Delivery Model Canvas (see Figure 8). This enabled participants to understand more complex ideas such as ‘delivery infrastructure’. Initially, contributors argued that the technical questions in the Delivery Model Canvas were not appropriate to our small-scale distribution of lanterns, which relies on informal channels of communications and existing networks of trust in semi-urban areas.

However, when the terminology was explained, fellow CSO groups Pro Natura and Social Action and Mgbuoba community participants argued that the Delivery Model Canvas was useful for assessing our model in relation to energy policies in Rivers State. Pro Natura observed that the Nigeria Electricity Regulatory Commission (NERC) launched feed-in tariffs for renewable electricity (REFITS) in the Multi Year Tariff Order II issued in June 2012. Moreover, Social Action highlighted the Rural Electrification Agency’s (REA) failed attempt

in 2009 to shift focus to renewable energy, especially solar energy systems and small hydropower. However, a new REA Board plans to launch a programme focusing on both grid and decentralised energy options.

Questions such as, “How does the value proposition sit with public policies and government strategies?” (see Figure 8 under Delivery Strategy) enabled respondents to cite government and private sector incentives, but contributors viewed government strategies as ‘dysfunctional’ with a poor reputation for outputs. The solar lantern model tries to bridge the energy gap.

While recognising the value of the EDM approach, project staff failed to see how the Delivery Model Canvas could account for informal channels of communication, ‘in-kind’ resources offered by the community and informal subsidies and incentives offered by the market distributor – the familiar and casual transactions which enable our model to work. In response, the SDN team extrapolated the meaning of the Delivery Model Canvas questions to align better with SDN’s context. By breaking down key sentiments of the EDM’s requests, we were able to tailor questions for our field research, described in detail below, to speak to the informal frameworks of business, and to enable community respondents to interpret the questions effectively. The process needed to describe the organic growth of our distribution network and the familiarity of small-scale entrepreneurs with SDN as the enabling NGO.

6.1 Challenging SDN's methodology: a reflection on the EDM approach

We agreed with the EDM approach that “principles of a well-designed pro-poor energy delivery model” emerge from negotiation among multiple stakeholders such as enablers, suppliers and end users. SDN arguably failed to formally consult broader stakeholder groups prior to implementing our original pilot project. We therefore decided, together with multiple stakeholder groups, to gather data from the field; we hoped to determine how this oversight in our methodology could have impacted the mechanics of our portable lighting model.

SDN's experience of survey work in Rivers State attests that the most effective means of gathering quantitative and qualitative data with community-based groups is through a combination of key informant interviews, focus group discussion and questionnaires. To this end we re-categorised EDM questions according to the stakeholder audience and suitability for structured or unstructured single interviews, facilitator-led discussions or quantitative surveys.

From the research team's different interactions with Pro Natura, Social Action, Mgbuoba community groups, SDN staff, suppliers Creeds, and stockists, the successes and failures of the current model were assessed so as to make recommendations on its wider appeal to end-user segments such as residents of rural areas of Rivers State. Applying the Delivery Model Canvas questions enabled the SDN research team to challenge SDN's assumptions as an enabling body. Reviewing our survey questions highlighted gaps in our methodology, such as:

- a failure to formally account for broader stakeholders such as suppliers, local government officials, oil company's corporate social responsibility programmes and their impact on the distribution of solar lanterns
- lack of knowledge of parallel solar lantern programmes such as Solar Sisters and TOTAL
- the need for a deeper understanding of methods of engagement and effective channels of communication from the communities' perspective. SDN relies heavily on community sensitisations and town hall meetings. How effective these inception and introduction meetings are is yet to be assessed
- the need to monitor how well solar power is understood on the ground
- a failure to challenge our own assumptions about the solar distribution model.

6.2 Adapting the EDM questions

We prepared to conduct key informant interviews and focus group discussions in peri-urban and rural communities in Rivers State. Focus group discussions, key informant interviews and a survey questionnaire were devised and directed at Rumunduru, Rumukwache, Mgbuoba communities, where solar lanterns have been distributed by the marketer and Oduoha, a rural community not yet included in the distribution project. *The Delivery Model Map and Canvas gave the research team an opportunity to re-design our methodology and bridge gaps in our knowledge.* 'Triangulated'⁴ Delivery Model Canvas and Map questions were mapped under the EDM headlines to ensure a holistic approach: 'socio-cultural context', 'value proposition', 'end-user experience', 'delivery infrastructure', 'accounting' and 'enabling environment' (see Figure 7).

4 'Triangulated' refers to the use of more than one method in a study, in order to cross check results.

Sets of questions were then re-categorised depending on the stakeholder audience and suitability for structured or unstructured single interviews, facilitator-led discussions or quantitative surveys. The triangulated questions were translated into pidgin, which was used to interact with individuals who didn't have a full grasp of the English language.

END USERS

End-user experience:

Are you aware of the solar lighting products introduced in your area? / You don hear about the solar lamp wey dem don dey show for your area?

What are the shortcomings/disadvantages of the various solar products? / From your own side, wetin you feel say na the bad tin wey you no like for the lamp body?

What has been the impact of the use of the solar lanterns and other products on your environment? / Wetin be the tin wey the solar lamp don do for your environment? E dey spoil your plants or wetin?

End-user channels:

How were the products promoted or advertised in your community? / How dem dey take advertise these products to una? Una bin like am?

Which advert method would you have preferred? / Which way you for like make dem advertise the products dem?

After you bought the lantern did you get any after-sales support? / wen you bin buy the lantern, person in help you wen the tin spoil for your hand?

End-user relationships:

What is your relationship with the market distributor? / Wetin be your relationship with the market distributor person?

How were the products demonstrated to you? / How dem take show you how to use the product?

Did you receive after sales support? / Persin help you wen you no understand how to use am?

Who do you feel should be responsible for providing you with energy/electricity services? / who you feel say suppose provide una with energy and electrical services?

Do you think services run by the private sector would be more effective? / You feel say services wey dem dey do for private sector suppose dey work well well pass the way e dey?

DELIVERY INFRASTRUCTURE

Key stakeholders:

What services have you seen SDN carry out with regards to the solar lantern distribution? / Wetin be the kine tin wey una don see SDN do wen dem dey give the solar lamp?

Why do you think they do it? / Wetin you feel say dey cause am?

What do you expect from them? / Wetin you want make dem do for una?

How does what they are doing (providing access to solar energy) fit with what the government is doing? / The tin wey dem dey do, how you feel say e take relate wit wetin government dey do for una?

6.2.1 Adapting questions for rural versus urban and semi-urban communities

Rural communities were not yet targeted in the solar lantern project, meaning only a small number of Oduoha residents were familiar with or used solar lanterns as means of decentralised energy supply. Survey questions aimed at rural communities were therefore hypothetical, to test the feasibility of introducing a range of solar products, such as the 12 kilovolts Schneider lantern or lower voltage Wakka lantern. The surveys worked towards understanding the needs of farming communities, such as energy needs for light versus cooking and identifying disposable income flows.

Table 5. Examples of adapted questions

EDM HEADLINES	ADAPTED QUESTION
Baseline perceptions of solar: Relationship to energy supplier:	Do you have any knowledge on solar energy? Are you satisfied with the number of hours of electricity you get from NEPA each month?
Energy usage behaviour:	Do you use your generator more than you get light from NEPA?
Socio-cultural context and decision-making structures:	Do men and women in the community work together to achieve community development? How effective is the organisational structure of your community?
Challenges of community-based projects and willingness to pay:	Are you willing to pay more for a stable electricity supply?
Perceptions of entitlement from the state:	Who is responsible for providing your household with electricity?
Appropriation of innovative technologies:	Do you prefer leaving things the way they are, and sticking with the same tried and tested methods?

In the urban and semi-urban communities where the pilot project is already operating, a basic surveying method was chosen to provide both qualitative and quantitative data. Personal questionnaires were used to assess demographic composition, local awareness and capacity, customary practices, user preferences, community dynamics and attitudes towards public services and new technologies of both rural and urban communities.

Table 5 gives examples of these generic, open-ended questions in the personal questionnaires.

Annex 2 gives **more details of our field research methodology**.

6.3 Challenges of using the Delivery Model Canvas and Map

In the spirit of the EDM framework being a 'work in progress' that needs to learn from real-world application, we noted a number of challenges in applying the EDM approach to the Niger Delta context.

- While we found stakeholder mapping an effective method for identifying stakeholders, time constraints made it difficult to engage broader stakeholders like the government ministries, departments and agencies and privately owned companies and businesses in the locale.

- The complex language of the Delivery Model Canvas and Map was a barrier to the project team's understanding. It needs to be simplified to cater for an audience that operates along informal channels. The team addressed this at the Port Harcourt workshop to demystify the language. In order to adapt questions for community surveys, they were triangulated and translated into pidgin. This was an effective but time-consuming process, and a degree of meaning was lost in translation.
- Interviewees complained of the length of focus group discussions.
- The Delivery Model Canvas suggests that, to some extent, small-scale businesses should document their saving and accounting. However, our portable solar lighting delivery model relies on small-scale business ventures with informal channels of communication and marketing. Areas that suffer energy poverty are likely to predominantly function through oral culture, and few keep note of expenses, saving and costing. This proved problematic for the team interviewing small-scale businesses when analysing sales spreadsheets; some questions were too complex, or interviewees were unable to answer due to lack of records.
- Women's participation during the community research engagements was minimal due to their perceived notion that some of the questions were too complex.
- Community hierarchies prevented interviewees from disclosing some information, as people were unwilling to comment on community management.
- The SDN team added questions centred on how a pro-poor energy delivery model could create jobs. The team felt the Delivery Model Canvas did not clearly link to entrepreneurship. It also needs to include questions on business viability and sustainability. While livelihood benefits are implied when discussing sharing value in the supply chain, the SDN researchers understand that Nigerian participants are driven by economic gain, so felt they should add questions on job creation specifically. If the model included a job creation component it could integrate community ownership and sustainability from the design phase.

7

Findings: the process

The results of our field study on the solar lantern distribution model flagged up imperative operational and process-based lessons. The results are reported below using the Delivery Model Map headlines: end-user relationships, channels and segments, accounting and revenue streams, and delivery infrastructure. We found that it was pivotal to understand the dynamics between stakeholders in the value chain, beyond the mere quantitative analysis of sales records.

7.1 End-user relationships: a non-profit/for-profit dynamic

Based on the Delivery Model Canvas (see Figure 8), research on end-user relationships asked, "What type of relationship does each type of end user expect us to establish and maintain with them?"

To better answer this question, it is important to understand the broader context within the region. During the last decade SDN has implemented several projects for energy stabilisation and justice across the region. This, along with the work of others, has led communities to express a sense of entitlement from NGOs and charity workers. According to Hamisu, market distributor, "Communities were expecting SDN to give them the solar lights free of charge." Given the federal government's inability to provide reliable services and supporting infrastructure in the Delta, it is common for communities to place responsibility on NGOs, the private sector and international oil companies operating in the region.

"People have gradually formed the habit to always receiving free stuff so if government picks interest and distributes the solar lanterns people will lose interest in buying, but rather pick interest in selling off the one they got through the government" – Hannah, supplier at Creeds.

Working in Rumukwachi, SDN employee Samuel had to negotiate direct sales of the N5,500 Sun King Pro in his community. Using his status as an influential community member, affiliated to the church and charity sector, initially it was difficult to enter a 'for profit' relationship with neighbours. Samuel explains the conflicting aims of stakeholders: "Rumukwache people see SDN as a non-profit organisation, how come we are coming with solar lanterns for profit making, they ask?" A sense of entitlement to free services from institutions undermines the small-scale entrepreneurship mentality, ownership and sustainability of the project, resulting in poor sales of the solar lanterns.

SDN acts as a conduit for the market distributor. Using SDN's trust networks and baseline understanding of the decision-making structure of core areas of Rivers State, the market distributor is able to exploit these well-carved channels and define his role as a for-profit business entrepreneur.

"These two things are conflicting because if you go alone, you make more sales but if you go on the name of SDN you get more attention. These are the two things experienced in the field" – Hamisu Usman, market distributor.

This perceived competition between the agendas of the private sector and civil society is an issue identified frequently in our field results. SDN's core principle of community empowerment sees economic incentives and job creation as key pillars to uphold sustainable solar projects. In theory, livelihood empowerment that meets the most practical and immediate needs of individuals significantly enhances the sustainability of the empowerment and development processes.

- **Recommendation:** In the Delta context, an intersection is needed between non-profit and for-profit to incentivise participants – but as distinct and separate activities. The market distributor's responsibility is therefore to engage with key sales people to promote the portable solar lighting project as a viable business; this will hopefully permeate into urban communities' understanding of an intersection between livelihood empowerment and solar energy. A transition to a sustainable business model supported by an investor would mean the NGO can support the project in the early stages of building awareness, trust, and the supply chain logistics while not being perceived by communities as a 'charity intending to make money' through selling energy products. The sustainable model is looked at in more detail in Section 8.

7.2 End-user relationships: expectation of services and willingness to pay

Based on the Delivery Model Canvas question, "Do end users expect services to be delivered by the public or private sector?" community members were asked, "Who is responsible for supplying energy to households?"

In 2011, the Presidential Task Force on Power's (PTFP) Roadmap for Power Sector Reform reported that Nigeria has the biggest gap between supply and demand for electricity in the world. The privatisation programme aims

to raise US\$35 billion over ten years, in order to boost the power supply 13-fold over a decade.

When questioned, 56.7 per cent of interviewees stated that services should be provided and subsidised by the government. This viewpoint stems from a culture of hand-outs and an expectation of free services from NGOs and government. Only 66.7 per cent of interviewees paid taxes.

In view of our solar energy distribution model, most interviewees had expectations of solar service delivery from government (see Figure 9).

"The private sector and NGOs will be more effective in distributing solar but people are used to not paying for services. We, as a community, need to take responsibility for services" – Social Action staff, Port Harcourt.

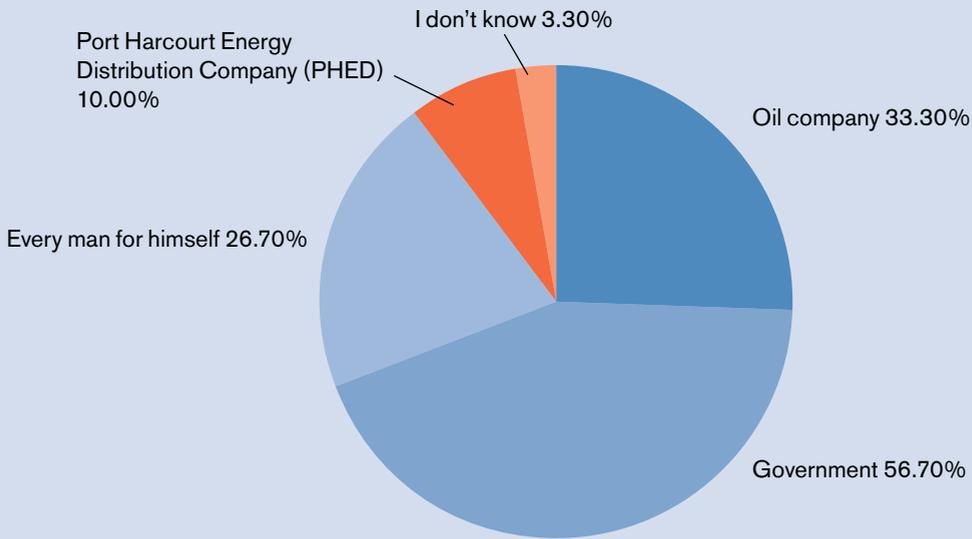
However, the transition to a private energy sector has perpetuated respondents' distrust of providers. Incorrect billing, extortionate pricing for darkness and the consequent damage to local businesses propagates a continued lack of confidence in PHED. This attitude is transferred into a lack of trust in solar providers.

"Close to a month there is no light and I spent at least N1,500 daily to fuel my generator. I am in a frozen foods business that requires steady and uninterrupted power. Unfortunately, it is not practicable. My profit on a carton of chicken is N1,000. Some days I sell up to a carton while few days not. My profit is not up to expenditure for fuelling and maintenance of generator but am managing the situation in order to keep the business going and believe that one day the story will change" – Gift, Mgbuoba.

7.2.1 The impact of PHED inertia on the solar distribution model

PHED has pledged to issue each building across Mgbuoba with individual electricity bills. Yet respondents state that house meters are rarely checked and bills do not represent their domestic energy use.

Figure 9. Responses to “Who is responsible for energy supply to households?”



“Initially when my bills were brought it was N15,000 per month, which was too outrageous because I had a faulty meter. So I wrote to NERC and my bill was slashed to N5,000 per month to PHED” – Resident, Mgbuoba.

From community surveys, we can deduce that PHED, commonly referred to as ‘NEPA’ (National Electric Power Authority) and ‘PHCN’ (Power Holding Company of Nigeria), issue three types of bills to the Mgbuoba community:

- Meters: approximately 80 per cent of the community received computerised bills based on individual meter readings. Currently, respondents note that due to lack of meter monitoring from PHED, the amount is estimated and incorrect.
- ‘Accelerated’ bills: 15 per cent of the community buildings do not have meters and

therefore have an agreed monthly payment plan to PHED.

- Hand bills: five per cent of the community pay via monthly payments made to PHCN officials. These are informal payments made to PHED staff to prevent disconnection.

“PHED officials do not respond promptly to reported faults by community representatives and when they eventually do, they exploit the community with excessive and arbitrary charges” – Gift, Rumunduru resident.

Respondents informed our researchers that, “New meters that would eliminate exorbitant estimate electricity bills are needed.” This inertia on PHED’s part means communities have to seek alternative energy sources to support their businesses. Gift’s feedback supports reliable green energy; however, it expresses distrust in energy providers.

Recommendation: Our current portable lantern project cannot replace PHED electricity services or grid connection in urban communities, nor is it intended to. Rather portable lanterns act as a reliable lighting source when the grid is not working and in areas of the community where the grid is not connected. By tracking the experience of consumers and their relationship with energy providers, SDN's efforts under the SUNGAS project need to continue to support an improved dialogue, payment systems, and the social contract between citizens and their energy providers, supported by the Nigerian Electricity Regulatory Commission. This will also assist with changing attitudes towards payment for products such as portable lanterns.

7.3 End-user channels

The Delivery Model Canvas asks, "Which channels do our end-users want to be reached through?" We asked interviewees what their understanding of solar was and how the products had been advertised in their community.

7.3.1 How people perceive the lanterns' value

Thirty per cent of those interviewed stated that the reason for not using solar power is cost. Forty per cent said their lack of participation is due to not having a clear understanding of how the product works. Such opinions limit progress and indicate issues to be addressed in our operational procedures.

When asked if there were preferences and customary practices that could affect SDN's value proposition, the responses seemed to show that a single community sensitisation does not 'ignite' inquisitive community members. Limited understanding is a barrier to our value proposition, and without understanding the value of sun-powered renewable energy sources, people are unlikely to take part in a payment plan. In Rumunduru community

in particular a limited understanding of solar energy meant a lack of motivation towards it.

"It was especially difficult to make residents of the rural community understand the concept. The trainer had to make it as practical as possible and communicate via pidgin English"
– Olumide, Senior Project Officer, SDN.

SDN's mandate for community empowerment states that 'capacity and knowledge' supports 'confidence and attitude', which in turn results in a 'willingness to participate'. 'Co-operation and ownership' are symptomatic of the willingness to uptake and promote the solar lantern (SDN/ CORDAID, 2015). See Annex 4 for more on SDN's lessons on community empowerment.

Results from the field indicated poor capacity and knowledge held by community members following an SDN sensitisation on solar lanterns. In response, suppliers of the Schneider, Sun King and Wakka Wakka products at Creeds suggest running awareness-raising activities that target specific stakeholders, as opposed to generic town hall meetings. The suppliers felt that for home-owners, women and youth it is best to demonstrate the product in the domestic sphere. Youth groups and university students act as ambassadors for Creeds products:

"Youth corps members helped in the installation of solar panels in the National Youth Service Corporation broadcasting studio on camp. There was a lot of interest shown from the corps members in renewable energy" – Hannah Kabir, Creeds, Supplier.

The findings of the field research support the suppliers' theory. Eighty per cent of respondents felt that targeted 'knowledge workshops' aimed at market women, as central to the home and domestic sphere, could increase community-wide understanding, the immediate gratification of renewable energy sources and the deferred gratification of paid instalments and monthly savings. The 'value' of the solar lantern is determined by the importance, worth, or use given by the user. The focus in the formative

stages of the business model is to introduce the product and communicate its 'value'.

"They called my wife's shop 'solar joint' because about five shops around her were using solar lantern Sun King Pro to illuminate their shops at night. As a result of the way my wife is promoting the solar lantern, it leads to increased patronage. I collected the Sun King Pro products from Hamisu and gave it to one Amos Adebayo (a health worker) that owns a chemist very close to my wife's shop. He is our seller in the community but not for profit making for now but to sell at cost price in order to create the awareness about the solar products. He has sold about 15 Sun King Pro and few pieces of Sun King Small" – resident, Rumukwache.

As the Rumukwache resident states, Amos currently sells lanterns, not for profit but to 'create awareness'. Many interviewees in Rumunduru and Mgbuoba own television sets, yet solar lamps – which are significantly cheaper than a television – are not valued as a prerequisite for the home. The project team saw potential opportunities for the community, if the business model expands, for job creation through installation of panels, maintenance and payment collection. The positive human impacts of using the solar lanterns are analysed in more detail in Section 6.

7.3.2 Reaching end users effectively

As the Delivery Model Map and the findings above indicate, in-depth analysis is needed in order to better understand what appeals to rural communities, before attempting to mobilise the community in a generic and unproductive 'sensitisation'. Asking "Which channels do our end users want to be reached through?" highlighted the importance of informality in enabling the delivery model to function. It prompted us to examine the marketing strategy and various channels of communication we had used to promote solar lanterns.

Town hall meetings

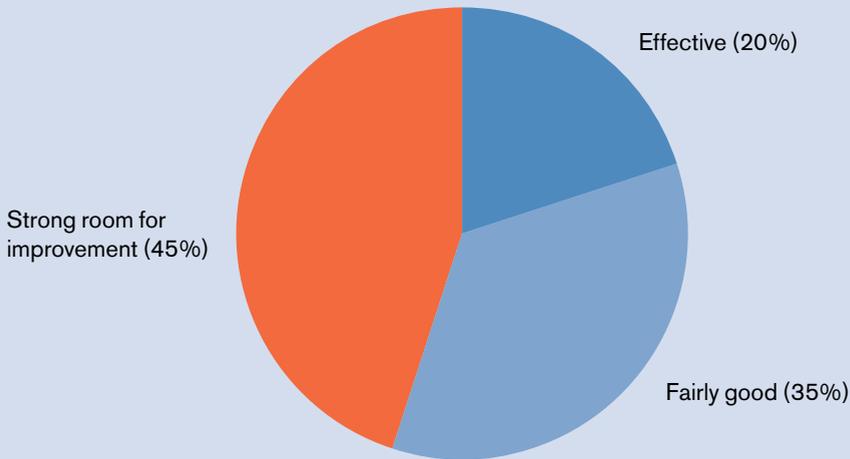
Awareness raising and promotional campaigns were structured around 'community sensitisations' held in public meeting spaces in each target community. As Samuel describes, the benefits of solar were contextualised in parallel with a demonstration of the Sun King Pro Lanterns:

"I was part of SDN/IIED team that organised sensitisation in Rumunduru, Mgbuoba, Tereama and Oduoha – Emoha around September/October, 2013. We did a workshop on Citizen's Rights, Obligations and Duties to better electricity service delivery. Participants were educated on the fundamentals of human and socioeconomic rights, power sector reforms and renewable energy with particular emphasis on the benefits of solar energy" – Samuel Agboola, SDN.

Town hall meetings create a space to mobilise the community. In line with SDN's ethos on community empowerment, the solar lantern project is an economic empowerment initiative. Practical demonstration creates a sense of ownership and partnership within the community.

"At the end of the discussions, the team explained the importance of renewable energy and solar energy. Afterwards, we demonstrated and showcased the different lights such as Sun King PRO, Sun King Small, and Wakka Wakka, Schneider electric and the price ranges. We went with Hamisu and introduced him as the marketer in charge of the products. We assured them that Hamisu will be visiting the community to market the products. Although some of them complained of the prices because they are used to the rechargeable lanterns that is sold at N500–N1,000" – Samuel Agboola, SDN.

Figure 10. Assessment of current solar marketing strategy in communities



However, the market distributor Hamisu Usman felt that one sensitisation per community does not sustain interest, or recruit people from the community as public mouthpieces for the product. A Rumunduru resident confirmed:

“Frequent sensitisation programmes should be carried out to keep the community abreast of developments and the benefits of new technology introduced to the community” – Ezekiel, Rumunduru.

SDN project staff thus felt it was important to offer multiple platforms to communicate and promote the solar lanterns.

Public demonstrations

Demonstrating the lanterns by installing them in public spaces with a high footfall is an effective way to exhibit them, since they are visible to a lot of passers by and gain support from public users. In some areas, public shelters can also function as evening community meeting spaces if they are well lit; an IIED solar installation at

Okrika Waterfront's Chicoco Media Centre means the community radio station also functions as a 'secure and safe' meeting space after dark.⁵ On a comparatively smaller scale, a local school in Mgbuoba community and shop front display in Rumunduru community are used as public demonstration points for the 12KV Schneider Lantern. “My school at night is a beacon. Solar can make us feel safe” – Student, Mgbuoba.

Radio and social media

The team noted that pidgin slogans through local radio gain more widespread attention than press or mobile marketing; this could be an effective channel for advertising.

One output of SDN's work on the SUNGAS project was the Facebook site: Influencing the delivery of electricity through advocacy.⁶ This social media space is a knowledge platform to bring together community groups and promote energy literacy. The portable solar lantern

5 Chicoco Radio: www.chicoco.fm

6 See <https://www.facebook.com/SDNSungasProject?fref=ts>



Chicoco Media Centre. Waterfronts use solely solar to power the radio equipment

team used it to incentivise the community with competitions to win the Sun King Pro. With 220 'likes', the community-run page was an effective means to advertise and distribute the product locally at low cost.

"I took part in the Facebook quiz on the Mgbuoba community page which I won and was awarded a laptop from SDN to be the community administrator for the social media site" – Christerbel, Mgbuoba.

Market distributor Hamisu and sub-distributors Ezekiel and Christerbel also used personal social media sites to promote their businesses.

"We can upload pictures and send links on our smart phones and blackberries phones. I can then charge my phone using Sun King Pro. Money I save using solar I can put toward buying airtime to go online" – resident, Mgbuoba.

A June 2013 survey suggests that Nigeria has around 48,366,179 Internet users. Currently, mobile broadband penetration is estimated at 28.4 per cent. Statistics denote that there is an increased interest and need for information

and communication technologies and mobile devices to be integrated into small-scale business development. Smart phones and social media are key channels to reach end-user segments.

This is evident in Hamisu's spending as market distributor. His monthly costs on phone and other communication is between N5,000 and N6,000. Data charges and phone communication also account for customer after-sales services. Hamisu notes that:

"My largest outgoing is transport; I spend N20,000 selling the lanterns and replacing faulty Schneider batteries. I also print marketing posters and materials. Facebook and Internet are cheaper and more environmentally friendly than printing materials. However this only appeals to some of my customers. Word of mouth and public demonstration still wins out."

Informal channels of communication

Our model suggests that for small solar lantern business entrepreneurs in Rivers State, informal lines of communication such as word of mouth, follow-up phone calls and social media, are

highly important in sustaining and developing their business activities.

Our field results show that informal information channels are characterised by:

- a high degree of reliance on the knowledge and experience of SDN staff and other solar distributors in the same community
- related to the above, information accumulated through enterprise-specific learning. i.e. learning what works for a particular context by doing, 'on the job'.

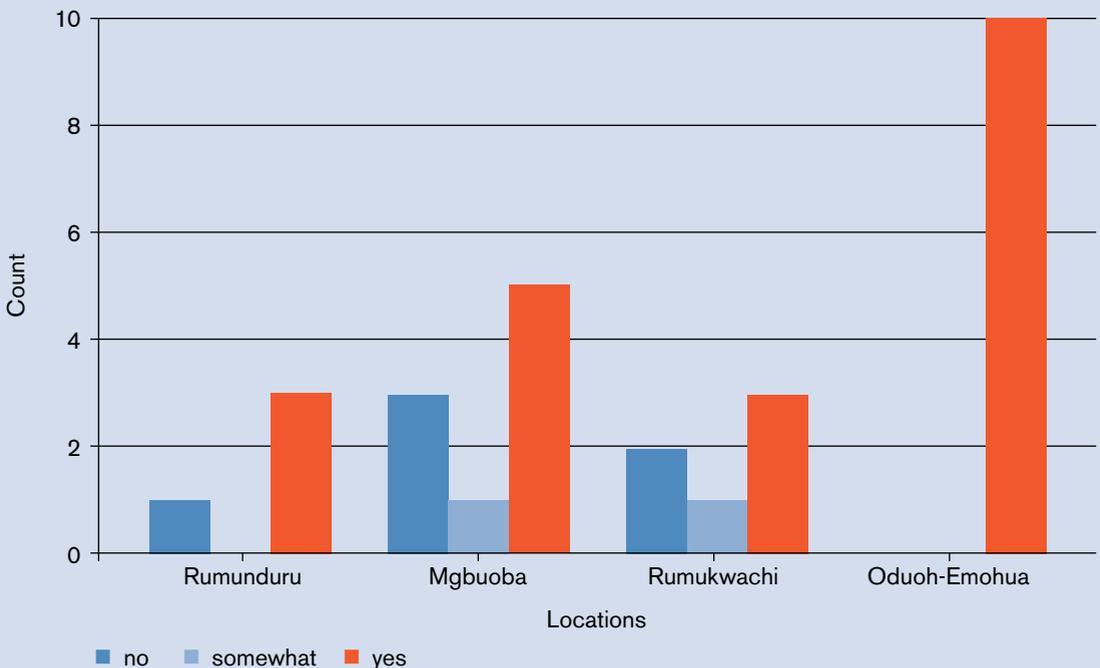
The rationale behind marketing through informal channels is that, in the Delta, information or knowledge is more likely to be accessed through peers or business associates than government institutions or the formal private sector. Informal peer networks are a trusted and quick means of circulating opinions on solar.

A study by the African Research and Training Centre in Administration and Development supports our business model's use of informal networks: "Information received through informal sources and channels was rated more highly by most business owners than information from formal institutional sources. This tends to be because entrepreneurs value the time, cost and convenience benefits of informal information systems" (CAFRAD, 1998).

7.4 End-user segments: gender and solar

Using the Delivery Model Map has led researchers to question the gender dynamics relating to end users. As a tool to collect data, results from the Delivery Model Map could potentially sculpt our engagement with women's groups in rural communities.

Figure 11. Perceived contribution of women to community development



Although 60 per cent of respondents state that the Community Development Committee (CDC) oversees community projects, 73.3 per cent of those interviewed state that women's groups are pivotal to the popularity of a programme and the propagated products. Figure 11 shows how women are perceived as contributors to community development. A Rumukwache resident notes that women are fundamental as 'advertisers' at home and in the market place:

"Women contributed to the building of stalls in community market in Rumunduru while women in all the communities have prayer warriors that are praying for peace and development of the community. They are your advertisers and your microphone" – resident, Rumkwache.

Julie, a Mgbuoba resident, supports the idea that women should be targeted by solar product advertising. Citizens of rural area Oduoha state that women are crucial, leading in farming, the domestic sphere and in market responsibilities for the family.

"Women dominate the household. We require light for preparing children for school in the early hours – however, in most families, the man control the finances" – Julie, Mgbuoba.

"Women's groups as a community mouthpiece for innovative technologies allows our solar lanterns model to operate within informal intercommunity social networks. This means the aims of sustainable markets projects can be voiced, allowing individuals or marginalized groups to circumvent institutional constraints and structures of exclusion within the wider society" (Meagher, 2005).

Recommendation: In line with SDN's Community Empowerment Model, community engagements should work to target disempowered groups. The distribution of solar lanterns could target market women's groups to act as the 'mouthpiece' for renewable energies, demonstrating the product in home and market stalls; mutually generating momentum around

the product and supporting women's livelihood empowerment. Capacity building exercises and skill acquisition around solar could further work to support women's rights.

7.5 Accounting: costs and revenue

We adapted questions for this part of the research from the Delivery Model Canvas, such as, "What are the most important costs inherent in our solar lantern delivery model?" and "Where will the revenue streams come from?"

7.5.1 Costs

Customer perceptions of the value of solar lanterns is significantly influenced by the cost of the product. This includes the overall cost (including any level of subsidy) individual payment costs over time - were the customer to be on a re-payment plan. Our analysis of the process-driven challenges found that costing, subsidising and managing instalments brought about operational issues for the distributor, the supplier and the end users in our market chain.

"The products are affordable yet expensive – the issues are with the value versus the output. It can only be used as a supplement to the (diesel/petrol) generator as people require energy to power other appliances" – resident, Rumunduru.

Eighty-five per cent of respondents in the three urban communities assessed stated that the lanterns were too expensive. Sixty-five per cent of Rumunduru and Rumukwache interviewees said that they could only afford the product if it was 'subsidised'. SDN's market distributor offers an 'ad hoc' payment system depending on customer income. The question, "How did you pay for the solar lantern?" elicited the different payment methods available:

- monthly instalments
- an informal pay back system for trusted members of the community
- 'Pay what you can when you can'

- personalised payment plans for each customer.

In a discussion on how we could adapt our model's operations in response to the 'too expensive' statement on cost, the market distributor said that it is important to target communities during festive seasons and weddings. He also noted that in some communities income cycles reflect the seasons – farmers usually have more money during and immediately after the harvest period. This indicates the need for a level of flexibility in repayment plans/cycles, and of seizing opportunities to introduce products to users during periods where they are more likely to consider them affordable – whilst ensuring the products are appropriate for the users and the users are informed enough to make a purchase decision.

7.5.2 Revenue streams and willingness to pay

We asked community members questions about 'revenue streams', including finance or credit, and found that the small-scale loaning or credit system had limited documentation. Most interviewees participating in a solar lantern payment plan pay a minimum of N1,000 per month. The market distributor then pays SDN in monthly instalments for products sold. A process to formalise or document the informal payment of instalments could provide a more accurate snapshot of customer behaviour. Although rated by some who have not bought solar lanterns as "too expensive for the output. I can buy a native [kerosene] lantern for N500–1,000", participants maintain they save money by using them. One end user, Julie, states: "I spend N5,400 every month on candles but since I got the solar lanterns I've saved more money than I used to, which I've added into my household spending."

For an analysis of our business model and down payments, see **Annex 5**

A large majority of respondents (87.7 per cent) stated that they would be willing to pay for solar energy if it was more affordable. While payment by instalments does make the lanterns more affordable, an absence of trust in overpopulated urban areas means that sub-distributors and customers feel there is no way of regulating instalments.

"Instalments do not operate in Rumunduru due to lack of trust within the community. The youth group spearhead development. Although able to actively organise the community they cannot control people's unwillingness to pay" – Ezekiel, Rumunduru.

An unwillingness to pay also stems from a culture of 'buying in bit': "I buy one cup of rice, one cup of sugar per day", explains Rita. It is uncommon to 'buy in bulk' or part up-front with large sums of money. Conversely, respondents note that there is no culture of savings. An informal lending culture operates along family lines. Touted as a 'softer' approach, these social networks are said to constitute a more flexible and efficient form of economic organisation under conditions of economic instability (Meagher, 2005). This consumer spending behaviour affects the realisation of our value proposition.

Respondents state that Rivers State banks' micro loans or credit scheme are restricted, and that informal loans are ruled by aggressive collectors. Restricted access to formal credit schemes permeates into community culture. Participants are unwilling to make an investment when the return (savings on fuel) is deferred across a six-month spending period. Moreover, there is no culture of documenting spending or savings. Areas of Rivers State predominantly function through an oral culture.

"The level of poverty in most communities won't permit people to part with a whole lump sum of N2,500, much less N5,000, because the little they have they'd want to spread across their needs. It's difficult to break into their budget" – Oby, SDN staff, Port Harcourt.

Recommendations: In order for our business model to be sustainable, regional entrepreneurs should operate on a for-profit basis. But by moving away from an NGO model where capital was fronted by the NGO, local investment sources could be problematic. The lending culture in the Delta is embryonic currently. The insignificant role that banks play in Rivers State society is demonstrated by the small quota of mortgages and small percentage of the population that use bank accounts.

- Replicating our model in rural areas, we would need to initially grasp informal economies, financial flows and the potential for disposable income in the area to be put towards solar lanterns.
- Accessible micro-credit schemes are also an area for further research in the Delta's development context.
- Since accountability when paying instalments is an issue, a formalised system of instalments and workshops on community trust could quell anxieties between distributor and customer.

7.6 Delivery infrastructure: resources and stakeholders

Using the Delivery Model Canvas helped us to assess key stakeholder relationships and key resources.

Under 'Delivery Infrastructure', the Delivery Model Canvas asks, "Are all resources within reach?" In interviews, the SDN market distributor and Creeds supplier concluded that being 'within reach' of solar products is partially dependent on the (international) manufacturers and the import tax on solar products.

On the challenges of importing solar lanterns into the country, the supplier stated:

"Easy entrance to market space by Chinese and Indian companies means that products are without due regard for standards or quality control. Customs and authorities are unclear about tariffs and import duties on these goods."

"Most resources are sourced from outside the country and stationed closer to states with ports. Manufacturing companies having a local base can help. Moving goods within the country also increases costs due to limited transportation options" – Hannah Kabir, Creeds Energy

The cost implications of import taxes have a significant impact on the market. Transport options are further limited due to poor road infrastructure across Rivers State. Facilitating dialogue between suppliers Creeds and solar technology organisations working in the Delta, such as Aleutia Computers⁷ currently working with Solar Peace⁸, could contribute to understanding the cost implications of importing reliable and ethically focused solar products into the Delta.

Community focus group discussions suggested that informed relationships with wider stakeholder groups could also work to broaden the reach of the Solar Lantern Distribution Model. The market distributor, Hamisu, thought that these groups – such as fellow CSO groups working on solar and local government area (LGA) representatives – could offer subsidies to make the lanterns affordable for community people. In view of our operational process, a stronger dialogue with other stakeholder groups could enhance sales and the potential

7 See www.aleutia.com

8 See www.solarpeace.net

for in-kind resources, such as storage space, local distribution and discount, adding to overall revenue.

“There was a time I approached the acting chairman of Obio Akpor LGA in the person of Chikordi Dike to subsidise lanterns for the community, ie, purchase 500 lanterns for the students in his community.

While the negotiation was ongoing, he was toppled out of office and the political situation did not encourage further discussion on it. Whenever the situation is calm, we will discuss further on the negotiations” – Hamisu Usman

Due to the hostile environment of Rivers State, making political alliances could be problematic. The SDN team therefore recommends continued dialogue with local CSO groups in support of green energy. As project officer Samuel describes, current SDN partners include:

“Social Action, Movement for the Survival of Ogoni People, Pro-Natura Initiative, Gender and Development Action, Kebetkache and Center for Environment Human Rights and Development (CEHRD). These are NGOs that worked with SDN during the implementation of a project called Strengthening Transparency and Accountability in the Niger Delta (STAND). SDN also involved them in the survey study on renewable energy and as a result of their experiences and light challenges in their respective areas and communities, they benefitted from the 50/50 subsidised rate when the solar was first introduced by SDN. Their demand for the products after the end of the 50/50 discount qualified them to be one of our key stakeholders” – Samuel, Project Officer, SDN.

Action points: Talks with local CSO groups such as Social Action and Pro Natura International offered peer learning on the operations of our model. Fellow NGOs agreed that **strategic partnership with popular institutions, television or radio could boost interest. The NGO, Solar Sisters Incorporated, teamed up with** international oil company Total to distribute a range of solar products called ‘Awango by Total’, leveraging Total’s service stations nationwide as outlets. Total’s Access to Energy programme’s aim is to “provide access to lighting for five per cent off-the-grid households in Nigeria by selling one million lamps by 2017” (Total, undated).⁹ SDN does not accept funding from oil companies; however, we can learn lessons from Solar Sisters’ experience. **Utilising an existing recognisable institution’s marketing network is an avenue yet to be explored, and could provide us with a valuable lesson for our operational model.**

7.7 Barriers to the solar market

Carrying out the fieldwork highlighted a range of barriers to the solar energy market; one example was the weather during the fieldwork, since poor road surfaces after torrential rains severely affected sales (as well as slowing the field research).

7.7.1 Black market

Black market fuel sales are prevalent in the community. Since this fuel is cheaper in the short term it could represent a barrier to the expansion of the solar lantern project.

7.7.2 Lack of trust

Lack of trust is one barrier to people’s participation in the portable lantern study. Rivers State interviewees face the challenges of poor governance, limited service delivery

⁹ For the Total Access to Energy Program see www.total.com.ng/service-stations/shop-food-services/solar-lanterns.html

and environmental devastation. Deep-rooted mistrust in the Delta region stems from exploitation of resources by international oil companies, maltreatment by government, land rights and tenure issues and political tussles between cult gang leaders. There are ongoing low intensity local conflicts fuelled by inter- and intra-community conflicts over oil-related contracts, political contracts and political control. This conflict continues to undermine communities' trust in their local government and efforts centred on renewables.

7.7.3 Negative perceptions of solar power

The most significant barrier to the solar energy market is local people's ingrained negative perceptions of solar power. Where have these perceptions come from?

While the previous engagement of the Federal Government of Nigeria in the renewable energy sector may appear significant in scale, it was characterised by poor quality standards and patronage by contractors, so it has not necessarily had a constructive impact. For example, the nationwide solar street lighting initiative has been disastrous. Project implementation and product design and installation were poor, with little technical oversight and monitoring. This allowed a model of solar streetlamp to be mass-produced and installed countrywide which, ironically, could not handle the power of the sun it was exposed to.

There are numerous examples of other installations failing across the country, characterised by poor quality system design and installation, inappropriate procurement of installation, little or no training given to end users in the community, and a lack of maintenance (Newsom, 2012).

“SDN should provide advocacy workshops to lobby the government to install the solar lanterns correctly. The solar street lights demonstrate that solar can work. But there were issues with the installation which means the lights were faulty. This affects what people think about solar and its outputs. There was no sensitisation on the benefits of solar prior to SDN's work in Mgbuoba” – Rita, Mgbuoba.

These projects are highly visible, particularly in southern communities, and public perceptions of solar projects have been significantly damaged. This bad reputation presents a significant challenge to aspirations for widespread uptake of solar power.

Actions point: Lobby government for correct installation. To overcome these perceptions, the potential of renewable energy must once again be instilled in communities. This will require promoting high-visibility 'best practice' projects with high-quality delivery, supported by user education.

8

Establishing a sustainable business model

A key 'process-based' lesson from our field research was on the sustainability of the lantern distribution model.

8.1 The NGO model and the sustainable business model

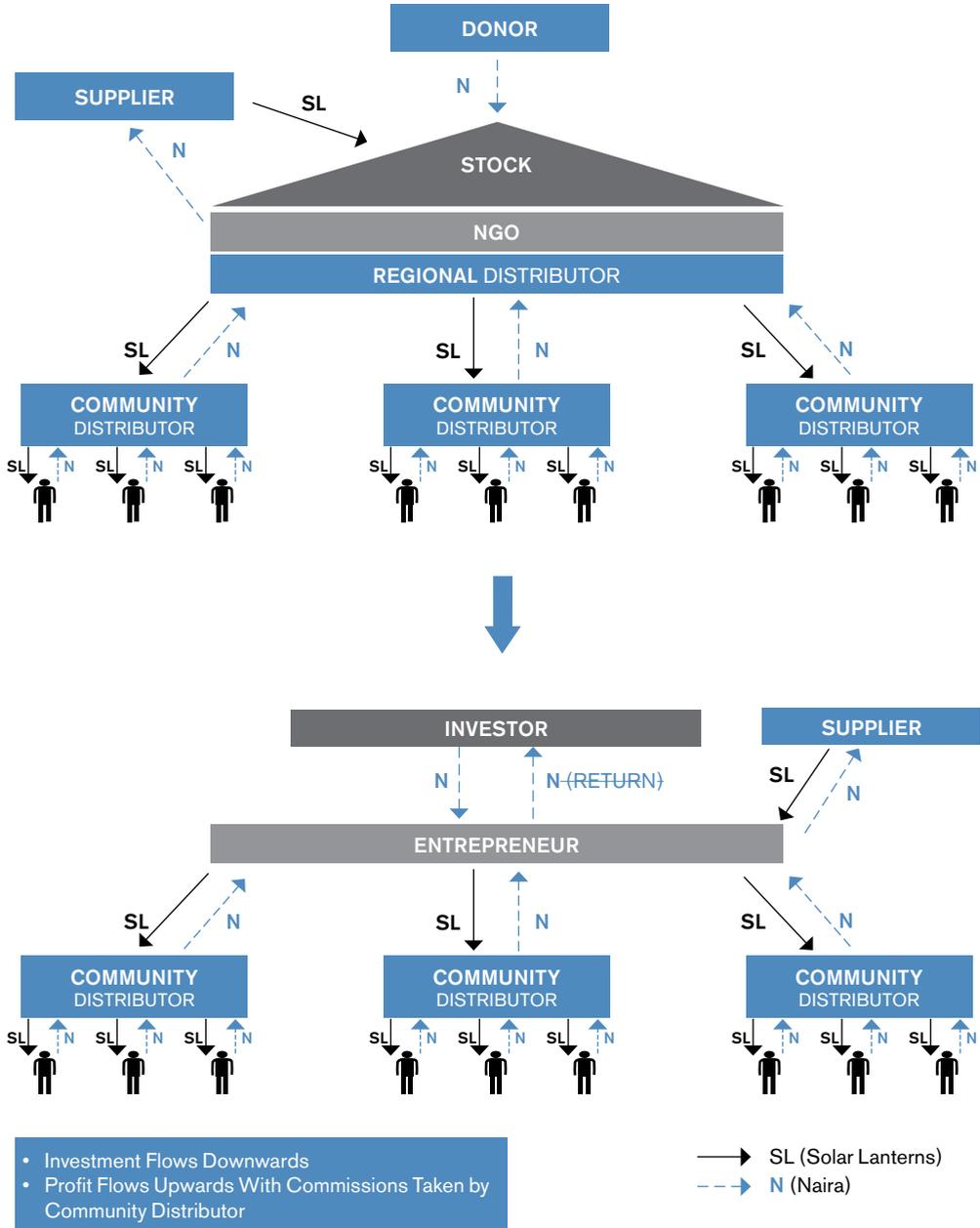
As mentioned in Section 2.3, the current structure of our solar lantern distribution is a 'NGO model'; products are distributed from SUNGAS, the donor, through to end users. A regional distributor sources products from the stock house and makes them accessible for community distributors to sell locally, with revenue generated circulating throughout. However, maintenance of the stock house currently relies on a donor and a supplier. In its current form, the model is therefore not self-sustaining.

To overcome this, we propose a sustainable business model (Figure 12). The main departure from the current model is the introduction of local privatisation. Rather than relying on a donor to keep stock afloat, individual entrepreneurs are given assistance to source investment and a supply of product themselves, which they can then sell directly to community distributors.

With this change it is envisaged that the financial benefits accrued through transactions will go directly to those engaged in the procurement and distribution of the products. What is more, within this business structure the potential reach of an entrepreneur is far wider than an NGO could aspire to. This could thus result in wider awareness, dissemination, and uptake. Ultimately the model will be sustainable, as dependence on donor and NGO has been removed.

However, SDN argues that the NGO and sustainable business phases are mutually reliant. In other words, it is a two-phase model, where the NGO phase is as important as the sustainable business model phase. The NGO role is essential for start up; to initially manage stock, build on networks of trust in the community and support the community-based entrepreneur with financial reporting prior to transitioning into the 'investor-based' structure.

Figure 12. The NGO model transitioning to the sustainable business model



8.2 A viable business model for solar lanterns in the Niger Delta

Based on the field research, it seems that lantern distribution could have sufficient profit margins to operate as a viable business model. We modelled this scenario, based on the following assumptions drawn from our research:

- initial investment of stock required to begin business
- products sold at full market prices
- only Sun King Pro and Schneider products sold
- finance agreements available to customers with a 40 per cent initial payment
- maximum and minimum stock levels identified, with profits reinvested into working capital and stock (to keep it constant)
- fixed costs of transport, communication and a 30 per cent contingency on these costs
- no storage costs as the entrepreneur is assumed to store at home.

Small-scale businesses would act as distributors – working with existing suppliers as they would not want the risk of importing products. Large-scale suppliers are already set up for imports and can manage customs and import risk; beyond a certain size this would also bring economies of scale.

This model confirms that selling solar lanterns could be a viable business, providing monthly profit margins of up to N294,935, or US\$1,482 (see Table 6).

8.3 Private sector potential

There are a number of structural reasons why this ‘privatisation’ combined with donor support can be particularly successful in the Nigerian context. Market-based activities, such as commercial business activities and financial service provision, have the potential to ignite innovation and deliver solutions to development challenges – through reducing poverty, enhancing livelihoods, protecting ecosystems, providing access to affordable goods, and extending services across hard-to-reach areas.

With this in mind, governments and development agencies worldwide are harnessing strategic alliances with the private sector to streamline development activities. Under effective regulation, businesses are in many cases able to provide services and alleviate the strain on oversubscribed governments. There are international and national policies aimed at encouraging private actors. Examples include the United Nations Framework Convention on Climate Change Private Sector Initiative to catalyse the role of the private sector in climate adaptation; and the World Bank Climate Investment Funds and the Global Environment Facility which promote

Table 6. Estimated monthly earnings from selling solar lanterns

CAPITAL INVESTMENT (N)	(N)	NET PROFIT MARGIN
559,000	0	0%
913,750	47,784	10%
1,343,750	111,565	15%
2,580,000	294,935	20%

private sector climate finance for resilience. The Federal Government of Nigeria can support this sector by ensuring an enabling environment for small and medium-sized enterprises (SMEs) and informal businesses to operate. It also has the potential to direct progress by incentivising entrepreneurship and investment through subsidies and favourable financial arrangements.

This approach supports a wide-reaching virtuous cycle of development. As these businesses develop they increase employment and the amount of money circulating in the economy, which in turn supports other livelihoods. Not only do they create value, but it is also distributed through the market chain. This builds self-sustaining market chains that are more robust, efficient and resilient, which benefit all participants, while reducing dependence on donor support.

Business-based approaches are flexible and can respond to demand, and a community's ability to pay – but in many cases they do not respond to broader customer needs where energy is only one piece of the puzzle. What is more, a free-market approach alone is often

not sufficient. Local capacity is key to realising benefits of new opportunities and remains an area that requires more extensive support than the private sector can or is willing to provide. Distribution and sales of solutions are quick and easy wins under the correct market conditions. Building these conditions in the first place can require 'pre-market' participation of other actors such as government – and as we have seen in this example, NGOs.

It is also the case that selling products in a market place has directly quantifiable outcomes which play better to the strengths of businesses. Larger and more complex questions such as how to build resilience to climate change are more likely to be of interest to development agencies, governments and NGOs, than the private sector. The participation of these public and NGO organisations may help to better steer markets in directions that begin to address these more complex questions. As has been discussed in the solar lantern model, it may help to foster 'pre-market' conditions to allow for a private sector model which delivers more appropriate and better quality products to poor users in the Delta.

9

Community impacts

As well as the *process-based* findings described in the last two sections, carrying out the field research yielded findings on *outcomes* of the lantern distribution in our focus communities. As the EDM principles state, an energy delivery model is explicitly designed to have a positive human development impact, creating health, education and livelihood benefits. The following section identifies how the use of solar power has impacted SDN's core communities.

9.1 Education

Energy poverty is a significant barrier to youth education and empowerment across Rivers State. The SDN Solar Lantern Distribution Model works to increase parents' access to portable solar lanterns in order to increase

productivity after dark. As we attempt to track the reach of the lantern distribution network and penetration of the market, we have yet to monitor education or examination progress in core communities. However, from surveys and key informant interviews we can deduce the following learning outcomes.

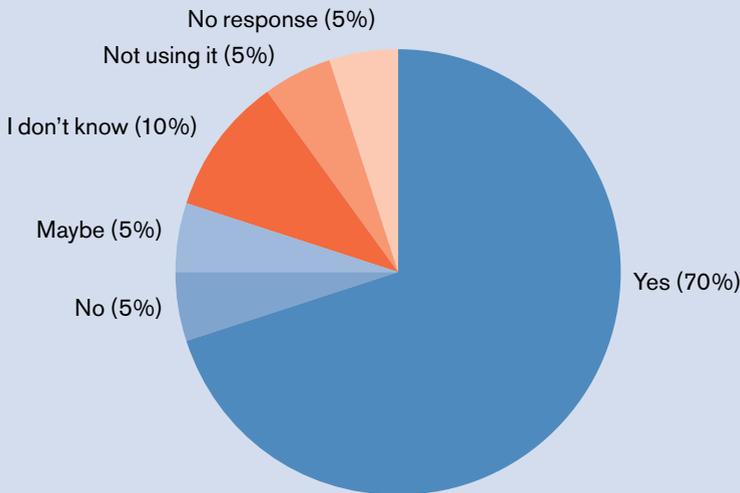
9.1.1 Solar lanterns versus 'native lamps'

Compared to kerosene lanterns, respondents note that solar can improve children's ability to study and complete assignments in the evenings (see Figure 13). However, interviewees claim that learning achievement does not correspond directly with the availability of light. Users of kerosene lanterns in semi-urban communities do not attribute lower learning outcomes to a lack



Icheche and Goodnews
Wiche's Family, Odouha,
Rivers State

Figure 13. Perception of solar lanterns as a better aid to study than other energy sources



of light, but to poor infrastructure, namely the state of school services, water sanitation and health services. Still, 70 per cent of respondents state that solar lighting provides a better study environment.

“Sporadic electricity has a negative effect on education because schools don’t get proper power supply to facilitate proper learning using their devices, they have to run on generators which sometimes can’t power all their devices. My kids make use of the generator for their homework when they get back from school” – Ezekiel, Rumunduru.

9.1.2 Increase in evening productivity

All respondents note that the time devoted to studies in the evening has increased. On average, the number of hours spent on studies and evening activities has increase from 0.5–1 hour to 2–3 hours. As a noiseless and smokeless product, the popular Sun King Pro and Schneider lanterns promote a clean

working environment, improving productivity in the household. The “brightness of the lantern is better than kerosene”, voiced one community member, meaning that, “my children do not have to crowd around the light.”

“Prior to solar, my kids use candles and kerosene for after school assignments which isn’t too convenient and most times they fall short of doing assignments because of power shortage” – Joe, Mgouba.

“The children are able to complete assignments in the evening and also have a longer length of reading practice” – Ezekiel, Rumunduru.

“It has provided light for my children to use at night. They use it to read and do their homework” – Rita, Mgouba.

“It helps us read at night when there is no power” – student, Rumukwache.

9.1.3 Redistribution of resources

Families can reallocate funds spent on candles and fuel to school tuition and materials.

“It helps in curbing spending on fuels, kerosene and battery and it has encouraged spending on school fees” –Chima, Oduoha.

9.1.4 Christerbel's International Academy Night School

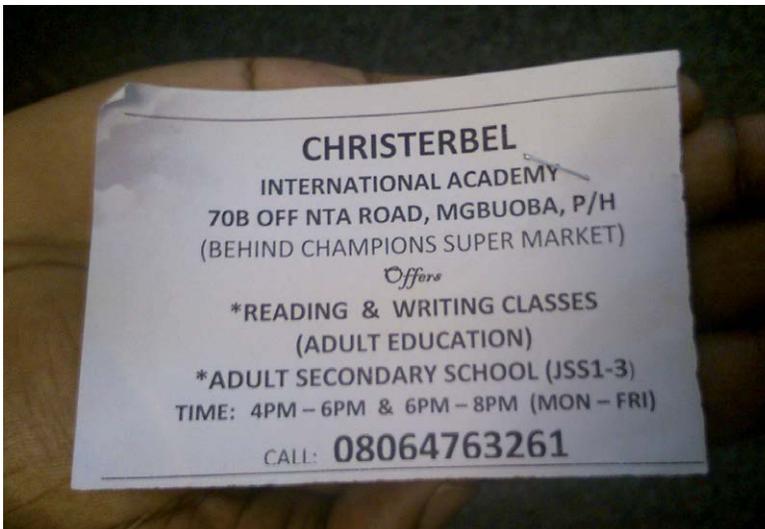
Although the portable lanterns cannot satisfy all the energy needs of an urban area, quantitative data show that they contribute to a positive after school working environment. In Mgbuoba Community, Mr Abel the Head Teacher at Christerbel Primary School, used his Schneider lantern to turn his primary school into a night school for adult education. Abel's 'reading and writing classes' support skills acquisition for small-scale business entrepreneurs and market women in the community.

“I run a primary school and the Schneider lantern means I now run an adult evening school [the International Academy Night School] at no extra cost. I use my generator

for light, fan and TV to view educational films, to power the school printer and other smaller appliances which costs me N8,000 per month. Since the introduction of the solar lanterns, I use the Schneider lantern for night classes. My primary outgoings are for printing materials. I also use solar lanterns to charge my rechargeable fan because it has the same jack as my Schneider lantern. I haven't used my generator in the last two weeks” – Abel, Mgbouba.

As a result of Abel's night school, his workload and working hours have increased, but these are offset by the ease of managing administrative tasks. As well as facilitating a clean productive learning environment, the Sun King Pro and Schneider are a learning tool for the demonstration of how renewable technologies work.

“The solar lanterns have brought increased learning in Mgbuoba, not only functioning as a reading lantern but also understanding and enlightenment on new and innovative technologies” – Student, Mgbouba.



Leaflet for Christerbel's Night School

9.2 Environment

Out of the 15.3 million Nigerians without access to the national grid, 90 per cent live in rural communities. Current energy consumption therefore remains dominated by traditional biomass fuels such as firewood, which constitutes 83 per cent of total primary energy consumption in 2011 (EIA, 2014) – while expensive generators are used to supplement supply for short periods of the day. Reducing the use of traditional sources of fuel through the solar initiative would be beneficial for the reasons outlined below.

9.2.1 Household air pollution

“The solar lanterns were originally designed to replace the kerosene lanterns, but in this community most of the people who got the solar lanterns never had to use the kerosene lanterns. But for me, solar lanterns have helped to reduce my overdependence on generator; now I put on my generator later than I used to, and it has also reduced the level of pollution in the environment” – Rita, Mgouba.

This feedback from Rita highlights a number of important messages. Firstly, the solar lanterns are being used as an important alternative to kerosene lanterns. This is a significant step for the health of everybody within participating households. Inhaling fumes from a kerosene lamp is the toxic equivalent to smoking between 3 and 20 packets of cigarettes a day. Moreover, the World Health Organization estimates that 95,300 people die annually from biomass energy smoke in Nigeria (WHO, 2007) – the third biggest killer after malaria and HIV/AIDS. A shift from inefficient traditional fuel uses will therefore have significant health benefits. It is often younger children who suffer most from kerosene pollution, with children under five years old accounting for 50 per cent of indoor air pollution deaths, contributing to a 2 in 1,000 increase in child mortality (WHO, 2002).

Secondly, a decline in individual lantern use could significantly reduce the impact on climate change. The black carbon emitted from kerosene lantern use amounts to roughly 115 kilograms of carbon dioxide per household per year (SolarAid, 2013). Worldwide use – with 290 million people using kerosene as their main source of lighting – contributes more to climate change than all the carbon dioxide released in the UK in a year.

The feedback also highlights the efficiency of the distribution model. Within the communities there was a long-standing demand for a better energy supply. This demand was not met through the supply of the most widely available source, namely kerosene lanterns. The solar lanterns were able to respond to this demand, while also providing an alternative that has enabled individuals to ‘leapfrog’ the insufficient, expensive and often damaging options, such as kerosene, that are most widely available.

9.2.2 Air and noise pollution

After biomass and kerosene use, the most commonly used energy source in Nigeria is diesel generators. This source is often used to supplement the erratic grid supply and is used by households, communities and businesses alike. About two-thirds of all electricity in Nigeria is created by these ‘backyard’ generators.

This source carries negative cost burdens for families and businesses of around US\$13 billion a year. This is problematic since a constant electricity supply is fundamental to wellbeing:

“Some children find it difficult to sleep at night without [a] fan. Their parents need to ensure that they have fuel in their generator always. They also spend a lot of money to buy fuel to cool their fridge and freezer” – Amos, Rumukwache.

These generators are also a major source of noise pollution and air contaminants. Since they mainly serve individual households, they must be placed nearby. The close proximity of these generators increases the households’ exposure

to the combustion emissions. Heavy reliance on this source throughout the year creates frustration and limits household wellbeing.

“Lack of power supply has caused a lot of environmental pollution, the emission of carbon monoxide into the air and the noise pollution is really tiring and annoying most times” – resident, Rumunduru.

“The generator has a bad effect on the environment because of its carbon monoxide emissions which makes the air unsafe for breathing, the noise is very uncomfortable and annoying too” – teacher, Rumunduru.

“It is very unhealthy and discomfoting. It infringes on ventilation in my home because we have to close up all the windows when the generator is on” – Ezekiel, Rumunduru.

Solar lights are seen by communities as a positive solution, and have the potential to save rural African families on average around US\$70 per year. As Nigeria is endowed with annual average daily sunshine of 6.25 hours, receiving about 4.851×10^{12} kilowatt hours of the sun's energy each day, families can rely on their lanterns to provide a steady supply of light. Encouragingly, there is wide exposure to these technologies in the area, and 95 per cent of interviewees understood the environmental benefits of solar products. However there are many poor quality products in the informal markets which impacts perceptions on whether solar works or is reliable.

Moreover, as an alternative to generators, the solar lanterns eliminate the nuisance of constant noise and vibrations that disrupt sleeping hours. Interviewees also associate solar products with cleaner air:

“Unstable power also affect the health of community people because during the dry season, everywhere will be hot and people find it difficult to sleep without fan, it leads to different diseases and people started looking for drugs. This dry season starts from October till February” – Amos, Rumukwache.

“My family can sleep and breathe better. There is less noise from the generator which can disturb us” – Chris, staff, SDN.

“The house is calm, no noise and less spending” – Alhaji Shehu Ahmed, Port Harcourt.

“Noiseless environment, nothing like smoke from generator” – Charles Veronica, Port Harcourt.

9.2.3 Reduced conflict and safer streets

The risk of violence would decrease with more lighting in urban areas, particularly in townships, spontaneous settlements and other notably dangerous areas. The safety in school premises in Mgbuoba has improved because of increased use of solar lighting, namely through less fire risk from kerosene lanterns and a reduced risk of snake bites. They also ensure safe toilet use at night.

“The children are more independent now. They can visit the toilet at night time using the solar light, without having to wake me or my wife up” – Joe, Mgouba.

9.2.4 End-of-life disposal of products

One consideration of using solar lanterns is that all the units have batteries. Disposing of them at the end of their useful lives poses a high risk to health if chemicals from the cells are extracted and come into contact with the skin, or worse, if ingested in a gaseous or solid state.

“Interestingly, community groups failed to think through the disposal of batteries – not of concern to end user” – Hannah Kabir, supplier, Creeds.

Waste disposal is currently a problem in the Delta, with a culture of disposal by burning instilled through generations of biomass use. Unlike organic matter however, which is easily burned, burning plastics and electronic waste carry a high risk. Avenues for recycling and proper disposal must therefore be incorporated into future implementation.

10

Expanding into rural communities

Having gained an understanding of the challenges of our model in the semi-urban settings of Rumunduru, Rumukwache and Mgbuoba communities, Oduoha Community acted as a pilot area to extend the reach of the portable lanterns into a rural setting. Our baseline study had assessed energy use behaviour, energy supply in the area and existing perceptions of the solar programme. Through the lens of the Delivery Model Canvas, SDN plans to adapt the lantern distribution model to Oduoha end users' specific income bracket, appropriate channels of communication, and means of payment.

10.1 Power supply in Oduoha

Oduoha community is on the grid – PHED installed two transformers in the community, but one is damaged. The community's Electricity Committee members Chingozie and Augustin explain the issue:

"The community has two transformers. This area that the transformer [is] faulty, we don't have light for weeks now but the other side is having light" – Chingozie Osigbo, Oduoha.

"There has been constant power supply in our community but one side of the community has



Oduoha Community



Damaged Transformer
Oduoha

been in total blackout since we had a problem with our transformer. A land owner levelling his land affected the poles near the transformer which cut off power supply” – Augustin Wiche, Oduoha.



Augustin Wiche, Member of the Electricity Committee

The Electricity Committee are set to lobby their LGA representative for a replacement pole, allowing PHED to rewire the connection. The destroyed pole indicates intra-community maintenance and communication disputes.

As the Electricity Committee affirm, decision making is channelled through the Community Development Committee (CDC). An Oduoha citizen stated that, “in order to get our voices heard, we activate our ‘sons of the soil’ network”; the Nigeria Labour Congress chairman is from the community. Moreover, the international oil company Shell operates in Oduoha. It seems the community is not informed of oil company activity. It is common in rural communities in the Delta for oil companies to cover electricity costs in areas where they operate, perpetuating the view that international oil companies function in the place of government.

“We have Shell location in our community here but they have not started using it. They have done everything but they have not started drilling. We don’t know whether they have started drilling the oil” – Chingozie, Oduoha.

The solar lantern distribution model would adhere to local decision-making structures. Prior research would encompass wider stakeholders such as the LGA and international oil companies present in Oduoha.

Bar the destroyed transformer, electricity supply is notably more reliable in Oduoha community, due to a smaller population and less need for electricity. The farming community rely heavily on biomass, firewood and kerosene for cooking, and interviewees state that the daily routine is adapted to daylight hours.

PHED uses a 'bulk billing' system. Each month when a general bill is sent to the community, the electricity committee divides the amount amongst the different households. This usually apportioned according to the size (one, two or more rooms) and type (residential or business) of the building. . Each resident pays between N500 and N1,000 per month. To provide a comparison with their urban counterparts, 66.7 per cent of Rumunduru and 70 per cent of Mgbuoba people pay more N2,000 per month, with 33.3 per cent of Rumunduru and 30 per cent of Mgbuoba people paying more than N5,000 per month. In semi-urban Rumukwache, 50 per cent pay less than N1,000 per month (see Figure 14).

For Oduoha, kerosene accounts for three times the cost of electricity, used for 'native lamps' and cooking. An average Oduoha household spends "N3,000 on kerosene stove per month" –Resident, Oduoha

Access to fuel is problematic due to the community's remote location. Black market fuel sellers operate in the area as well as artisanal oil refineries, producing 'illegally' refined kerosene and petrol, increasing the likelihood of accidental combustion.

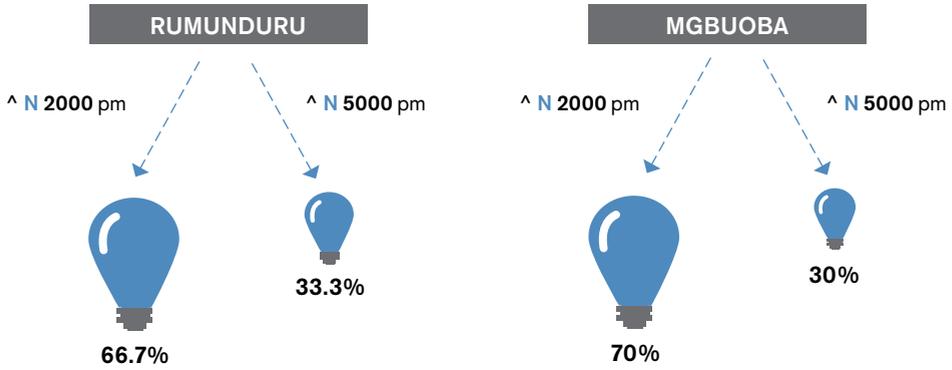
Mgbuoba community member Rita is quoted above as thinking that the portable solar lantern project was targeted at generator users in urban communities. In Oduoha, portable lanterns could instead substitute kerosene lanterns. Currently rechargeable torches and 'native' lanterns are commonly used in the evening for reading and checking for snakes when returning from the farm. Solar lantern distribution could be moulded around the more affordable Sun King product.



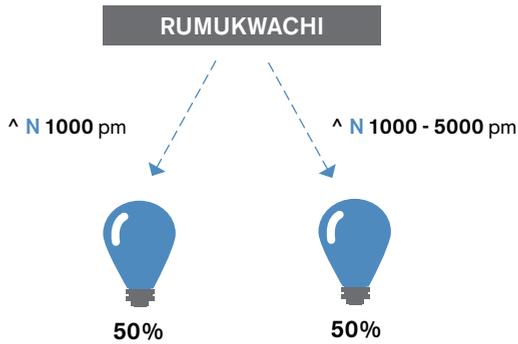
Oduoha Farm worker

Figure 14. Monthly spending on electricity bills per household

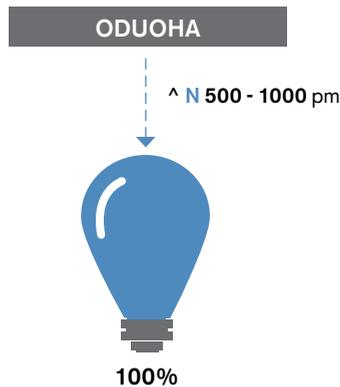
URBAN COMMUNITIES



SEMIURBAN COMMUNITIES



RURAL COMMUNITIES



“Solar lanterns should be promoted as a safety device that people could use to check for snakes on their way back from their farms at night” – Chima, Oduoha Community.

10.2 Adapting our model to Oduoha

Focus group discussions outlined some potential adaptations to our model to suit an end user specific to rural Oduoha:

- Community testimonials should be shared through word of mouth, using informal social networks.
- Community sensitisation should target market women and farming groups.
- Potential public places to demonstrate the lanterns include Oduoha Anglican Church and town hall, which are central meeting spaces for the community and have high public footfall.
- The marketing distributor could use ‘in-kind’ physical resources by storing lanterns in community representatives’ homes.
- Promoting a single product simplifies the strategy.
- Payment should be structured through instalments and monitored by the Electricity Committee as influential stakeholders in community development.
- Training should be provided in operating and maintaining the solar lanterns.
- The role of women should be promoted in the distribution of lanterns and entrepreneurial skill sets.

“The farmers should be taught about solar because they would use it when returning from the farm at dusk. The Oduoha people go farming three times week for yam, cassava, cocoyam, okra, vegetable” – Ichiche, Oduoha.

Demonstrator Augustin Wiche first piloted the Sun King lantern in Oduoha. His savings of N15,000 over eight months now “pay my children’s school fees, for shelter and clothing”.

‘Word of mouth’, ‘town crier’ and ‘door-to-door sales’ were terms frequently used across the community. These neighbourly recommendations and social networks “portray the informal economy as alternative forms of regulation operating outside the framework of the state” rather than “representing economic informality in terms of absence of regulation” (Meagher, 2005: 3). The Electricity Committee manages PHED payments, an arrangement which works well, arguably due to the “tight communal groups, relationship of kinship and friendships that can reduce the transaction costs of economic activities”, such as marketing and business contacts (Meagher, 2005). The members of the Electricity Committee were therefore identified as ideal distributors for the solar lanterns in Oduoha.

The Electricity Committee formed a strategy with SDN’s market distributor, Hamisu Usman, for distributing solar lanterns in the community. The Chairman of the Electricity Committee felt that marketing the solar lanterns in Oduoha was viable. Respondents advised a ‘reduced price’ and/or payment plan by instalments. Hamisu Usman engaged committee members as local distributors and agreed on the terms of engagement; he then supplied the Electrical Committee with stock (with no initial capital outlay from the committee). In order to simplify the model, only the small Sun King lantern will be sold. Using the Electricity Committee’s network and monthly payment collection for PHED bulk billing, the chairman agreed that instalments for the solar lantern will be paid using these existing channels. The committee has the scope and flexibility to add commission independently of the marketing distributor. After sales of initial stock, money will be remitted to the regional distributor who will re-stock accordingly.

10.3 Recommendations for marketing in rural communities

Having seen our portable lighting project through the lens of the EDM framework, our approach will be different in rural communities. For instance, we would engage community people prior to forming our marketing strategy. Once the market distributor has had initial input in a community, demonstrations and personal recommendations are an effective informal channel. However, social media is arguably isolating for rural and off-grid communities. Preferred advertising methods in the rural context include:

- through family organisations
- installing demonstration solar lighting in public spaces with high footfall, such as a health clinic, church or night market.

- mobile advertisements on bicycles
- advertising via SMS
- slogans in pidgin and local Ekiwerre languages
- radio advertisements on Nigeriainfo.fm¹⁰ and TouchPH¹¹
- specific community ‘mouthpieces’ – market women are influential in their buying habits and are ‘vocal’.

“Pidgin advertisements on the radio” – Chingozie, Oduoha Community.

“I think the house-to-house method of advertising will be more effective. The information on the benefits will be passed on through word of mouth” – Linda Evro, Oduoha Community.

¹⁰ NigerianInfo Fm is currently the talkback Radio Station in the Niger Delta that is most tuned in to. It broadcasts local and international news with a blend of talk and sports shows, while also addressing current affairs and topical issues.

¹¹ TouchPH is the biggest and most vocal online community in Rivers State. It has over 21,500 followers on Twitter and its website receives tens of thousands of hits daily.

11

Next steps

This section looks at alternative and parallel solar energy schemes, and ideas for scaling up the current model of solar lantern distribution. This is followed by next steps in research for SDN and its partners, and a look at the future of Nigeria's solar energy sector.

11.1 Alternatives, parallels and scaling up

11.1.1 *Micro-grids and more*

A micro-grid is a form of embedded solar generation which is unregulated in Nigeria if it produces less than one megawatt of power. Interviewees had limited knowledge of micro-grids. Following the introduction of portable solar lanterns, a scaled-up version using micro-grids could serve to provide rural communities in Rivers State with clean light and mobile phone charging functions. Brian Shaad of Mera Gao Power installs micro-grids in Reusa, India. He states that, “while alternative solutions, such as individual solar-powered lanterns, can also provide light and charge phones, the advantage of a micro-grid is that the installation cost can be spread across a village. The system can also use more efficient, larger-scale generation and storage systems, lowering operational costs.”

The socio-cultural contexts and enabling environments of Reusa and Kendrapara in India differ from Rivers State in their levels of relative poverty, product prices and import taxes. However, we can still glean lessons from Mera Gao Power for solutions to energy poverty.

In the Delta, Solar Sisters and Green Village operate in this space. To scale up the solar lantern distribution model, a potential technical partnership with Green Village could look to serve off-grid communities in the Delta and Bayelsa State. Installing larger solar panel installations, with costs shared across communities, could meet rural people's energy requirements, make renewable energy accessible and create job opportunities through the installation, maintenance and payment processes.

Entering into riverine, off-grid and isolated communities requires dedicated and sustained engagement with community people. An inception phase is pivotal in order to understand and respect local decision-making structures; community hierarchies must be adhered to. A crucial first step in our programme would be to conduct a baseline feasibility study, without provoking hostility, in order to understand informal money flows and disposable income. The greatest challenge in potentially hostile villages is safety.

One possible rural area to pilot the portable lighting model is Nembe Island, Bayelsa State. SDN has already worked in Nembe alongside the United States Bureau of Conflict and Stabilization Operations, when Nembe communities participated in a 13-part documentary series to promote non-violent civic activism in the Delta called *Dawn in the Creeks*.¹² This existing relationship could be a starting point.

12 See www.dawninthecreeks.tv

11.1.2 Clean cook stoves



Odouha Cook Stove

Expanding our model into rural communities could be strengthened by also promoting clean cook stove initiatives through solar. Respondents in more rural and remote locations complain of smoke impact on households. The Clean Cook Stove Alliance¹³ and Solar Sisters¹⁴ support solution-driven initiatives in Nigeria. In line with SDN's Community Empowerment Model and solar distribution model, The Clean Cook Stove Alliance supports "training on the operation and maintenance of clean stoves" and women's livelihood empowerment. In the light of our model, solar powered or clean fuel cook stoves represent an opportunity for further research.

11.2 Follow-up activities

The model and research to date suggests a number of follow-up activities that will further test these lessons and help prove a viable market that takes real-world community conditions into account. These range from continuing with activities that are essentially 'confidence building' in both solar and the particular marketed items, through to higher-level efforts to improve market conditions and price options. Further research is needed:

- **Micro-grids:** Green Village Electricity (GVE) is piloting innovative solar-based energy solutions, demonstrating the affordability of solar power in rural areas in the Niger Delta. GVE's model offers ideas as to how the distribution of 'small solar', such as lanterns, could be an initial phase in the transition to a solar grid system.
- **Expanding into Nembe Island:** SDN's work in rural communities on governance and conflict projects also gives it opportunities to further test the refined delivery model in rural communities that are well beyond the grid. Some of them like Nembe Island (Bayelsa state) and Ozoro (Delta) have intermittent community generator services but are also likely to be candidates for long-term complementary power options – especially lighting. As oil 'host communities', it is conceivable that there could be significant sponsors for subsidised light schemes, and household incomes will vary markedly.
- **Lantern user manuals:** SDN is still not satisfied with the quality of consumer information and manuals provided with small solar products. Otherwise innovative manufacturers often let themselves down by providing user guides that are either too simplistic or do not contain critical information. SDN proposes to write at least one user-friendly guide to small solar products that will also cover the specific essentials for the most popular four or five products on the market. It is hoped this will improve how customers make use of their product and lead to a swifter resolution of any problems.
- **Environmental issues:** A consistent deficiency across all the solar lantern manufacturers that we are aware of is the absence of any battery recycling and disposal schemes for Nigeria. While this is understandable for many companies

¹³ See <https://cleancookstoves>

¹⁴ See www.solarsister.org

who have just arrived, it is an area that should be addressed by any companies who claim to be producing environmentally sustainable products. SDN will be engaging manufacturers, local authorities, distributors and recycling entrepreneurs in order to address this issue.

- **Pilot a for-profit model:** Pilot our solar distribution model as a for-profit enterprise with corporate investors, targeting women's networks and women's groups as key community-based distributors. This will further test the EDM framework and the CORDAID/SDN Community Empowerment Model being used with a focus on women's rights and livelihood empowerment. This will remove the challenges of being perceived as a 'non-profit charity' selling products.
- **Provide access to credit schemes** for small-scale business entrepreneurs to assist with the move to a sustainable model.

11.3 Moving forward

With government policy increasingly geared towards reducing its interference in investment and ownership, it is crucial to move focus for the best solutions from government initiatives to the supporting actors in the marketplace.

In addition, the technical focus has now shifted away from improving experimental products. Thanks to technological innovation in solar panels, bulbs, batteries and other components, the price of end products has dramatically reduced over the last decade. In the last four years alone the cost of a single solar lantern has reduced from US\$100–500 to around US\$25. This dramatically lower price makes the transition much more justifiable for low-income households.

The emergence of competing products of varying power has the potential to provide meaningful gains for differentiated individual

demand. The challenge is to make packages relevant and visible to household needs, incomes and aspirations. This cannot be done without consumer and distributor awareness about the value of these new products in meeting different energy needs. Consumer (and distributor) education should therefore be incorporated into any renewable energy strategy. As seen in this study, there can be a role for NGOs in helping understand this value based on locally specific needs, in raising awareness through brokering trusted relationships, and building the capacity of local distribution networks.

One key factor keeping the costs of installation high is the lack of competition in the solar sector. Yet the overall costs of labour in Nigeria are relatively low. This signals a potential area for investment in this sector. With an increasingly automated manufacturing sector, jobs in the renewable sector are increasingly being created in installation and maintenance. Training technicians who can provide a professional and affordable service will therefore drive down the cost of installation and improve efficiency.

Moving forward, success in Nigeria's renewable energy sector will ultimately rely on good, experienced specialists who are able to promote and support renewable energy projects across wide areas. These kinds of actors are rare in Nigeria, and remain isolated. Supporting entrepreneurship of small and medium-sized businesses through technical and financial assistance will help get these kinds of schemes off the ground.

Once this process has started it will increase the size of the sector, and in turn develop strengthened networks and supply chains, facilitating future investment and growth, building confidence in the market and a virtuous cycle of demand and market development.

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Annex 1.

Solar lantern specifications

PRODUCT IMAGE	NAME AND DESCRIPTION	PRICE
	<p>Sun King Pro</p> <p>Bed Light Mode 20 Lumens (15 hours after charging mobile phone fully. 30 hours (lighting only).</p> <p>Normal Power 40 Lumens (6 hours after charging mobile phone fully. 12 horus lighting only).</p> <p>Turbo Power 100 Lumens (3 hours after charging mobile phone fully. 6 hours lighting only).</p>	N5,500
	<p>Waka Waka</p> <p>Provides 16 hours of safe and decent reading light on less than a day of sunlight. Ruggedized, water resistant, it can withstand extreme environments.</p> <p>200% brightness (120 lumen) super bright torch mode. 100% brightness (60 lumen) bright ambient light. 50% brightness (30 lumen) bright reading light. 10% brightness (6 lumen) soft night safety light.</p> <p>SOS emergency beacon</p>	N3,500
	<p>Schneider</p> <p>Indiya single light (Lighting Africa certified)</p> <p>5W light with 90 LEDs with 630 lumens light output. 20 years LED life (avg. 5.5 hours usage per day).</p> <p>10W Panel.</p> <p>2V–5Ah SMF battery provides 8 hour backup</p> <p>Suitable for home lighting, department stores/shops, hospitals, hostels, hotels</p>	N13,000

Annex 2.

Field work methodology

Three focus group discussions, 20 key informant interviews and 40 applications of a survey questionnaire were devised and directed at both rural and urban communities, namely: Rumunduru, Rumukwache, Mgbuoba, and Oduoha. This section breaks down how the Delivery Model Map questions were adapted, determined by whether they are urban or rural.

Adapting questions for urban and semi-urban communities

A basic surveying method was chosen to provide both qualitative data and quantitative data with regards to the communities where pilot projects were implemented. Personal surveys were used to assess demographic composition, local awareness and capacity, customary practices, user preferences, community dynamics and attitudes towards public services and new technologies of both rural and urban communities.

Examples for these generic questions from our open survey are:

EDM HEADLINES	ADAPTED QUESTION
Baseline Perceptions of Solar:	"Do you have any knowledge on solar energy?"
Relationship to Energy Supplier:	"Are you satisfied with the number of hours of electricity I get from NEPA each month?"
Energy Usage Behaviour:	"Do you use your generator more than you get light from NEPA?"
Socio Cultural Context and Decision Making structures:	"Do men and women in the community work together to achieve community development?" "How effective is the organizational structure of your community?"
Challenges of Community Based Projects/ Willingness to Pay:	"Are you willing to pay more for stable electricity supply?"
Perceptions and entitlement from the state:	"Who is responsible for providing your household with electricity?"
Appropriation of Innovative Technologies:	"Do you prefer leaving things the way they are, and sticking with the same tried and tested methods?"

Analysing the survey questions:

- Quantified opinions and attitudes of a number of respondents across Rumunduru, Rumukwache, Mgbuoba and Oduoha communities.
- Enabled statistical analysis on the demographical composition of the target audience.
- Tracked the correspondence between demographic data, and different attitudes and experiences.

The interpretation of key statistics established the statistical relationship between the level of education/age/profession and the awareness of solar energy. Such data can be used as a baseline to identify future audiences.

Profiles of ‘end users’ assist our prospective widening of distribution and marketing strategy of solar lanterns. Quantitative data analysis was used to identify knowledge gaps to be addressed in depth during key informant interviews and focus group discussions.

Urban communities: key informant interviews

Again, questions centred on solar lantern use varied according to urban or rural audiences. Market distributor Hamisu Usman has engaged residents of urban communities Mgbuoba and Rumunduru since 2013. For this reason, technical lines of enquiry were directed at existing participants in urban groups in order to understand how to incentivise citizens to participate in SDN’s programme, such as how to engage small-scale market distributors within core communities to understand whether the business proposition is economically sustainable.

Examples of questions are below.

Targeting small-scale business entrepreneurs:	“Which of the solar products do you patronise?”
End-user experience of services:	“How would you rate/assess the current solar products?”
Monitoring positive human development impact:	<p>“How would you describe the impact of the solar products on your finances?”</p> <p>“How would describe the impact of the solar products on your town/community’s educational system?”</p> <p>“How would you describe the current solar distribution/ marketing strategy in your area?”</p>

Monitoring positive human development impacts shapes SDN’s perceptions of the local context in which we are trying to introduce our model. It can also be beneficial when building strategy for wider user buy-in. The following questions aimed to investigate:

<p>Developing our strategy</p>	<p>“If ineffective, what methods/ approaches would you recommend that SDN adopt to create more impact and allow for the replication of the project on a wider scale?”</p> <p>“What processes in your opinion can be put in place to increase community buy-in, sales increase, community usage and patronage and most importantly the replication of the project on a national scale?”</p>
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- Climate and farming seasons
- Needs for solar light versus clean cook stove initiatives
- Attitude toward the introduction of new technologies
- Access and affordability; payment plans and credit schemes
- Relationship and participation to oil company corporate social responsibility energy schemes.
- Intra and inter-community conflict and management structures.
- Potential channels of advertising; working in pidgin and local languages.
- Effective community sensitisation strategies.

Open-ended questions encourage respondents to give detailed description of their experiences and express their opinions. In order to cover a wide range of respondents with different socio-cultural backgrounds, SDN facilitated 20 structured and unstructured consultations, choosing interviewees from each community. Respondents included three SDN staff members, a supplier and a distributor. Key informant interviews significantly improved SDN's understanding of community dynamics, relationship between key stakeholders, underlying motivations and attitudes towards using solar energy. Combined with the analysis of statistical data, gaps in our model could be identified with regards to communication and modes of engagement and sensitisation.

Rural communities: ripe for replication?

The rural fieldwork aimed to understand the needs of farming communities, such as energy needs for light versus cooking, and identifying disposable income flows.

Surveys determined:

- Demographics
- General attitudes towards the use of solar energy as opposed to using kerosene lanterns
- Agricultural cycles' effect on waves of income

Focus group discussions

The team also used focus group discussions (FGDs) to generate fluid dialogue between the youth group, women's groups and community development committee members in urban communities and SDN staff in Port Harcourt. FGDs examined: project implementation, roles and relationship between users, business entrepreneurs and the market distributors. Example questions follow.

<p>Working with women's groups and youth groups to understand how to improve our model</p>	<p>“What improvements or changes do you think SDN should make to the way we are operating (customising products, wider range of producers, training)?”</p> <p>“Who should be our main target for the solar lantern sales?”</p> <p>“Are there any local customs, attitudes to change and risks that could affect our solar distribution project?”</p>
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Annex 3.

Community profiles

Mgbouba Community

Mgbouba is an urban community in the Obio-Akpor local government area of Rivers State, sharing boundaries with Rumuokwuta, Elioparawon, Rumuigbo and Ozuoba communities. With an estimated population of 1.5 million, residents' occupations mirror that of urban communities in the city of Port Harcourt City; including artisans, civil servants and administrative staff in the local government council. Mgbouba Community is a low to middle-income community. Average income is between N20,000 and N60,000 monthly.

Mgbouba is made up of three sub-communities – Rumuaghanorlu, Rumuevuorlu and Rumungwanwo. Although each has its own chairman, the three communities do not operate autonomously. Mgbouba is the collective representation of the three sub-communities. For decision-making structures, each of these communities has its own Community Development Committee and Youth Group. Field research attests that a cross-cutting women leader or women's group was not apparent. However, an electricity committee, managed by interviewee Joe Hardy, does represent Mgbouba community.

Ethnicity: Mgbouba residents share the Ikwerre ethnic nationality and the dominant language is Ikwerre – a distinct language only similar to that of the Igbos. However, due to population growth and migration to the urban centre of Rivers State, English and pidgin languages are common.

Access to media: Despite the unstable power distribution, generator-powered television and radio are used. Common radio stations are Nigeria Info 92.3 FM, WAZOBIA FM, and Rhythm 93.7. Residents have access to newspapers.

Political affiliations: The political division that led to the removal of local government chairman Nsirim and the appointment of a caretaker chairman Chikordi Dike by Amaechi, Governor of Rivers State, means that politically Mgbouba constitutes a mixture of the People's Democratic Party (PDP) and All Progressive Congress (APC).

Rumunduru Community

Rumunduru is an urban community in Obio-Akpor Local Government Area of Rivers State. The main occupation of the estimated population of 15,000 people is farming, while some of the residents are artisan and civil servants. The average income is between N15,000 and N50,000 monthly.

The community is headed by a paramount ruler, HRH Eze P. Okene JP, who is the general head of the community. The paramount ruler is assisted in the administration of Rumunduru by the Council of Chiefs, the Community Development Committee, and youth and women's groups.

Ethnicity: Ikwerre ethnic nationality.

Access to media: Nigeria Info 92.3 FM, WAZOBIA FM and Rhythm 93.7FM.

Political affiliations: See Mgbouba description

Oduoha Community

Oduoha Emohua Community shares boundaries with Elibrada, Ewekwu and Rumuoboju communities and is one of eight communities located in the Emuoha Local Government Area of Rivers State. Oduoha Emohua is a rural community inhabited by an estimated population of 8,000, mainly occupied in farming and fishing as their livelihood. Others are employed as artisans, teachers and civil servants. Incomes in Oduoha Emohua range from N10,000 to N35,000 monthly.

The community is ruled by a Paramount Ruler named Chief Oha Ferdenard Ogbuehi. The Paramount Ruler is supported by about 16 'Ofo Holders', who are representatives of various compounds in the community. The Paramount Ruler and the Ofo Holders discuss administrative and development issues and settle disputes and misunderstandings among community members. Additionally, the Community Development Council and youth groups play a vital role in the development of the community.

Ethnicity: As in Rumunduru and Mgbuoba, the community members hold the Ikwerre Ethnicity and speak the Ikwerre language.

Access to media: Despite the unstable power distribution that they experienced until recently, when they became connected to Choba Federal line, the majority has access to television and radio.

Political affiliations: The community was predominantly aligned to the PDP but they currently support both the PDP and APC. Moreover, Emohua Constituency is represented in the Rivers State House of Assembly by politician Chidi Lloyd.

Annex 4.

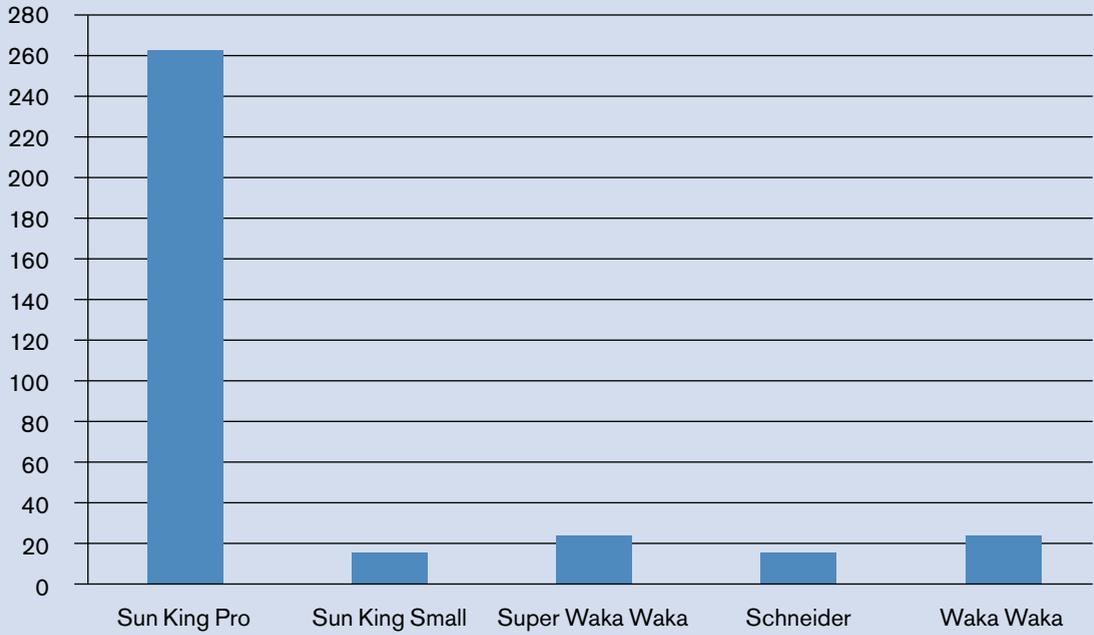
SDN's lessons learnt on community empowerment

1. Individual and collective empowerment processes should be complementary and build on one another: while the first addresses the practical needs of individuals and builds their skills and confidence, the second uses the gains of the first and through collective action tries to achieve more strategic long-term needs of disempowered communities.
2. Communities should be partners in empowerment initiatives; unless communities take ownership and the responsibility for improving their own situation while they also demand change of power relationships, even well-intentioned top-down systems can rarely deliver.
3. Livelihood empowerment that meets the most practical and immediate needs of individuals significantly enhances the sustainability of the empowerment and development processes; conversely, individuals who struggle to meet their most basic survival needs are less likely to be mobilised to meet long-term strategic goals such as improving local governance.
4. Empowerment interventions should be well-balanced and targeted beyond the narrow group of disempowered beneficiaries. Activities such as building the capacity of government and sensitizing men on women's rights are necessary for the success of empowerment processes.
5. All sustainable empowerment interventions should facilitate the gradual process of acquisition of assets and capabilities by individuals and communities. As such, those activities are long-term processes. Implementing NGOs and donors should be aware that short-term funding cycles do not work and take this into consideration in respectively planning and funding the projects implanted by civil society actors.

Annex 5.

Solar lantern sales records

Product sales: December 2013–March 2014





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The Niger Delta region fuels Nigeria's economy, accounting for 95 per cent of Nigeria's export earnings and over 80 per cent of the federal government's revenue. Yet it remains one of the poorest parts of the country. Its considerable potential for socio-economic development has been hampered by a lack of access to modern energy services, despite rich energy resources. Renewable energy has become a competitive option for improving access to energy.

The European Union-funded Sungas project aimed to develop community-based energy solutions in the Niger Delta using renewable energy sources. As part of this project, Stakeholder Democracy Network (SDN) piloted the use of solar-powered portable lighting in four Niger Delta communities, using the 'energy delivery model' approach. It aimed to catalyse market development by demonstrating and selling small solar lanterns as a commercial and sustainable business model.

This paper reviews and evaluates the impact of SDN's solar lantern distribution model at a community level. It identifies what SDN has learnt through distributing solar lanterns in four rural and urban communities in Rivers State, Nigeria, in order to critique the approach and consider how to implement the model more effectively, as well as analysing its potential for scaling up in the region.

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