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Master Thesis

Solar Off-Grid Lighting and Charging Solutions for the Base of the Pyramid – Business Strategies for Sustainable Poverty Alleviation

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List of Abbreviations

BOP	Base of the Pyramid
CO2	Carbon Dioxide
EDI	Energy Development Index
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSM	Global System for Mobile Communications
IEA	International Energy Agency
IFC	International Finance Corporation
MFI	Micro Finance Institution
MNC	Multinational Corporation
NGO	Non Governmental Organisation
PPP	Purchase Power Parity
PV	Photovoltaic
R&D	Research and Development
SACCO	Saving and Credit Cooperative
SHS	Solar Home System
SME	Small and Medium Enterprise
SMS	Short Message Service
U.N.	United Nations
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
WHO	World Health Organisation

Introduction

The availability of sustainable energy services is a decisive factor in tackling two of the world's most pressing challenges: reducing poverty and fighting climate change. "The availability of adequate, affordable and reliable energy services is essential for alleviating poverty, improving human welfare, raising living standards and ultimately for achieving sustainable development." (U.N. General Assembly 2012, p. 2) Underlining the necessity of improving worldwide access to modern, reliable, affordable and sustainable energy services in order to address these pressing challenges, the UN General Assembly has declared 2012 the International Year of Sustainable Energy for All. (U.N. General Assembly 2011) One central aspect of the sustainable energy and development nexus is poor people's access to electricity. "One out of every five people on Earth has no access to electricity and the opportunities it provides for health, safety and well-being, working, learning, or operating a business." (Ibid., p. 2) Changing this also requires the involvement of the private sector. In fact, not only does achieving this necessitate leveraging the strength of the private sector, but it also represents a business opportunity. The private sector has a key role to play in changing this and improving access to sustainable energy for all in order to alleviate poverty and ensure sustainable development. (U.N. General Assembly 2012) This thesis is aimed at illustrating this by examining how the private sector can contribute to poverty alleviation and environmental sustainability at the example of the solar off grid lighting sector in developing countries. In order to do this the thesis examines two research questions. The first is more theoretical and looks at the theories on business approaches to poverty alleviation and their applicability to the solar off grid lighting sector. The second question is more practical and seeks to further concretise the thematic by looking at the implications of the answer to the first question on a concrete project in the solar off-grid lighting sector. More precisely, this thesis seeks to answer the following two research questions:

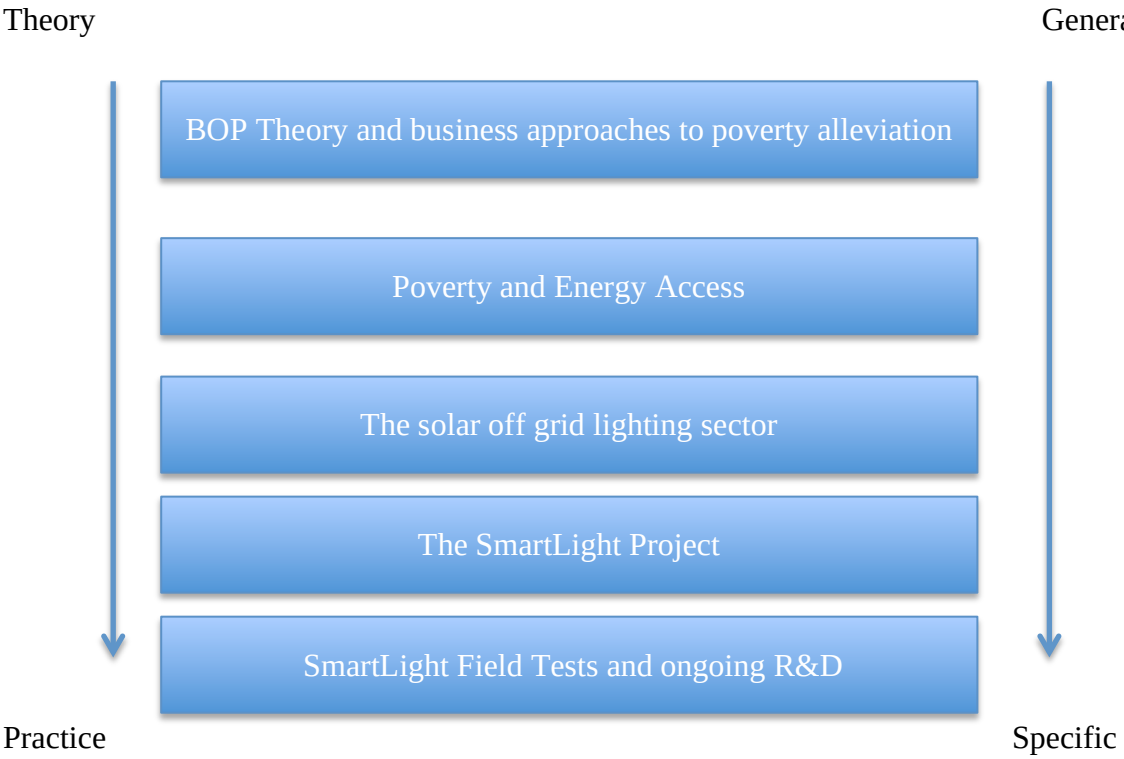
1. What is the potential of a business approach to poverty alleviation in the solar off grid lighting sector in terms of:
   - poverty alleviation impact
   - economic viability
   - impact on environmental sustainability?

2. What are the practical implications of the answer to the first question for a concrete project, in the solar off-grid lighting and charging sector, seeking to contribute to poverty alleviation and environmental sustainability based on business strategies?

The theoretical background of this thesis are BOP theories and other private sector approaches to poverty alleviation. And even though these theories also touch upon environmental sustainability, the aspect of environmental sustainability mainly intervenes as a result of the choice to examine business approaches to poverty alleviation at the example of the energy sector, which of course is closely linked to environmental sustainability.
Even though numerous publications on business and poverty alleviation have emerged over the past decade, this field of research is relatively new. Because of this and also owing to its cross-disciplinary character this field of research is relatively fragmented. There are very few publications that look at the whole picture of this field of research. The vast majority of publications are a combination of theoretical arguments either for or against BOP approaches and case studies in support of the respective argument. (Kandachar & Halme 2006)
This thesis proposes a different approach. It looks at the spectrum of different theories on business and poverty alleviation, from fervent proponents, to more cautious and nuanced arguments and critics in order to identify a common ground regarding the potential, the challenges and best practices of business approaches to poverty alleviation. Next the thesis examines how this relates to a particular aspect of poverty, energy poverty and a particular sector, the solar off-grid lighting and charging sector. This in turn is then further concretised by looking at a particular project in the field of solar lighting and charging solutions.

The thesis has both a theoretical and a practical part, but the transition from the first to the second is fluid, as the line of argument moves from general theory (business approaches to poverty alleviation), to a particular aspect of poverty (energy access) and a concrete sector (solar off grid lighting and charging solutions) and from there to a concrete project (SmartLight) and to practical questions within the project.
In short, the thesis starts with general theory and moves step by step towards the specific and practical.

Figure 1: Graphic Representation of the Structure of the Thesis



Source: own illustration

The first part of this thesis reviews the literature on the topic of business and poverty alleviation. The review starts with the most prominent and most controversial proposition on business and poverty alleviation, the theory of 'the fortune at the base of the pyramid, first proposed by C.K. Prahalad and his co-authors A. Hammond and St. Hart. This is followed by the corresponding critique and an overview over the key elements where other theories on business and poverty alleviation and more recent developments of BOP theory differ or propose amendments.

The second part then examines how the theory relates to one particular aspect of poverty, energy access and one particular sector, solar off-grid lighting and charging, by looking at market studies, reports from international organisations and academic publications in order to conclude on the potential and on the challenges of a business approach to poverty alleviation in the solar off grid lighting sector.

The third part then further concretises the theories discussed in the first part and the insights from the studies on the solar off grid lighting sector by looking at a specific project in this field, the SmartLight Project and identifying the implications of the insights gained in the first two parts for this project. Also, this part looks at two practical issues in the future development of the project, more precisely the future payment system and the organisation of

the field tests. So, this part draws on the previous two parts and on specific information on the SmartLight Project. Methodologically the part on the field tests is based on market research theory adapted for BOP markets, namely the Market Creation Toolbox from the BOP Learning Lab (Mollebaek Larsen & Flensborg 2011) and on literature on case study research design.

PART 1

Introduction

The most prominent proponent of the theory that business has a central role to play in the fight against poverty is C.K. Prahalad. The two articles Prahalad co-published with A.Hammond and St.Hart respectively in 2002, and his book "The fortune at the bottom of the pyramid" (2005) received much positive, but also negative attention, both in the academic and in the corporate world. Prahalad and his co-authors are however not the only ones who have claimed that the private sector can significantly contribute to poverty alleviation. Other researchers, international organisations, development organisations and development practitioners have advanced similar propositions before and since. Their propositions on the private sector's role in poverty alleviation are however in general more cautious and more nuanced than Prahalad's theory.

This Part is in three chapters. The first chapter introduces the proposition of "the fortune at the base of the pyramid" first put forward by Prahalad and his co-authors and by other early publications taking up these ideas. These publications are often referred to as 'the first generation BOP strategies' or 'BOP 1.0 theory'. The second chapter summarises the main criticisms in reaction to the BOP proposition. The third part then identifies the key additions and amendments of the more cautious and more nuanced propositions on the role of the private sector in poverty alleviation. These additions and amendments are drawn from two different sources. First, other propositions on the private sector's role in poverty alleviation put forward by other researchers, international organisations, development institutions and development practitioners. Second, the more recent developments of BOP theory seeking to accommodate both criticisms and the first practical experiences made by BOP ventures since the first BOP publications. These more recent developments of BOP theory are often referred to as 'second generation BOP theory', 'BOP 2.0 theory' or 'new BOP strategies'.

C.K. Prahalad and the 1st generation BOP theories

Introduction

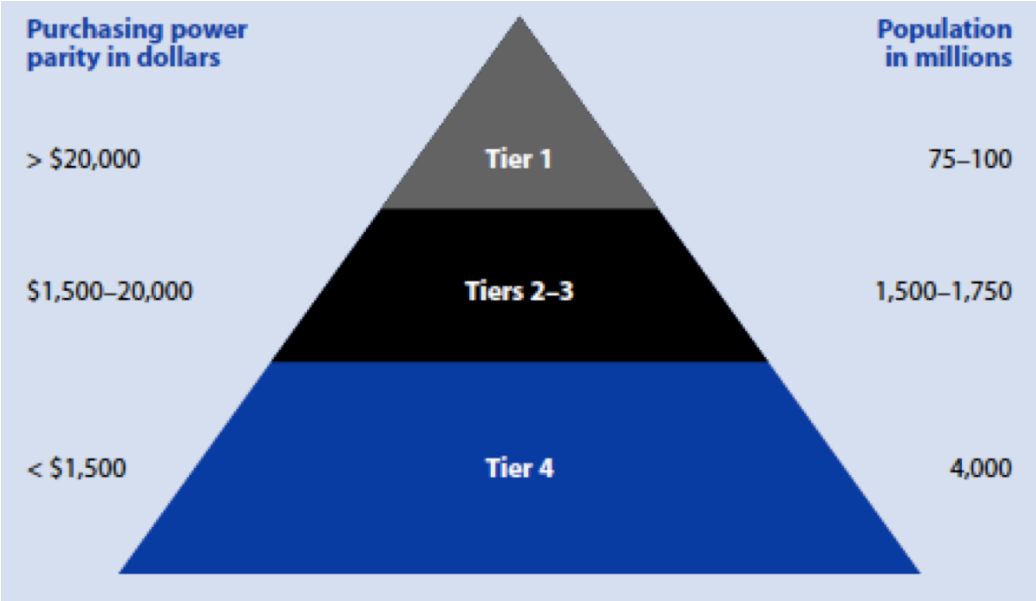
The first generation BOP theories argue that the poor people living in developing countries represent a vast untapped market that represents a viable business opportunity for MNCs, but has so far been ignored because of a number of false assumptions. Proponents of the first generation BOP theories claim that if MNCs start to serve this market they not only will have access to new markets and additional opportunities to make profits, but also will they help to

lift millions, or even billions of people out of poverty. This chapter explains the main arguments of the first generation BOP theories around C.K. Prahalad.

The Base of the Pyramid

The expression "Base of the Pyramid" is referring to the base tier, or tier 4, in the world economic pyramid. The world economic pyramid illustrates the distribution of annual per capita income in the world. Tier 1, or the tip of the pyramid, represents the small affluent population, composed of the high- and middle income segment in the developed countries and a small elite of wealthy people living in the developing world. Tier 2 and 3, or the middle of the pyramid, comprise the low-income population in the developed world and the rising middle class in the developing world. Tier 4, the BOP, represents the large population living in poverty in developing countries. (Prahalad & Hart 2002; Prahalad & Hammond 2002)

Figure 2: World Economic Pyramid



Source: Prahalad & Hammond 2002

According to Prahalad and his co-authors this tier 4 represents a multi-trillion dollar market. (Prahalad & Hammond, 2002 ; Prahalad & Hart, 2002) The estimated size of this market varies among the different publications, depending on where the poverty line is drawn. In the early publications the poverty line is drawn at 1,500$ or 2,000$. The most recent publication "The Next 4 Billion" (Hammond et al. 2007), based on extensive research by the World Bank

and the World Resource Institute estimates the size of the market at the BOP at 5 trillion dollars. This is however based on a poverty line of 3,000$ at PPP.

The invisible opportunity

The population of this Tier 4 is largely un- or underserved by the formal economy. The large majority of firms, especially multinational corporations (MNCs) focus almost exclusively on the markets of tiers 1, 2, and 3, while ignoring tier 4. According to Prahalad and his co-authors the reason for this is that a number of widespread assumptions about the poor and about business strategies lead companies to the conclusion that it is not in their interest to do business at the BOP. More precisely, they assume that the poor cannot be considered as potential target customers for three reasons: First, the poor do not represent any purchasing power. All they have is spent on essential needs, such as food and water. Second, in order to be able to sell to the poor, goods and services need to be offered at a price so low that makes it impossible for companies to produce for and compete in this market. Third, the poor do not have use, nor appreciation for brand goods produced for the developed world such as advanced technologies. In addition to these assumptions about the people living at the BOP, Prahalad and his co-authors also identify widespread belief that it is hard to find talent to work in these markets and managers are not interested in the challenge of doing business at the BOP. (Prahalad & Hart, 2002 ; Prahalad & Hammond, 2002 ; Prahalad 2005)

There is a market at the BOP

However, according to the first generation BOP theories these assumptions are prejudices that do not correspond to the realities at the BOP. First of all, “while individual incomes may be low, the aggregate buying power of poor communities is actually quite large”(Prahalad & Hammond, 2002, p.5). Tier 4 constitutes two thirds of the world population. So “given its vast size, Tier 4 represents a multitrillion-dollar market” (Prahalad & Hart, 2002, p.2). Also, the poor do buy goods that are traditionally considered “luxuries” and often they pay more than affluent consumers for the same goods and services. These last two points can be illustrated at the example of the Mumbai shantytown Dharvi: The people in Dharvi live in poverty and they neither have running water nor proper sanitation, but 85% of them own a television. And compared to the prices in an upper-class neighbourhood of Mumbai, the prices in Dharvi are much higher: While rice ‘only’ costs 1.2 times more, phone calls are twice as expensive, diarrhea medication ten times and water even 37 times more expensive in Dharvi than in the

upper class neighbourhood. The same is true for interest rates on credit, which are 53 times higher in Dharvi. This poverty penalty is universal and exists throughout the developing world. In general poor families pay as much as four to a hundred times as much for water, and 20 -30 % more for food than middle-or upper class families. The main reason for this is that the poor are generally forced to live in informal economies characterised by inefficiencies and local monopolies. Also, their low and in most cases irregular income forces them to buy everything in small quantities, which is generally more expensive. (Prahalad & Hammond, 2002)

Furthermore, the poor actually have high appreciation for brand products and advanced technologies. They cannot afford to waste their very small, and therefore very precious income on experimenting with buying different variations of a product or risk spending good money on a product of dubious quality. In fact, they are "very brand-conscious" and "they are also extremely value-conscious by necessity" (Prahalad, 2010, p. 38). Also, the poor have both use and appreciation for advanced technologies. For example, they have taken to mobile phones very quickly, despite, in many cases, never having used a phone before. In fact, because of the general lack of modern infrastructure the BOP may be an ideal testing ground and an attractive early market for new innovative and sustainable technologies. (Prahalad & Hart, 2002 ;Prahalad, 2005; Hart & Christensen 2002)

Finally, the assumption about the difficulty to find talent willing to face the challenge of doing business at the BOP does not hold either. In fact, "many employees want to work on projects that have the potential to make a difference in improving the lives of the poor" (Prahalad & Hammond, 2002).

So, in fact, there is huge latent demand for low-cost high quality goods, which represents a huge business opportunity. According to first generation BOP theories companies who start to serve this huge market at the BOP will have access to a new customer base of millions of new customers. And while their individual purchasing power may be small, aggregated together they represent a multitrillion-dollar market. This represents a huge opportunity for companies, especially since it becomes increasingly difficult to grow in the markets of the upper tiers. (Prahalad & Hammond 2002)

Strategies for doing business at the BOP

However, turning the latent demand at the base BOP into a thriving sustainable market depends heavily on a deep understanding of this environment and the capacity to innovate solutions, tailored to the BOP, not only in terms of product design but also in terms of supply

chain management, marketing and distribution. (Prahalad & Hart, 2002; Prahalad & Hammond, 2002; Prahalad 2005).

Creating buying power and making products affordable is central. More precisely, income generation and access to credit as well as innovative payment schemes and selling products in very small units (e.g. single serve packaging for personal hygiene products) are possibilities to achieve this. (Prahalad & Hart 2002 ; Prahalad & Hammond, 2002; Prahalad 2005).

Prahalad (2010) identifies three vital components, named "Three A's" (Affordability, Access, Availability), in the creation of the capacity to consume: First, products need to be made affordable, either through offering "single-serve package or novel purchasing schemes" (Prahalad, 2010, p. 43). Second, products need to be easy to access physically. The vast majority of the poor work long days and do not have the time or means for long travel. Therefore stores need to be located nearby and closing hours must be adapted to the long working hours. "This calls for *geographical intensity of distribution*" (Prahalad, 2010, p.43). Third, since the poor have a very small and in most cases irregular income, their buying decision depends heavily on the "cash they have on hand at a given point in time. They cannot defer buying decisions." So, *distribution efficiency* is crucial to assure availability. (Prahalad 2010, p.43)

Also, in order to create a thriving market at the BOP a great deal of emphasis has to be placed on innovation. Simply downgrading solutions offered in the developed world does not work. Serving the BOP profitably requires innovation based on a combination of a deep understanding of the realities at the BOP and the most advanced technologies. (Prahalad 2005) Designing for the BOP means in most cases designing for a hostile environment. The quality of infrastructure varies substantially, so what is taken for granted in developed countries may not be available at the BOP. One good example to illustrate this is electricity. Even when people have access to electricity there are usually frequent power outages and there can be significant fluctuations in voltages and amplitudes (Ibid.) This is why solutions for the BOP need to be based on the newest technologies and not on downgrading traditional solutions from the top of the pyramid. An additional reason why simply downgrading solutions from the top of the pyramid is not an option is that the economy at the top of the pyramid is based on resource wastage. Recreating the same patterns of production and consumption at the BOP would have disastrous implications for the environment and would place enormous pressure on resources and it would therefore not be possible to create a sustainable market. So, instead of creating and trying to sell environmentally sustainable solutions at the top of the pyramid, which can be difficult because traditional technologies are

well established, companies should focus on the BOP, where it is easier to implement those innovations because the BOP is largely underserved. (Prahalad & Hart 2002; Hart & Christensen 2002)

According to Prahalad and his co-authors Hammond and Hart the best actors to put all this into practice are MNCs. They believe that MNCs are ideally suited to tap into the fortune at the BOP for several reasons: First, they have the necessary resources to innovate and to build the necessary infrastructures at the BOP. Second, because of their global network they have a large knowledge base and also the capacity to transfer this knowledge from one region to another and also between different market segments. Third, MNCs are able to integrate various actors doing business at the BOP trying to alleviate poverty. MNCs could act as a catalyst for existing efforts. Prahalad and his co-authors suggest that MNCs should therefore assume a leading role in the BOP market. By serving the BOP they can both gain access to a large new market and help lift millions, or even billions of people out of poverty. And while eradicating poverty is not something that MNCs can achieve on their own because this also requires substantial investment from the developed world and policy changes in the developing world Prahalad and Hammond are convinced that "prosperity can come to the poorest regions only through the direct and sustained involvement of MNCs." (Prahalad & Hammond 2002, p. 5)
However because of the particular nature of the challenges facing MNCs wanting to operate at the BOP, good partnerships are crucial. BOP markets are unfamiliar for MNCs and they therefore benefit from partnering with local BOP entrepreneurs who have a good understanding of the dynamics of BOP markets. In fact, the BOP is a place of thriving entrepreneurship and both MNCs and local entrepreneurs benefit from partnering up. (Prahalad & Hammond 2002; Prahalad 2010) "Poverty alleviation can become a business development task, shared among large private sector firms and local BOP entrepreneurs." (Prahalad 2010, p. 29)

So, to sum up, Prahalad and his co-authors are convinced that if MNCs recognise the huge business opportunity at the BOP and start to serve the four billion people living at the BOP this creates a win-win situation. On the one hand, "business can gain three important advantages by serving the poor – a new source of revenue growth, greater efficiency, and access to innovation." (Prahalad & Hammond 2002, p. 6) On the other hand, the poor gain

access to a choice of high quality products, which gives them dignity and choice and helps to lift them out of poverty. (Prahalad 2005)

So, "if we stop thinking of the poor as victims or as a burden and start recognising them as resilient and creative entrepreneurs and value-conscious consumers, a whole new world of opportunity can open up." (Prahalad 2010, p. 25)

Critique

Introduction

The first generation BOP theories have engendered both enthusiastic, positive reactions and fervent criticism. This chapter gives an overview over the key criticisms addressed to the first generation BOP theories. The critics, most prominently among them A. Karnani (2007), discredit Prahalad's proposition on methodological, empirical and ethical grounds. More precisely, they take issue with the following seven aspects of the BOP proposition: The emphasis on consumption as a poverty alleviation strategy, the absence of sensibility to the vulnerabilities of the poor, the definition of the poverty line and the calculation of the BOP market size, the suggestion that MNCs should take the lead, the reduced role of the government in poverty alleviation, the optimism about the potential of entrepreneurship and microcredit at the BOP, and the state of empirical evidence. The reasoning of the critics is explained below for each of these seven points.

Emphasis on consumption

According to Karnani (2007) the BOP approach puts far too much emphasis on viewing the poor as consumers. Consumption as such does not alleviate poverty. The main reason for the suffering of the poor is lack of income, not an insufficient selection of consumer goods and services. (Karnani, 2007) "The only way to alleviate poverty is to raise the real income of the poor". (Ibid., p. 100) There are two ways to achieve this: Either by raising their earnings or through lower prices of the goods they consume. But since the poor spend 80% of their earnings on food, clothing and fuel, making consumer goods that are traditionally considered "luxuries" more affordable will hardly raise their real income. The effect is at best neutral. (Karnani, 2007) In fact, marketing consumer goods, other than those serving basic needs, to the poor may even harm them by seducing them to divert part of their meagre income away from important products to wastefully spend it on "luxuries". (Karnani, 2009a) There is

substantial evidence, that the poor spend a larger percentage of their income on alcohol, tobacco and festivals than more affluent people. In many cases, they would be able to buy more nutritious food or build up small savings if they reduced their spending on alcohol, tobacco, sugar, tea, spices and entertainment, such as festivals or television. (Banerjee & Duflo, 2011)

The poor's vulnerabilities

There are several explanations for this consumption pattern. First, the majority of people living in poverty in developing countries do not have bank accounts. So, when they do have money to spend, it is in cash. This makes resisting impulse purchasing much harder. This is exacerbated by the fact that typically the number and the severity of stress factors the poor have to deal with in their daily lives is high: hunger, pollution, crowding and violence are a few examples. They seek instant gratification to alleviate their suffering and turn to products that make them feel better in the short term, but may not be in their best interest in the long term (Karnani, 2009b). Also, the poor are often uneducated and lack access to information. (Banerjee & Duflo, 2011) So in many cases they lack the necessary basis to make informed choices and therefore easily fall victim of deceptive marketing strategies. According to Karnani encouraging companies to tap into the market at the BOP by selling to the poor just results in companies making profits by exploiting the vulnerabilities of the poor. (Karnani 2007) "Many corporations exploit poor people's vulnerabilities such as their lack of education and their desire for cheap relief from chronic distress." (Karnani 2009b, p. 42) It is unethical to allow this and it is therefore necessary to impose limits on the free market. In developed countries there are limits to this kind of exploitation of consumers through companies thanks to customer protection regulations. In developing countries however, such regulations are often absent or not sufficiently enforced. Both legal and social protection of consumers is generally weak in developing countries. (Karnanai 2009a) The BOP critics approach is primarily about firms' interests in new markets and not about poverty alleviation. "The traditional conceptualisation of the BOP is corporation centric and profits are the primary motive of engaging with the BOP." (Jose 2008, p. 200)

Poverty line and market size

The BOP critics also take issue with the definition of the poverty line and the calculation of the market size. "Prahalad states that there are more than 4 billion people with per capita

income below $2 per day at PPP rates." (Karnani 2007, p. 91) This translates into a potential market of 13 trillion dollars at PPP. This however is a gross overestimation for several reasons: First, it overestimates the number of people. The World Bank estimate is significantly lower at 2.7 billion people. Second, "the average consumption of poor people is $1.25 per day". (Ibid.) Combining these two elements translates into a 1.2 trillion market, only a fraction of Prahalad's estimations. Finally, this market size is further reduced if one looks at it from the perspective of MNCs based in developed countries. The reason for this is that "profits will be repatriated at the financial market exchange rates, not PPP rates". (Ibid.) More recent calculations conclude that the market size is at 5 trillion. But they only arrive at such a high number "by defining the poverty cut-off level at $3'000 PPP, which is much higher than any commonly used poverty line. " (Karnani 2009a, p. 7) In fact, many of the so-called successful BOP companies actually operate in a higher customer segment, above the poverty line of 2$ per day, the emerging middle class. (Karnani 2007; Karnani 2009a)

Not only is the market size at the BOP much smaller, but also is making profits very unlikely. There are several reasons for this: First, distribution and marketing costs tend to be very high because the poor are geographically dispersed and culturally heterogeneous and because infrastructure is generally weak. Second, the products that make up the bulk of the poor's consumption, like food and clothing typically do not allow significant cost reductions in distribution and tend to have small margins. Third, the sizes of individual transactions tend to be very small, which results in higher transaction costs. (BMZ 2009; Rangan et al. 2011; Jose 2008)

The role of MNCs

The BOP approach suggests that MNCs should take a leading role in poverty alleviation by serving the poor as customers. But according to Karnani MNCs are not well suited to serve the poor because it is difficult to exploit economies of scale in the BOP environment. There are several reasons for this: First, the people living at the BOP are both, culturally heterogeneous and geographically dispersed. Second, infrastructure in these regions is in general very poor. Third, the majority of the products the poor consume are not brand- and marketing intensive. (Karnani 2007) So, insofar as there are opportunities at the BOP, MNCs are not well suited to exploit them. "Small to medium sized local firms are better suited to exploiting these opportunities." (Karnani 2009a, p. 10) Even if it was profitable for MNCs to serve the BOP it would not be a good thing anyway because it would most likely lead to a situation where "cheaper global products rather than locally developed ones dominate, and in

turn put margin squeezes on suppliers and prevent local entrepreneurship". (Jose 2008, p. 201) Local SMEs are much better suited to serve the BOP and to contribute to poverty alleviation. They bring much more benefits, both economic and non-economic to the BOP because they are locally embedded. (Karnani 2007; Jose 2008) There is also some empirical evidence to support the fact that SMEs are better suited to serve the BOP: In fact, the majority of successful BOP enterprises are local SMEs, and not MNCs. (BMZ 2009)

The role of the government

The proposition that MNCs should take a leading role also implies a lesser role for governments. This is problematic. Providing infrastructure, public health and education are central responsibilities of the government. These basic services are absolutely crucial for sustainable poverty alleviation. Deemphasising the responsibility of the government to provide these is very problematic. (Karnani 2009a) Also, governments have a responsibility to impose some boundaries on the free market in order to protect vulnerable participants in the market economy. Without these boundaries the market is not efficient and both the economy and the people do not prosper. (Karnani 2009b) Certainly, in many developing countries governments struggle to fulfil their function, but this does not mean that they should be replaced by MNCs. "Even though government initiatives may have failed in the past, it may be too soon to write off the role of the government in meeting aspirations at the BOP." (Jose 2008, p. 200)

Entrepreneurship and Microcredit

The BOP propositions description of the poor as 'resilient and creative entrepreneurs' is, according to Karnani, not helpful because it romanticises their situation and thus downplays the severity of their difficult life circumstances. This is closely related to the frequently exaggerated potential of microcredit to lift people out of poverty. (Karnani 2007; Karnani 2009b) "Most microcredit clients are not entrepreneurs by choice, they would gladly take a job at reasonable wages if one were available." (Karnani 2009b, p. 43) Certainly, there are also true entrepreneurial spirits among the poor, but the majority of them are self-employed entrepreneurs by necessity, not by choice. The ILO's definition of 'own account workers' is therefore more appropriate. (Karnani 2007) Usually they operate in sectors characterised by low capital intensity and low skill levels. In such sectors entry barriers are low and competition is tough and most own account workers thus struggle to make ends meet and

repay their loans. (Karnani 2007; Karnani 2009b) The microfinance institutions " appear not to recognize that many of their clients, despite getting loans, have been unable to achieve a higher standard of living." (Rangan et al. 2011, p. 116) Microcredit in itself does not improve living standards, nor does it change whether the poor can afford something. This depends on the price. Micro-credit only helps to even out spending over time. (Rangan et al. 2011; Karnani 2007)

Empirical evidence

To date there are no rigorous studies on a sufficiently large scale that analyse impact of BOP approaches. Virtually all the evidence is based on case studies. This tends to an overrepresentation of successful examples and tends to neglect unsuccessful cases. This leads to a bias towards positive evidence of BOP approaches impact. (BEZ 2009)

Second generation BOP theories and other theories on business and poverty alleviation

Introduction

The proposition of 'the fortune at the base of the pyramid' introduced in Chapter 1 and the criticisms discussed in Chapter 2 have lead to a lively debate on the role of the private sector in poverty alleviation. It is however important to note that there have been other publications on the question of the private sector's potential role in eradicating poverty before and since. In general their propositions are more moderate, nuanced and cautious than the positions discussed in Chapter 1 and 2. And while they concur with the first generation BOP approaches in many aspects, they also contain notes of caution in line with the criticisms. These other publications on the role of the private sector in poverty alleviation are close to the propositions of the 'second generation BOP strategies'. The second generation BOP strategies are a further development of the original BOP theories that seeks to accommodate experiences from BOP ventures that followed the BOP proposition as well as some aspects of the criticisms. This chapter gives an overview over the key amendments and additions to classical BOP theory that both other theories on business and poverty alleviation and new BOP approaches have in common. They include, the necessity of market creation efforts, the importance to not only engage the poor as consumers but to integrate them all along the value chain, the importance of dialogue with the BOP, the selection of appropriate products, the

importance of partnerships, the need to put more emphasis on environmental sustainability and the role of donors and patient capital.

Market Creation

The proposition that serving the BOP is both a viable business opportunity and a very effective way to alleviate poverty was met with much enthusiasm and many corporations have sought to tap into "the fortune at the base of the pyramid". Ten years later, only a few have succeeded. Market obstacles such as lack of infrastructure certainly play an important role but often the BOP simply did not show much interest in the products that were offered to them. Even when the products had been developed specifically for BOP and after extensive and thorough research at the BOP. (London 2011;Simanis 2011) The reason why many corporations failed to tap into the market at the BOP is that "the base of the pyramid is not actually a market". (Simanis 2009, p. 1) Certainly, all the poor people making up the BOP have a lot in common and they have numerous unmet needs and combined they do have a significant purchasing power, but this does not mean that they actually represent a market. (Simanis 2009 ; Simanis 2011)

There are two main reasons for this: First, the BOP is not "a whole" but very heterogenous. There are significant differences in for example culture and language and while in some places the poor live very concentrated in shantytowns a large part of them are living highly dispersed in rural areas that are difficult to access. (Viswanathan 2011) Second, "needs" does not equal "market. Even if there is a need for a certain product or service and the poor are able to afford to pay for it, this does not necessarily mean that they value the product or service and are willing to pay for it. One example to illustrate this is clean water. If the poor do not see the benefit and do not make the connection between clean water and disease, they will not be willing to pay for (clean) water when they have always been able to get (polluted) water for free. This second point, the distinction between needs and market is central. (Simanis 2009; Simanis 2011 ; Kennedy & Novogratz 2011)

So, BOP approaches need to recognise that in most cases markets at the BOP do not yet exist in the traditional sense of the term because awareness and demand are not sufficiently developed. They need to move away form the idea of 'tapping into', 'entering' or 'serving' the BOP market and recognise that they will have to take an active role in creating this market. (London 2011 ; Simanis 2011) "Market creation is fundamentally different from market entry" (Simanis 2011, p. 103) In addition to designing useful products and making sure that they are affordable either through radical new design or through innovative

financing schemes, market creation also necessitates supply chain development and the promotion of not only a new product, but also new values, habits and lifestyles. (Heierli 2000 ; Simanis 2009; Simanis 2011) In order to create a consumer market it is necessary to bring people around to recognising that the value proposition of the product or service being offered is something to aspire to, worth adjusting behaviours and priorities to, and worth paying money for. In other words, it is creating a new lifestyle. (Simanis 2011) It is therefore central to communicate and explain cost-benefit trade-offs and to provide complementary information and education. "Communications must help potential customers visualize benefits." (Viswanathan 2011, p. 155) It is important to note that not only ventures seeking to engage the BOP as consumers face market creation issues. Those seeking to serve BOP producers often face similar challenges because there is for example lack of awareness among BOP producers of the existence and the advantages of new channels to sell their goods. (London 2011) Furthermore, a market cannot function without well functioning supply chains. In the BOP context there are frequently no pre-existing supply channels to rely on, so supply channel development is a central aspect of market creation. The key to well functioning supply chains is making them profitable. (Heirli 2008) "As soon as it pays for retailers, wholesalers and manufacturers to produce, to stock and to sell those goods and services, thriving markets can emerge and can do wonders." (Heierli 2000, p. 16) However, the private sector is very reluctant to invest into these market creation tasks. (Heierli 2008)

Careful selection of products

Initially BOP approaches have focused predominantly on engaging the poor as consumers as the main strategy to alleviate poverty. This emphasis on consumption is one of the main points that is often criticised. Still, engaging the poor as consumers is one important BOP strategy. (Jenkins 2008) But when marketing to the poor, carefully designing and selecting the right products is crucial. The emphasis should be on supplying poor people with useful and affordable products with a high poverty alleviation impact". (Heierli 2000 p. 14)

So, the focus should be on products which serve basic human needs and which increase the productivity and income of the poor. More precisely this means clean water, nutrition, sanitation, electricity, health care, information and communication technology, financial services, agricultural equipment, and production equipment and technology. (Jenkins 2008, Heierli 2000, UNDP 2008) "Of course, poverty is not easy to eradicate: poverty does not only mean a lack of resources, but dependence, indebtedness, isolation and marginalisation. Even a miracle product cannot just wipe out these factors. (Heierli 2000, p. 22) But good

useful products can contribute very effectively to significantly improving the lives of the poor. (Heierli 2000) Identifying and designing products with a high poverty alleviation impact however is a challenge. Taking the poor seriously as customers and engaging in a close dialogue to understand their requirements and finding out what they value is crucial. Like everyone else, the poor wish for and deserve high quality products that take their aspirations and feelings seriously. For instance, making products visually appealing can also be important. (Viswanathan 2011; Heierli 2000) It is a fine line between designing a product that is tailored to the specific requirements of the poor, and destroying any appeal of the product by putting too much emphasis on the product being for the poor. It is just a small and very evident mental leap from "product for the poor" to "poor product" which then "nobody wants to buy, and certainly not the poor". (Heierli 2000, p. 23)

Finally, the adoption of these products by the BOP should contribute, or at least not infringe upon all three dimensions of sustainability. The solutions need to be economically, ecologically, and socially sustainable. In order for the solutions to be economically sustainable the products need to be affordable for the poor and offer high returns on investment. Also, it must be possible to deliver them efficiently and the (global) market needs to be big enough to allow for sales at a sufficient scale. If the product is affordable, allows for efficient distribution and for sufficient scale, it should be possible to cover operating costs in the end. But subsidies may be necessary in the initial stages of R&D and market creation. Furthermore, the solutions should fit into the local culture and have a positive influence on social development. Ideally they should, for example, have a positive influence on gender equality. Finally, the solutions should have a positive, or at worst a neutral impact on the environment. They should not infringe upon ecological sustainability. (Heierli 2000; Viswanathan 2011 ; Kennedy & Novogratz 2011 ; Hart 2011)

Integrating the BOP all along the value chain

Engaging the BOP as consumers and meeting their basic needs is one way that business can improve the lives of the poor but in order to have a high poverty alleviation impact it is crucial to increase the productivity and the income of the poor. This means doing business *with* the BOP and engaging them as business partners. (Simanis & Hart 2008; Jenkins 2008 ; UNDP 2010 ; London & Hart 2011a) "Doing business with the poor people can allow them to increase their income – both through higher productivity and through new economic opportunities as employees, suppliers, distributors and the like." (UNDP 2008, p. 23) Access

to electricity, information and communication technologies, credit, insurance, production and farming equipment as well as knowledge can significantly increase poor peoples productivity and hence their income. (UNDP 2008; Jenkins 2008) But in order to increase incomes business strategies for poverty alleviation also need to engage with the BOP as business partners. This means creating inclusive business models that consciously include poor people at various points in the value chain as employees, entrepreneurs, suppliers, distributors or franchisees. (Simanis & Hart 2008; Jenkins 2008 ; UNDP 2010)

"Core business operations and value chains can create shared value by involving poor people – and benefitting them – as producers and business partners in the supply and distribution chain, as employees in the workplace and as consumers in the market place." (UNDP 2010, p. 5) Thus, one way to benefit poor people is employing them and offering them fair wages and decent work conditions. A second possibility is integrating them into the supply chain by buying from small and micro enterprises. This is especially beneficial if it is coupled with investment in skills and knowledge through training, technical assistance and quality management. A third possibility is distributing through small and micro enterprises. (Jenkins 2008; Heierli 2008 ; UNDP 2010)

Relying on small- and micro entrepreneurs for distribution is a very effective way to reach BOP markets. Traditional distribution methods require infrastructure and a certain volume to be cost-effective. And since in BOP markets infrastructure is often poor or non-existent and volumes can be small, micro entrepreneurs are often the best choice. (Jenkins 2008) "Small enterprises are very good in the retail business, in last mile delivery". (Heierli 2008, p. 39) Even though intermediaries are a cost factor because of profit margins and commissions, enterprises profit more from distributing through them as opposed to find a way to sell directly. This is because these intermediaries also offer important benefits. First of all, they are much closer to the customers, which is a significant asset in BOP markets where successful marketing and sales of products and services depends on word-of-mouth promotion and close relationships between customers and vendors based on mutual trust. BOP customers are risk averse and they are much more willing to try out something new if they have a trusting relationship with the person selling the product or providing the service. Second, these local micro entrepreneurs often also provide additional services such as consumer education, technical assistance, credit, after sales services and stocking spare parts. Third, their knowledge of the local market can be very valuable in identifying which products are in demand. This significantly lowers the risk for companies to make losses in designing and stocking the wrong products. (Jenkins 2008; Heierli 2008; Viswanathan 2011)

Increasing incomes is central in poverty alleviation strategies. Besides for example investing in production equipment that further increases their productivity a higher income allows poor people to send their children to school, reduce their vulnerability through access to better food, healthcare, and insurance, which are all investments that play a key role in lifting people out of poverty. The virtuous circle set in motion by increased income is not limited to the poor families themselves. Increased incomes of poor people also set in motion a virtuous circle within the community. If their numbers are sufficiently strong, this can even extend to the larger economy. (Heierli 2000; Heierli 2008; Jenkins 2008; UNDP 2008) "Poor people's higher incomes can set off economic multipliers within the local community, indirectly increasing the income of many others". (UNDP 2008, p. 23) "The benefits from inclusive business models go beyond immediate profits and higher incomes. For business, they include driving innovations, building markets and strengthening supply chains. And for the poor they include higher productivity, sustainable earnings and greater empowerment. " (UNDP 2008, p. 2)

The importance of listening and dialogue

In order for BOP strategies to succeed, companies and organisations must first "acknowledge their own weakness in understanding BOP contexts" and recognise that they "need to learn from these consumers and producers". (Viswanathan 2011, p. 149) And while insights from market studies, BOP experts, NGOs, self-help group leaders, community based organisation and development organisations can be valuable, "relying exclusively on 'filtered' views of the BOP", offered by middle- or upper income individuals is not advisable. Such insights cannot replace direct interaction with the poor. "Direct interaction with BOP consumers and entrepreneurs is essential." (Ibid., p. 152)

The development of solutions for the BOP must be based on close interaction with the poor that takes them seriously as consumers and producers. It is vital to understand their needs, wishes, aspirations and their key constraints. (Heierli 2000) "Solutions succeed and fail based on the extent to which they are based on a deep understanding of life circumstances." (Viswanathan 2011, p. 153)

It is important to underline that in order for business strategies of poverty alleviation to be successful engaging with the BOP, they must go beyond merely listening. It is not sufficient to just listen and collect information and then develop solutions. The aim is also to build trust and understanding on both sides. (Simanis & Hart 2008) Also, dialogue is crucial because BOP consumers and producers need to fully understand the value proposition that is being

offered to them. In order for a product and/or business model to be successful, helping BOP customers and producers visualise benefits is crucial. (Viswanathan 2011)

The importance of partnerships

BOP approaches benefit greatly, and even depend upon successful partnerships. The success of inclusive business models is often based on mutually beneficial partnerships and collaborations, not only with other companies, but also with public institutions and NGOs. (UNDP 2008; Jenkins 2008) The private sector has a huge potential to contribute to poverty alleviation and human development, but it will not succeed on its own. (UNDP 2008; UNDP 2010) The private sector for example can provide effective and sustainable distribution. But without a sufficient existing market the private sector has no interest in investing into effective distribution channels. So there is an important role in market creation to play for NGOs and development cooperation institutions. The same holds true for the extensive R&D necessary to create solutions for the BOP. In many cases the private sector companies need support from donors in this initial phase. Other examples for partnership include large scale marketing campaigns that aim at changing behaviours. The private sector is usually only willing to promote their products but not to invest in campaigns that aim at behavioural change. (Heierli 2000; Heierli 2008; London & Hart 2011; Hammond 2011). Although partnerships with public institutions and NGOs are critical, partnerships between different types of companies are just as important. Large enterprises and MNCs for example have access to global supply chains and they have the potential for large scale production. However, they usually do not have an existing distribution system in the BOP environment and therefore benefit from partnering with small enterprises who are often very effective in last mile distribution. (Heierli 2008; UNDP 2010 ; Viswanathan 2011) "Building business in the markets of the poor works best when all stakeholders contribute to their strengths". (UNDP 2008, p. 11)

More emphasis on environmental sustainability

Poverty and degradation of the environment are closely linked. The poor are very vulnerable to the effects of environmental degradation. From contaminated soil and polluted water to noise, dust, and waste, the poor are very exposed to the consequences of a degrading environment. "For individuals living in poverty, ecological issues are not distant, but

immediate, with disease and death resulting from degraded local environments." (Viswanathan 2011, p. 148)

So it is crucial that BOP approaches also commit to environmental sustainability. While Prahalad and Hart (2002) already touched upon this, this has often been neglected by BOP ventures. The single-serve packaging revolution creates enormous amounts of additional waste and has already resulted in severe pressure on the environment. (Jose 2008) But this is just the beginning. If the billions of people living at the BOP start to consume the same amount of ecologically unsustainable products and services as developed countries, the consequences on the environment will be disastrous. (Viswanathan 2011; Simanis & Hart 2008) If the BOP were to equal the consumption of the Americans "we would need 3 – 4 planet Earths to supply the raw material, absorb the waste, and stabilize the climate. (Simanis & Hart 2008, p. 5) So, simply adapting and then marketing environmentally unsustainable products and services to the BOP is not an option. Instead BOP approaches should aim to leapfrog today's environmentally unsustainable solutions and move directly to new green technologies. (Hart 2011) "For example, renewable energy sources provide new electricity without putting new stress on the world's climate." (UNDP 2008, p. 50) In fact introducing new sustainable technologies at the BOP has a higher potential of success than trying to establish them at the Top of the Pyramid. The reason for this is that at the top of the pyramid, new green technologies have to compete with established unsustainable technologies, whereas at the BOP unsustainable technologies often have not yet developed at a large scale and green technologies are therefore not perceived as a threat to existing solutions. (Hart 2011) For example, at the top of the pyramid, everyone is connected to the grid and has access to reliable electricity at reasonable prices. However, they are reluctant to make the transfer to greener electricity. These technologies are much more welcome at the BOP where huge areas are not connected to the grid and the alternative is no electricity. (Ibid.) So, fighting poverty with the help of environmentally sustainable technology has a huge potential. Taking "the Green Leap", that is to say leapfrogging to green technologies at the BOP has the potential to significantly contribute to solving two of the worlds most pressing problems, poverty and environmental degradation. (Ibid.)

The need for donor funding and patient capital

Whether the private sector can successfully contribute to sustainable poverty alleviation depends on a number of activities that are very time and capital intensive: Designing a product for the BOP that is affordable, desirable and has a significant poverty alleviation

impact requires extensive and thorough R&D. The same holds true for developing a successful business model for the BOP environment. Also, marketing and supply channels often do not exist but need to be set up. And in addition to that, promotional activities on a large scale to explain benefits of a product and to bring about changes in habits and attitudes are necessary to turn needs into a demand. These tasks all require a significant amount of time and capital. (Heierli 2008; Kennedy & Novogratz 2011) "Market creation is a very long-term investment." (Heierli 2000, p. 11) But the private sector is very reluctant to make these necessary investments for two reasons: First, the time horizon of traditional venture capital providers (3 – 4 years) is far too short for BOP endeavours where piloting, developing and growing can take ten years or more. (Kennedy & Novogratz 2011). Second, the costs of these market creation activities may never be recovered with the product later on "as it is difficult to defend the exclusivity of the product" (Heierli 2008, p. 108). So, in order for the private sector to contribute to poverty alleviation other sources of funding from donors or patient capital funds are necessary to "enable the private sector to share the cost of creating social value" (UNDP 2008). Subsidising market creation and investing in the removal of market constraints can be a very effective way for development cooperation to combat poverty because when the private sector steps in the initial investment is multiplied many-fold in terms of poverty alleviation impact. (Heierli 2000) The emerging patient capital sector is also increasingly "helping to create and support an economic ecosystem that allows BOP ventures to thrive" (Kennedy & Novogratz 2011, p. 51). Patient capital organisations are funds with private capital structures that focus on investments with high social or environmental impact. They provide investment with a long time horizon, focus on social and environmental returns above financial returns and have a higher tolerance for risk. (UNDP 2010, Kennedy & Novogratz 2011)

Conclusion Part 1

In conclusion it can be said that, while Prahalad's proposition that there is 'a fortune at the base of the pyramid' has raised a lot of awareness on the private sector's role in poverty alleviation, most more recent publications as well as some earlier publications on the private sector's role in poverty alleviation are more cautious than Prahalad. They agree with Prahalad that there is a role for the private sector in poverty alleviation, but emphasise that the situation is more complex. Both, poverty alleviation impact and economic profits are a challenge not to be underestimated and require a lot of consideration. The poor do spend money and they have a need and desire for affordable quality products, but simply encouraging consumption will

not automatically contribute to poverty alleviation. Selling products to the poor only has a poverty alleviation impact if it increases their income, either by allowing them to buy staples at a lower price or through products that enhance their productivity. So, the products aimed at serving the BOP need to be carefully selected. Also, engaging the poor as consumers is only one aspect of how business can contribute to poverty alleviation. Just as, if not more, important is integrating them all along the value chain, as producers, business partners and employees. This increases the income of the poor and thus significantly contributes to poverty alleviation. Also, engaging with the BOP must be based on a deep dialogue. It is vital to understand poor people's needs, circumstances and desires in order to design appropriate solutions. But it is just important to be able to communicate the value proposition offered and encourage changes of behaviour in order to turn needs into a market. In addition to creating a demand, developing value chains is crucial task of market creation. These are however very resource intensive activities the private sector is often reluctant to invest into. So, there is an important role for donor funds and the public sector.

In conclusion it can be said that in order for a business approach to poverty alleviation to succeed, the focus should be on *market creation with* the BOP based on deep dialogue, careful product selection, environmental sustainability and the integration of the poor all along the value chain. This however requires donor funding and a partnership with the public sector.

PART 2

Introduction

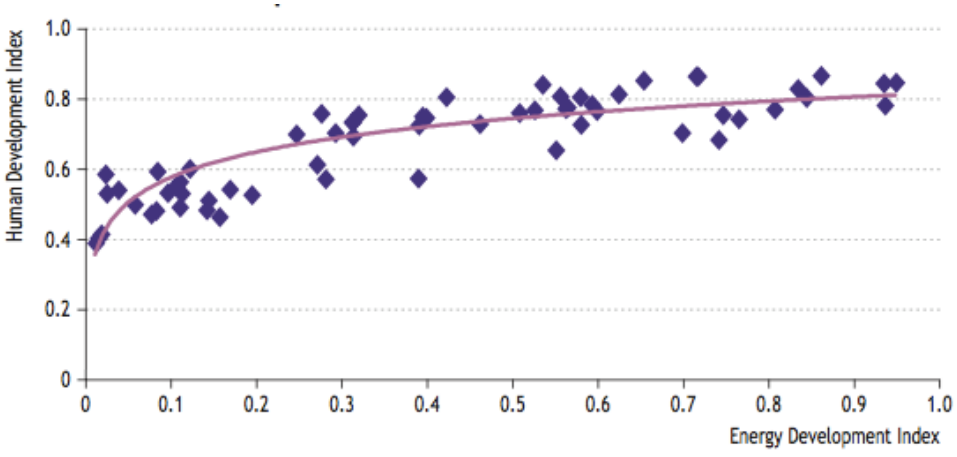
This part of the thesis examines one particular aspect of poverty, energy access and one particular sector, the solar off grid lighting sector. The first chapter is dedicated to the relation of poverty and lack of energy. The drawbacks of energy poverty are explained using the example of lack of electricity for lighting and charging ICTs. The next chapter gives an overview over the solar off grid lighting and charging sector and the potential market. This is then followed by the discussion of the main obstacles to serving this potential market.

Energy Access and Poverty

Introduction

Poverty and access to modern energy are closely intertwined. Lack of energy access is both, a manifestation and a contributing factor to poverty. On the one hand poverty is the main obstacle to achieving universal energy access. On the other hand lack of access to reliable energy is a key contributing factor to poverty. (Practical Action 2012) "The UN Millenium Development Goal of eradicating extreme poverty by 2015 will not be achieved unless substantial progress is made on improving energy access." (OECD/IEA 2010, p. 237) Almost half of the world's population, 3 billion people have no access to modern clean fuels and have to rely on traditional solid fuels like biomass and coal to meet their basic needs like cooking. About one quarter of the world's population, 1.4 billion people have no access to electricity. One additional billion people are 'under-electrified', that is to say have only access to unreliable electricity. (UNDP 2011; IFC 2012a ; Lighting Africa 2010) The lack of access to modern energy is a huge challenge for developing countries. The situation is particularly urgent in the least developed countries in South Asia and Sub-Saharan Africa. (UNDP/WHO 2009; UNDP 2011) "Although energy access varies widely across developing countries, it is much lower in poor developing countries than in other developing countries, placing poorer countries at a huge disadvantage." (UNDP/WHO 2009, p.1) This close relation between poverty and energy access can be illustrated by comparing the Energy Development Index (EDI) devised by the IEA with the Human Development Index. The EDI and the Human Development Index are clearly correlated. (IEA/UNDP/UNIDO 2010)

Figure 3: Comparison of the Human development Index to the Energy Development Index



Source: OECD/IEA 2010

"It has been well documented that without electricity and efficient cooking and heating options, economic activity is curtailed and advancement toward the Millenium Development Goals is constrained – particularly in meeting health, education and local environmental targets." (IFC 2012a, p. 22)

A central aspect of the energy and poverty nexus access to electricity for lighting and charging small devices. "Lighting is a fundamental human need. People who cannot simply flick a switch to light their homes lose many productive hours as soon as the sun sets." (Practical Action 2010, p. 2) Also, access to ICTs, which depends on charging possibilities, can be an important contributing factor to poverty alleviation because it reduces one of the poor's vulnerabilities, lack of access to information. (Klein 2008) The next section illustrates the energy poverty nexus at the example of efficient lighting and charging solutions.

The benefits of lighting

"A lack of reliable lighting access limits the productivity of nearly a quarter of the world's population, hindering their ability to carry out basic activities at night or early in the morning, including household chores, reading and competing schoolwork and conducting business." (Lighting Africa 2010, p. 14)

Being able to do housework after dark and early in the morning frees time during the day that can then be used for income generating activities. Also, in rural areas "obtaining fuel for lighting can be a time-consuming task that requires traveling long distances and is often undertaken by women and children, reducing women's available time for income-generating activities. " (Lighting Africa 2010, p. 15) So, improved lighting can have a significant impact on women's productivity by freeing time during the day, which they can then devote to additional income generation. (Ibid.)

Insufficient lighting inhibits children doing their homework and studying at home after dark. Several studies suggest that improved lighting at home directly translates in children studying for longer in the evening, which in turn has been shown to directly result in improved school performance. (Lighting Africa 2010) Better school performance in turn has a significant impact on future employability of these children. The benefit of being able to study and read in the evening is not limited to children. It also provides adults with the opportunity for home study or for holding evening classes. So, one way how improved lighting helps to improve the lives of the poor is by providing a basis for better education and hence future economic

prospects. (UNIDO 2009; Practical Action 2012) “Household lighting is a fundamental need, required in the home to extend work and study hours, and allow household tasks and social gatherings.” (Practical Action 2012, p. 49)

Improved lighting also allows people with various occupations to extend their working hours. Virtually all work activities are highly dependent on lighting. Traditional crafting, handiwork, sewing and looking after livestock are just a few examples. (Lighting Africa 2010)

For many small shop owners and people selling their goods on outside stands, who only have access to fuel based lighting it is not profitable and often also too risky to stay open after dark. Being able to illuminate their display is crucial to attracting customers and discouraging thieves. It also facilitates counting money and recognising customers. Longer opening hours and better illuminated displays translate in higher incomes. Since many people work long hours and are therefore not able to make their purchases during the day, shop owners who are able to stay open after dark and can attract customers with well lit displays make good money in the evening. (Lighting Africa 2010; Lighting Africa 2011)

“Lighting for work after dark improves productivity and incomes, particularly in areas where customers have a demand for evening services. Even in areas without evening customers, lighting increases flexibility of operating hours, allowing other activities to be performed during the day.” (Practical Action 2012, p. 20)

The health hazards fuel-based lighting

Fuel based lighting poses three different health hazards: indoor air pollution, fire and poisoning. An estimated 2 million deaths through respiratory diseases such as pneumonia and lung cancer are associated with indoor air pollution. 99 % of these deaths occur in developing countries. (UNDP/WHO 2009) This is mostly blamed on solid fuel use for cooking, but fuel based lighting is also a contributing factor. “Kerosene lamps emit fine particles that are a major source of air pollution because they quickly become lodged in the bronchial system and can result in chronic disease and death. (…) Since these particles may not disperse easily in the close quarters of a typical BOP household or small business, burning a lamp indoors for just four hours can result in concentrations of toxic particles several times higher than the World Health Organisation standard.” (Lighting Africa 2010, p. 15) Exposure to toxic fumes of kerosene lamps is comparable to smoking two packs of cigarettes a day and leads to health problems such as coughing, headaches, itchy eyes, asthma, bronchitis, tuberculosis, heart

disease and lung cancer. (Lighting Africa 2010; Lighting Africa 2011) Children and women are most at risk because they spend more time indoors. (Reiche et al. 2011)

The second major health hazard of fuel-based lighting is the danger of accidentally overturned kerosene lamps or explosions resulting in severe, often life-threatening burns and deadly house fires. (Reiche et al. 2011; Lighting Africa 2010) "In India alone, 2.5 million people suffer severe burns due to overturned kerosene lamps annually." (Lighting Africa 2010, p. 15)

The third health hazard is that because kerosene is often stored in soft drink bottles it happens that children accidentally drink it and get poisoned. (UNDP/WHO 2009; UNEP/WHO 2010)

The burden of kerosene prices

Energy expenses are a heavy burden on poor peoples household budgets. Prices vary across countries and regions, but typically poor people spend between 10 and 25 per cent of their household budget on energy. (Practical Action 2012; Lighting Africa 2010) "(…) Even in countries where kerosene is heavily subsidized by the government, like India and Sri Lanka, the cost of a month's worth of kerosene can equal between three to five days of income." (Lighting Africa 2010, p. 16) Fuel expenses burden on household budgets is estimated to be highest in African BOP households. In fact, in rural areas expenses may even be higher. The reason for this is that estimations are generally based on national kerosene prices. Kerosene prices in rural areas however are higher than national kerosene prices, even more so when kerosene is bought in very small quantities. So, rural BOP households who are forced to buy kerosene in very small quantities because they can only afford to spend very small amounts of money at a time, spend even more money on kerosene. (Lighting Africa 2010; Tracey & Jacobson 2012) A Lighting Africa study across five African countries found that "the median price per litre of kerosene sold in small quantities in the rural villages was 35 % higher than the median price recorded in the urban centres, $US 1.30 versus $US 0.96." (Tracey & Jacobson 2012, p. 7)

Furthermore, the fact that expenditures on fuel represent a significant proportion of poor peoples household budgets is a source of vulnerability as kerosene prices generally follow world oil prices. Poor people are hence subjected to the fluctuations of world oil prices. Over the past decade world oil prices and kerosene prices have seen a period of both a high volatility and a general upward trend. This is likely to continue in the future, leading to more pressure on poor people's household budgets and making them more vulnerable. (Tracey & Jacobson 2012)

What is more, not only are poor people forced to spend a high proportion of their income on energy, but also, they get less in return for their precious money compared to affluent people. (Gradl, C. and Knobloch, C. 2011; Pode 2009) Two examples to illustrate this: The first example is a comparison of the cost of 1 kWh in rural Bangladesh to the cost of 1 kWh in Western Europe. Whereas in Western Europe 1kWh costs about 0.30 $, it costs 2.30 $ in rural Bangladesh. So, people living in rural Bangladesh pay more that 7.5 times more than people living in Western Europe. (Gradl, C. and Knobloch, C. 2011) The second example is about the quality of light. Lighting based on kerosene is both more expensive and of much lower quality than electric light. "The amount of light from the (kerosene) lamp is only about 0.2 % of what the people in industrialised countries have for the same price." (Pode 2009, p. 1098) "Energy from kerosene or candles is much more expensive than electricity form the grid, the disadvantaged pay expensive rates for low quality services. The high cost hinders economic productivity." (Gradl, C. and Knobloch, C. 2011, p. 10) So, in a cruel twist of irony, poor people spend more on household energy than affluent people, but still cannot afford modern energy services. So, in comparison to people who have access to modern energy services poor people's productivity suffers twofold if they have to rely on fuel based lighting: They suffer from both, a heavier burden on their household budget and from poor quality lighting that inhibits them in performing productive tasks after dark. (Practical Action 2012; Lighting Africa 2010 ; (Gradl, C. and Knobloch, C. 2011)

Environmental impact

Overall contribution of household kerosene use to global CO2 emissions is estimated to be around 190 millions tons. This is comparable with the emissions of 30 million cars and more than the emissions of the UK and Australia combined. (Lighting Africa 2010) "Use of kerosene for lighting likely accounts for well over half (100 – 150 million tons) of these kerosene emissions." (Ibid., p. 14) However it is important to underline that the people using kerosene for cooking and lighting are at the very low end of the scale in terms of CO2 emissions per capita. (Lighting Africa 2010) In addition to the CO2 burning kerosene also produces black carbon (soot), which contributes to climate change. Black carbon is believed to have a doubly negative impact on glaciers because the particulates contribute to the heating up of the lower atmosphere and they set on glaciers, making them darker and thus less reflective. Both of these effects accelerate the melting process of glaciers. (Gradl & Knobloch, 2011; Lighting Africa 2010)

Thus, replacing kerosene based lighting with solar off grid lighting solutions can significantly contribute to lower global CO2 emissions and thus help to fight against global warming.

The solar off grid lighting sector

Solar off grid lighting solutions

The IFC (2012) groups solar off-grid lighting products into three main categories: small devices like solar lanterns and task lights, solar kits and solar home systems.

Solar home systems (SHS) are large solutions where a large PV Panel is permanently fixed on the rooftop. They require professional initial installation and regular maintenance. SHS not only provide several lights, but also allow to power large household appliances like TVs and refrigerators. Smaller SHS usually cost between 300 and 500 dollars. But there are also larger systems from 500 dollars upward. (IFC 2012a) “Solar home systems have a fairly long history among development institutions but are increasingly an energy access solution offered by local entrepreneurs.” (Ibid. p. 41)

A more recent development are solar lanterns and solar task lights. They generally cost between 10 and 50 dollars and include a single light and a small solar panel for charging. Some solutions also offer charging for mobile phones. Solar lanterns can be bought off the shelf and do not require maintenance. Due to their low prices solar lanterns and task lights have become quite popular for BOP consumers as alternatives to kerosene lamps and torches with disposable batteries. (IFC 2012a)

The most recent development are solar kits. They can be placed between SHS and solar lanterns in terms of size, energy service and price. Solar kits are portable systems that can be bought off the shelf like solar lanterns and do not require installation or maintenance. They offer more than one light and allow the charging of mobile phones and other small appliances such as small radios. They usually cost between 100 and 150 dollars and therefore help to close the large gap between solar lanterns and SHS. Early evidence on the reception of solar kits in the market is very promising. They are considered as a valuable asset to aspire to and worth paying precious money for. In combination with consumer financing, solar kits therefore have a significant potential. (Ibid.) “There is early evidence of unexpectedly rapid penetration of solar kits in some markets.” (Ibid, p. 42)

Based on a comparison of current BOP household spending on energy with the cost of modern alternatives the IFC estimates that "90 per cent of (poor) people already spend so much on kerosene lamps, candle, and disposable batteries to meet their lighting needs that they could afford to purchase better options, such as solar lamps."(IFC 2012a, p. 12)

In the "lighting plus" market, that is to say the market for solutions that offer improved lighting and charging of small devices, approximately 256 million households would theoretically be able to afford modern solutions. Aggregated together they spend an estimated 18 billion per year on lighting and charging services for small devices. (IFC 2012a) Theoretically this is a huge market opportunity. Even more so as "the addressable market is really a conservative lower bound as it is based on current cash spending on traditional energy and does not assume savings opportunities for the poor, or subsidies" (Ibid. p. 31)

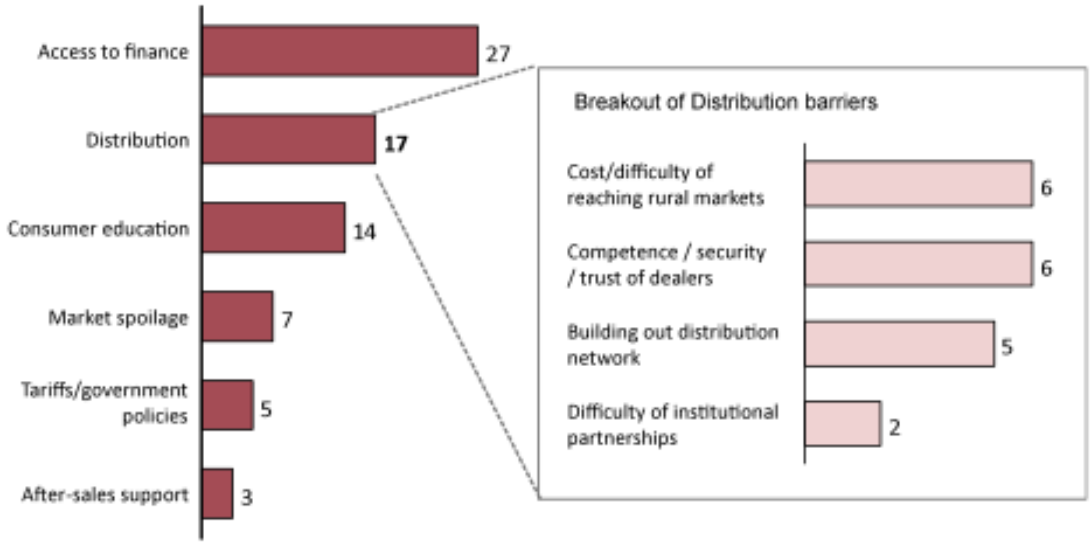
However, it cannot be stressed enough that this only represents a theoretically addressable market. The main reason why this is only a theoretically addressable market is that these estimations are based on cost calculations that assume that costs are spread evenly over the life-cycle of a product. But in reality there is a huge difference between solar lighting solutions and fuel based lighting as to how the cost is distributed over time. While solar lighting solutions have high upfront costs and virtually no operating costs, fuel based lighting only requires a small initial investment but has relatively high operating costs. (IFC 2012a) Poor people are very sensitive to up-front costs due to their limited income and cash flow. They are typically just barely able to meet their basic needs on a day-to-day basis and therefore do not have any savings and they cannot risk buying faulty products. So, while they may be able to spend a few dollars per week, they struggle to come up with a lump sum of 10$ and higher up-front investments are often an insurmountable hurdle. (Lighting Africa 2011; Lighting Africa 2010 ; IFC 2012a ; Heierli 2008) " (…) Consumers are very often reluctant or unable to make such a one-time investment up front, due to the nature of their available cash flows, as well as to the real and practical risks of investing in a potentially, sub-standard product." (Avato & Madeira, p. 7) The reason why most BOP households rely on kerosene-based lighting is that it can, if necessary, be purchased in very small quantities. This allows for flexible resource allocation. They can adjust the quantity they buy at any time according to the cash they have at hand. In fact, even people who live in proximity to the grid and could theoretically get connected to the system, have been known to choose kerosene based lighting over a grid connection because kerosene allows for purchases in very small amounts. Poor people's incomes are in many cases very irregular. Being able to adjust purchases to their cash flow on a daily basis is an advantage, whereas a fixed monthly bill

represents a risk. (Practical Action 2012) “A study for UNIDO concluded that ‘it is not proximity to the power line but cost that constitutes the main factor excluding poor people from grid connection.” (Ibid., p. 81)With kerosene prices rising and prices of solar lighting solutions falling rapidly due to technological advancement and higher volumes of production, solar lighting solutions are more cost-effective than traditional solutions in terms of costs spread out over the product life-cycle. (Glemarec, Y. 2012) “However, as low-income consumers do not have the luxury to reason in terms of levelized cost of energy; upfront costs are likely to remain the major bottleneck to achieve universal clean energy access.” (Ibid. p. 89) Without consumer financing that allows spreading the cost of solar lighting solutions over time the market opportunity shrinks to only a fraction of the theoretically addressable market. “The addressable market estimate assumes that costs are broken down into monthly payments; the estimate would be much smaller if users were required to pay the total cost up front.” (IFC 2012a, p. 34)

The Challenges

The access to finance is the number one challenge to the development of the solar off-grid lighting market. This includes not only consumer finance, but also access to finance for manufacturers, wholesalers and small retailers. The second major challenge is distribution. And the third largest challenge is consumer awareness and education. (Lighting Africa 2010)

Figure 4: Barriers in the solar lighting market



Source: Lighting Africa 2010

This section examines the top three challenges in the solar off-grid lighting and charging market: Access to finance, Distribution and consumer education. The section on finance focuses on consumer financing.

Consumer Financing

It is not a coincidence that the number of people who have no access to basic financial services is roughly the same as the number of people who rely on fuel-based energy to meet their basic needs. (Glemarec 2012) Affordability and access to financing is the number one obstacle to the adoption of solar lighting solutions in the BOP market, especially in rural areas. (Lighting Africa 2010) "There is evidence that the continued growth in clean energy markets, which initially reflected sales to people living above the poverty line in urban or peri-urban areas, is constrained from reaching new market segments by the lack of appropriate end-user finance." (UNDP/UNCDF, 2012a) Poor people typically do not have savings and they tend to have irregular (seasonal) income patterns. This inhibits their access to credit. (UNDP/UNCDF 2012b) "Access to financing adapted to the cash flow profiles of poor households will therefore be a key enabler for scaling up clean energy markets." (Glemarec 2012, p. 90) To date most sales of sustainable energy solutions are either paid in cash or with the help of consumer credit through commercial banks. The poor have neither of these options and therefore require alternative solutions (UNDP/UNCDF 2012b)

There are four different solutions that allow consumers at the BOP to spread costs over time and thus overcome the up-front investment hurdle: fee-for-service, consumer credit, dealer credit and hire-purchase or leasing:

Fee-for-service

In the fee-for-service model customers only pay for the energy service, while ownership and the responsibility for maintenance of the energy system remains with the energy service company for the whole duration of the contract. The energy service company is also fully responsible for maintenance and repair. (UNDP/UNCDF 2012b ; IEA 2008)

Since this eliminates both, up-front payment and the long-term risk of faulty equipment for customers, this model is the credit scheme with the lowest entry barrier for customers and has the highest market penetration potential. There are however still risks for customers associated with this payment scheme. Under this scheme customers are usually required to

pay every month, without exception. For poor people, who typically have irregular incomes this can be a substantial burden. Especially for those working in agriculture and therefore have seasonal incomes this scheme can represent a major risk. Even more so as energy companies tend to charge relatively high fees in order to compensate for the high fee collection costs and to hedge against risks. The fact that this payment scheme typically does not allow customers to miss a payment is a major disadvantage compared to kerosene based lighting. Spending on kerosene based lighting is very flexible and customers are always free to decide not to buy it or to buy only a very small quantity whenever their budget is very tight, preventing them from getting into debt. (IEA 2003 ; Anisuzzaman & Urmee 2006 ; Practical Action 2012 ; UNDP/UNCDF 2012b)

Even though the risk of non-payment is low because the company can take the equipment back if necessary the fee-for-service model is costly for the company and usually requires additional funding from the government. This is due to high costs of payment collection and due to the risk that because customers do not own the equipment they may not take adequate care of it, which then leads to premature failure of the equipment. The cost recovery period is very long and rates of return are low. This system depends on the energy servicing company having access to long term capital from a credit institution of from other funding sources. (Ibid.)

One common variation of this system is that the battery is owned by the end user and not the energy service company. (IEA 2003 ; Anisuzzaman & Urmee 2006)

Consumer Credit

In the consumer credit model, a credit institution grants a credit to the customer in order to finance the equipment. In this case the credit agreement is exclusively between the customer and the credit provider. For the supplier this equals a cash sale. The credit institution pays the full price of the equipment and then collects the payment from the customer. The customer usually has to make a down-payment at the beginning and then pays the rest of the price to the credit company in small instalments over a time period. Depending on the credit terms ownership passes directly to the customer at the moment of purchase or the credit company is the owner until the customer has repaid the full loan to the credit company. Often the system itself is used as a collateral for the loan. (IEA 2003; IEA 2008 ; UNDP/UNCDF 2012b)

The main benefits for the end-user under the consumer credit model are that it significantly lowers or removes the up-front cost barrier and that upon repayment of the full credit the customer is the owner of the system and energy consumption is for free from this point on.

This is an advantage compared to the fee-for-service model where the customer never becomes the owner of the system and will always have to pay for energy use no matter how many fee payments accumulate over time. The main disadvantages are that both interest rates and the down payment can be quite high. If the repayment schedule does not accommodate end-users irregular (seasonal) income patterns, the consumer credit can quickly become a burden and a high risk. If they are not able to keep up with the payments, they lose both the system and the down-payment. (IEA 2003)

For the dealer this system has major advantages. Because the credit scheme runs independently from the seller and is like a cash sale the seller does not run any risks associated with the credit and does not have any resources tied up in the credit scheme. This is a plus for the seller compared to dealer credit sales. (Ibid.)

However, the fact that the full financial risk is carried by the credit institution and not the seller can be problematic because the seller may not feel responsible for the performance of the equipment once it has been sold, which leads to poor after sales service. The dealer usually does not have responsibilities beyond warranty, which often does not mean much as it can be difficult to enforce. A major advantage in comparison to the dealer credit model is that the credit institution is very experienced in payment collection and also has the necessary infrastructure, whereas for the dealer this is a major challenge. (Ibid.)

Dealer credit

The dealer credit or instalment model is similar to the consumer credit model. The difference is that it is the seller who provides credit for the consumer by allowing the customer to pay in instalments. This is often a semi-formal agreement between the local dealer and the customer. Ownership passes from the seller to the customer either when the down payment is made or when the full payment is compete, depending on the arrangement. (IEA 2003; IEA 2008)

Besides lowering the up-front cost barrier the customer usually also benefits from better after sales service. The reason for this is that the seller has an interest in assuring that the equipment is fully functional because this is related with cost recovery. If the equipment is faulty customers will not pay the rest of the amount they owe to the dealer. The main disadvantages for customers are short payback periods and high interest rates. (IEA 2003)

For the dealer this type of arrangement boosts sales as more customers are able to afford the products but at the same time it also puts pressure on resources because a significant part of his resources will be tied up in the credit scheme. The dealer is usually not in a position to offer consumer credit without having financial backing himself. (Ibid.)

Leasing and hire-purchase

Leasing and hire-purchase schemes are often treated together because they are very similar. The central difference is that in the hire-purchase scheme it is obligatory that ownership passes to the customer upon full payment, whereas in the leasing model ownership of the equipment may be passed to the customer (the lessee) at the term of the contract (financial leasing) or the equipment may return to the lessor (operational leasing). Under the lease/hire-purchase scheme the customer and seller agree that the customer will hire the equipment in return for small fees. Typically the customer has to make a small initial down-payment and is then allowed to use the equipment in return for small payments. These payments accumulate over time until the sum of accumulated instalment payments equals the full price of the equipment or the agreed leasing time period ends. Depending on the agreement the ownership passes to the customer at the end of the leasing agreement and/or upon payment of the full price of the equipment. (The full price is a little higher than if the item were paid in cash at the beginning to compensate the seller for providing credit by allowing purchase in instalments. In some cases for example ownership is passed to the customer upon payment of the down-payment but the equipment is used as collateral. Typically the ownership remains with the seller or with a leasing company until the customer has paid the full price. The seller also remains responsible for any reparation and maintenance that may be necessary. (IEA 2008 ; IEA 2003 ; Anisuzzaman M & Urmee, T.P. 2006 ; Stewart, R. et al. 2011)

For customers this model is attractive because the down-payment is usually smaller than under the other credit schemes and the repayment period is generally longer. Also, they do not carry the responsibility for maintenance. The hire-purchase model and the financial leasing model also have the benefit that the payments accumulate and the customer owns the equipment at the term of the agreement. From this point on the customer has the electricity for free, which is an advantage compared to the fee-for service model. This of course applies only if the equipment is of good quality and has a longer life-expectancy than the hire-purchase or leasing agreement. (IEA 2003)

For the dealer, the hire-purchase scheme is very resource intensive because of payment collection, maintenance responsibilities, and because of the need for finance in order to be able to allow payment in instalments. (Ibid.)

The role of MFIs

It is often argued that MFIs are very well suited to supply financing for solar off grid lighting solutions. They have extensive experience with poor people's financing needs, income patterns, saving and spending habits. Also they usually have a very well developed network of existing relationships with the poor and have access even to those living in very remote areas. Furthermore, MFIs also have the necessary resources, infrastructure and experience for effective payment collection. (UNDP/UNCDF 2012a; UNDP/UNCDF 2012 ; Glemarec 2012) Also, since solar lighting solutions allow people to both make savings in household expenditures and improve productivity of their micro-enterprises, hence increasing income, they will also most likely have the means to repay the loan. Offering clean energy loans has therefore the potential for MFIs to improve their overall portfolio and benefit from a growing market segment (UNDP/UNCDF 2012a; UNDP/UNCDF 2012)

However, despite all these arguments for an active involvement of MFIs in the off-grid solar lighting sector, MFIs are relatively reluctant to offer loans for solar lighting solutions. There are two main reasons for this. First, for the few MFIs who have already granted sustainable energy loans, experiences have been disappointing. MFIs have experienced higher default rates with this type of loans than with other, more traditional micro loans. This is mainly to blame on technology failure. Unfortunately a number of low quality products have spoiled the low-price market, which has led to a poor repayment track record. It is understandable that customers were very reluctant to repay their loans if equipment was faulty. Also, solar lighting products are investments aimed at increasing income generating activities and micro loans and repayment schedule are taken up with the anticipation of a higher income, and therefore the means to repay the loan, in the future. (UNDP/UNCDF 2012a; Glemarec 2012) Second, "most MFIs do not understand the range, purpose of potential of clean energy technologies; their value to low-income clients; or their contribution to MFIs objectives." (UNDP/UNCDF 2012a, p. 8) In addition to this, traditional MFI loans are not well suited for investment in solar off grid lighting solutions because the maturities of the loans (6 -12 months) are too short for a long-term investment like solar off grid lighting solutions, especially in rural areas where people tend to have seasonal incomes. "The better met the cash flow profiles of the poor, new credit modalities with longer maturities might be required." (Glemarec 2012, p. 90)

The risk for the consumer and for the dealer varies depending on the payment scheme. To ensure access to finance and minimize the risk product quality is central. So, regardless of the

payment system, product quality is essential in order to assure the functioning of the micro-finance systems.

Distribution

The second key challenge for companies, who want to provide the BOP with solar off-grid lighting solutions, is distribution. “Distribution is one of the overriding challenges for device companies attempting to reach low-income markets. Customers typically live in remote rural areas and do not shop at established retail channels where they would discover new technologies.” (IFC 2012a, p. 51)

Good, effective distribution channels however are crucial for reaching target customers, reducing costs, and thus making products more affordable and increase customer confidence. “Distributor presence in rural areas increases customer confidence since end-users are assured that they do not need to travel far in the event they encounter any quality issues (…)”. (Lighting Africa 2010, p. 68) There are numerous obstacles to efficient distribution, especially covering the ‘last mile’, but some companies do succeed. “Local distribution chains are fragmented, and cash-poor merchants struggle with working capital constraints, low sales volumes compared with other products that they could stock and limited shelf space. Yet, other sectors such as beverages, pharmaceuticals and mobile telephony have become very good at distribution in low-income markets.” (IFC 2012a, p. 51) However, building such a distribution network is very resource intensive and most solar off-grid lighting companies, especially smaller ones, are better advised to organise distribution through partners and rely on existing distribution channels. The most frequent suggestions for promising distribution partnership are: MFIs and SACCOs (Savings and Credit Cooperatives), Unions and Cooperatives, NGOs and Mobile Phone Companies. (IFC 2012a; Lighting Africa 2010; Gradl & Knobloch, 2011)

Mobile phone operators have been very successful in distributing mobile phones and pre-paid cards even in very remote areas. And since most solar off-grid lighting solutions (generally all except simple low cost solar lanterns) now also allow the charging of mobile phones, a higher market penetration of solar off-grid lighting solutions coincides with mobile phone operators’ interests. (Lighting Africa 2010 ; IFC 2012) “Given the mobile subscription economics, mobile operators may be incentivized to provide cheap charging solutions to their customers since, beyond expanding the potential customer base, such solutions tend to increase spending on airtime (with one study suggesting an increase of average revenue per user of 10-14%) and

a boost in mobile phone penetration in off-grid regions." (Lighting Africa 2010, p. 69) Thus, establishing partnerships with mobile phone operators and piggy-backing on their distribution network is a very promising possible distribution strategy that allows to reach even remote areas and that therefore has the potential to significantly contribute to a solar off-grid lighting company's success. (Lighting Africa 2010 ; IFC 2012a)

Despite often cited potential of partnerships between MFIs and sustainable energy firms and some successful examples, MFIs as distribution partners or solar off-grid lighting companies are not reached scale. The reason for this is that although MFIs have very good local networks that reach even remote areas, their infrastructure, internal organisation and the training of their workers are designed to provide financial services and not to distribute physical goods. (Achwal 2010; Gradl & Knobloch, 2011 ; Lighting Africa 2010) " MFIs have so far not proven to be useful partners for the distribution of lanterns in Africa due to their at times overly-cautious attitude, lack of understanding of the lighting market, and limited operational capacity and appetite for distributing 'physical' products like lanterns on the ground." (Lighting Africa 2010, p. 69) According to Lighting Africa, SACCOSs are more promising than MFIs as distribution partners. SACCOs have a large network (20 million members across Africa) and they are "true 'last mile' entities (…). (Ibid.)

Organising distribution through cooperatives is a very promising approach for solar off-grid lighting companies to reach their target customers. First of all, cooperatives generally have existing well functioning distribution channels for 'physical' products such as seeds, fertilizer and agricultural equipment. Second, cooperatives are widespread in developing countries. Also, cooperatives are interested in enhancing their members' productivity such as through better access to information through ICTs. This of course depends on charging solutions. Gradl & Knobloch, 2011; Lighting Africa 2010)

NGOs can be valuable partners for distribution because they usually have strong local networks and a thorough understanding of local communities. In addition to distribution, solar off-grid lighting companies can also benefit from partnering with NGOs for market research, marketing, and consumer education. NGOs in turn also benefit from partnering with companies because the support of a private company allows them to scale up their operations. (Gradl & Knobloch, 2011) "Many humanitarian and environmental NGOs in developing

countries are involved in the energy business because it is so interlinked with topics such as health, education and climate change." (Ibid. p. 15)

Consumer education and consumer preferences

The fact that solar lighting solutions offer much better light than fuel based solutions, without creating fumes, is very visible and tangible. Convincing poor people of the benefits of solar light is therefore not as challenging as for example convincing them to buy water filters, where the difference of filtered water is often not visible. At first, people who have not had experience with solar lighting before tend to mistrust solar lighting solutions. But exposure to solar lighting solutions dramatically changes this and increases people's readiness to invest in them. (Lighting Africa 2010; Lighting Africa 2011) A Lighting Africa study across five countries has found that "consumer's willingness to pay for lighting products depended strongly on their level of exposure to the lighting products." (Lighting Africa 2011, p. 7)

The main factor that prevents people from buying solar lighting solutions is the upfront cost. Either, because they can not afford it, because they do not understand that the investment pays off in the long run, or because they mistrust the quality of the product and therefore fear that they would not see the return on investment because of premature failure of the product. This last problem has increased recently because of market spoilage through poor quality products. Because of the above reasons the availability of consumer financing dramatically increases people's interest in buying solar lighting solutions. In order to increase customer acceptance the most important thing to do is therefore offering them consumer finance and quality assurances and educating them about it. (Lighting Africa 2010; Lighting Africa 2011)

In terms of the product features Lighting Africa (2011) had found that customers especially value solutions that are multipurpose and portable. More precisely, customers appreciate solutions that are not only task lights that can stand on their own, but also can be hanged from the ceiling and carried around. (Sanitary facilities for example are often outside the house and people' appreciate it if they can carry a light with them.) Also, solutions that offer more than one light and sufficient cable length are highly appreciated because they allow to light two or more rooms at once. A very important feature for customers is also the possibility to charge mobile phones. Furthermore, long battery life, a user-friendly appearance and being able to detach the solar panel from the lamp(s) (in order as to prevent theft) are also important for customers. (Lighting Africa 2011; IFC 2012a)

Conclusion Part 2

The potential of a business approach to poverty alleviation in the solar off-grid lighting and charging sector is very promising for three reasons: First, solar lighting solutions are products that have a potentially very high poverty alleviation impact. Not only do they have a positive impact on people's disposable income by reducing the share of energy expenditure in the household budget and increasing their productivity, but also they do contribute to improve health and education, which are key success factors in poverty alleviation. Second, solar lighting solutions also satisfy the environmental sustainability criterion because they can significantly contribute to the reduction of CO2 emissions. Third, poor people already spend a huge amount of money on fuel-based lighting, which means that there is money in the lighting sector. So, there is already market for lighting and hence the market for solar lighting solutions does not need to be built entirely from scratch. However, there are two major challenges that need to be met in order to realise the potential of business approaches to poverty alleviation in the solar off-grid lighting and charging sector: The access to finance and effective distribution. So, the solar off-grid lighting sector not only shows the potential of a business approach to poverty alleviation, but also the difficulty. Overcoming these difficulties requires partnerships and funding.

Part 3

Introduction

Having established that the potential of a business approach to poverty alleviation in the solar off grid lighting sector is promising and having identified the key obstacles that have to be overcome to realise this potential, this part looks at the implications for a concrete project in this field, the SmartLight project. The first chapter introduces the project and the product. The second chapter then discusses the project in relation to the key challenges for a business approach to poverty alleviation in the solar off-grid lighting sector that have been identified in Part 2. The final section then makes practical contributions to aspects of the future plans of the SmartLight project.

The SmartLight Project

The project

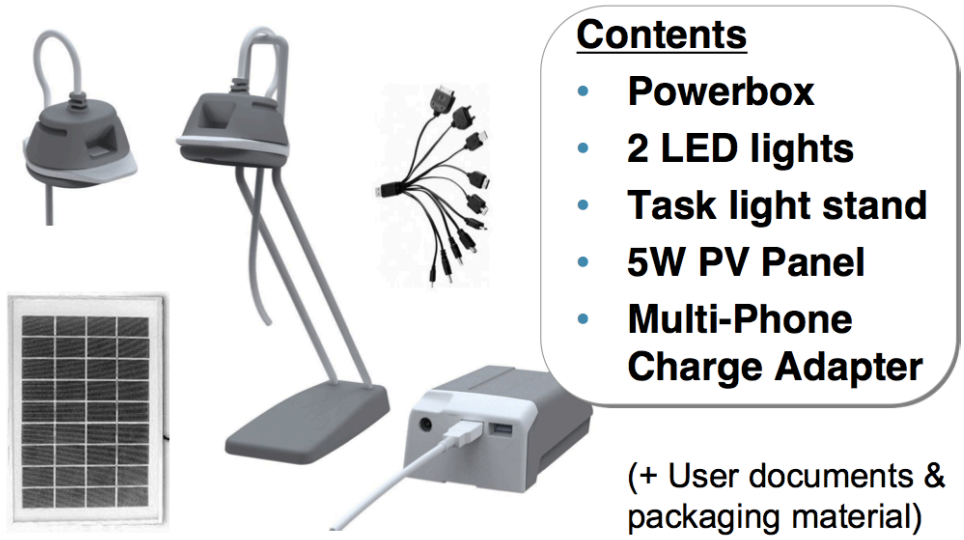
SmartLight is a joint project of Antenna Technologies, Caritas Switzerland, and Bern University of Applied Science. The project is aimed at reducing energy poverty in developing countries by developing and distributing a high quality solar lighting kit. More precisely, a solar lighting kit has been developed at Bern University of Science and a test series of 1000 kits is currently being produced. In the beginning of 2013 these will then be tested in 4 or 5 pilot countries Africa, Asia and Latin America. (Antenna Technologies 2012) The Long term goal of the project is to "create a viable distribution company in the form of a social enterprise that can ensure the long-term distribution of this promising solar off-grid light system through local partners on a profitable basis." (SmartLight 2012a)

The product: The oolux solar lighting system

The oolux solar lighting system is a small home lighting system. In terms of size, price and the features it offers it is between the solar lanterns and task lights and solar home systems. It falls under the IFC (2012) category of solar lighting kits. The oolux solar lighting system consists of a solar panel, the oolux PowerBox, two 1 Watt LED lights and a light stand. The PowerBox contains the battery and an integrated micro-finance software that allows to activate the battery for a certain amount of time. In addition to providing efficient lighting the oolux lighting system also allows to charge mobile phones and other small devices. The system is flexible and modular. The Solar Panel, the PowerBox and the LEDs are all separate items. It is therefore possible to sell it in parts. For example, if the customer already has a solar panel it is also possible to buy the oolux soalar lighting system without the panel. The PowerBox allows charging with any type of solar panel between 1 and 10 Watt. The oolux lighting system offers a high performing battery and a long runtime. The runtime is 32 hours with one light and 16 hours with both lights. The oolux solar lighting system has been designed with an emphasis on quality, design, functionality and user-friendliness. (SmartLight 2012b ; Antenna 2012)

The key asset, which distinguishes the oolux lighting system from other products available on the market, is the integrated microfinance system. This is described in more detail below.

Figure 5: The oolux solar lighting system



Source: SmartLight Project 2012

The oolux payment system

The oolux solar power kit features an integrated micro-financing system. The system is designed in a way to consolidate both customers and supplier's interests. On the one hand it accommodates poor people's income patterns and spending habits by allowing them to pay in instalments of different sizes, thus making it more affordable. On the other hand it seeks to minimize the risk of non-payment. More precisely, the oolux financing system allows for the activation of the PowerBox for a certain amount of time corresponding with the instalment paid. The system is roughly comparable with the pre-paid system for mobile phones. When the customer buys pre-paid airtime he can telephone for a certain number of hours corresponding with the top up amount bought. When the pre-paid airtime is used up the customer cannot make any more phone calls. The oolux solar power kit works in a similar way. The customer pays for having light for a certain amount of time, for example one week. The PowerBox is then activated for the length of this period and the customer can use it for lighting or for charging small devices. When the time period the customer paid for ends the PowerBox automatically deactivates itself and does not give any light anymore until the customer pays the next instalment. (Antenna 2012; SmathLight 2012b)

Potential and challenges of the SmartLight Project

The SmartLight Project has a high potential of success for several reasons. First, and most importantly, it offers a solution how to overcome the number one obstacle in the solar-off grid

lighting and charging market: The consumers spending patterns and lack of access to finance. The oolux payment system allows to mimic the spending pattern of kerosene-based lighting very closely. Also, the payment system is designed in a way to minimize the risks of microfinance systems. The risk faced by the customer is low because he can pay in small amounts and irregularly depending on the cash at hand and because the retailer remains responsible for the performance of the product. The risk faced by the retailer is also reduced because there is a strong incentive for the customer to pay, as the PowerBox switches off, when the next payment is due. Second, the oolux solar lighting system has all the features and characteristics that market studies have shown to be particularly valued by customers: The oolux lighting system features two lamps, that can be either hung from a hook or attached to a task light stand, it allows to charge small devices like mobile phones, it is modular and the panel can be detached from the lamps and the PowerBox, it offers a high performing battery and long runtimes. However, whether this promising potential of the oolux lighting system is confirmed in the market will only be sure after the field tests the SmartLight project is planning for 2013. Assuming that the payment system will work, there is still one key obstacle to be overcome: Distribution.

The Next Steps

The SmatLight Project has four central tasks planned for the near future. First, conducting field tests in 4 or 5 developing countries in the beginning of 2013. Second, to refine the product and the payment system through continuous research on new technologies. Third, to develop a business model that allows the effective distribution of the oolux lighting system. And finally, planning for scale and creating a viable distribution company. (SmartLight 2012a) This section is aimed at making practical contributions to the first two future tasks: The upcoming field tests and the future development of the payment system.

Possible future developments of the oolux payment system

Cash/Retailer

This is the current system that will be employed for the field tests. It works as follows: The customer brings the PowerBox to the retailer and buys “oolux time” to top up his/her account. The retailer then branches the PowerBox to his/her computer (a smartphone or tablet would also be a possible solution) and activates the PowerBox for a certain time corresponding with the top up amount. (SmatLight 2012b)

The advantages of this system are: First, that it is very straightforward. For the customer it's almost the same as going to the store to buy kerosene. Second, it is very flexible. Top up amounts are not predetermined. So the customer can choose whichever amount he/she wants to pay and the software translates this into the corresponding amount of time, such as 1 month or 1 week. Also, the pricing plan can be set up individually for each location and it can be adjusted if necessary. Third, this system does not depend on any additional infrastructure than an activation device and a data server for the account management. Finally, and most importantly, this payment system allows close links with the customers because there is regular direct interaction between the retailer and the customers. This can be a very valuable asset because customers are more likely to trust the system when they have a local contact point and the retailer is well placed to make sure that customers make their payments and to provide after sales service. The retailer can also be a valuable source of market intelligence.
However, there are also a number of interrelated challenges and drawbacks to this system: The customer needs to travel physically in order to top up his/her account, which means that the retailer needs to be located close to the customers. So, in areas where population is dispersed the retailer/customer ratio will be relatively high. This is of course a cost factor, especially since every retailer needs to be provided with a small computer that allows him/her to activate the PowerBox. In addition to this the retailer also needs some technical expertise to be able to manage the payment system. (SmartLight 2012c)[1]

Scratch Card

This payment system is almost the same as the pre-paid system for mobile phones where the customer buys a scratch card, sends the code on the scratch card to a server which then tops up his account. In the case of oolux there are two variations imaginable. One version works as follows: The customer buys an oolux top up scratch card that has a certain value in terms of lighting time. Next, he/she sends the code on the scratch card via SMS to a central server. The server then sends back another code, which the customer then has to tap into the PowerBox via an integrated keypad. The PowerBox recognises the code and activates itself for the duration corresponding with the value of the scratch card. The other version works as follows: The customer buys the scratch card and then directly taps the code on the scratch card into the PowerBox via a keypad. The PowerBox then sends an SMS to the central server, which responds and activates the PowerBox for the time purchased. (SmartLight 2012c)

[1] SmartLight internal document developed by Abdurrahman Dhina (Antenna) and the author.

The main advantage of the scratch card system is that it allows for more flexibility in terms of the retailers who sell “oolux time”. Almost any entrepreneur can stock and sell scratch cards, even travelling salespeople and street vendors. The reason for this is that they do not need any additional equipment or infrastructure, nor any technical expertise. So, the choice of possible sellers of “oolux time” is much larger, which also makes it easier to reach customers in remote areas. And the costs of providing the local retailer with a small computer fall away. Scratch Cards, even in very high numbers, are very cheap to produce. A good illustration of the advantages of this system is that nowadays one can buy scratch cards to top up mobile phone accounts even in the remotest village shops. The fact that with scratch cards many more entrepreneurs have the capacity to sell “oolux time” is a major advantage compared to the Cash/Retailer system. In addition, this system also adds convenience for the customers because they do not need to bring the PowerBox to the specially designated retailer each time they want to top up their account. They simply need to buy a scratch card, which can easily be done in passing for example on the way back home from work. (Ibid.)

There is one major challenge to the scratch card payment that if not resolved translates into a huge disadvantage. The system only works if there is a sufficient supply of scratch cards at all times and in the vicinity of all oolux customers. It would be a very bad situation if oolux customers were without light because they are unable to find scratch cards to top up their oolux account. The future company of the SmartLight project would therefore have to find a way to assure a constant sufficient supply of scratch cards. And just in case, they would have to develop quick efficient remedies or alternatives in case of a shortage in the supply of scratch cards. Certainly, mobile phone companies have been very successful in achieving this, but they are large companies and they have had to make considerable investments. The future oolux company will not have comparable resources in the foreseeable future. In addition to supply there are two other small challenges: First, price adjustments are a little more complicated. Second, the process has to be designed in a user friendly way. This relates mainly to the question of literacy. It is necessary to find a way to make the process understandable and manageable also for illiterate people. (Ibid.)

Furthermore, there is the question of the costs of the necessary adjustments to the PowerBox. Whereas with the first version of the Scratch Card System the price of the PowerBox increases only slightly because of the integrated keypad, the price increase of the PowerBox with the second version is quite substantial because it requires an inbuilt GSM chip/antenna.

Finally, the Scratch Card Payment System has the disadvantage that it is dependent on other infrastructure like an SMS server and a GSM network. (Ibid.)

Pay By Phone

This payment system is based on mobile banking, which is increasingly popular in developing countries. (Must & Ludewig 2010)

There are three variations of this system imaginable. To make distinction easier they are called 'Centralized SMS', 'Direct SMS' and 'Direct Centralized SMS'. (SmartLight 2012c)

In the Centralized SMS version the customer sends the top up amount via mobile banking to a central server. The server then sends a code in return, which the customer then taps into the PowerBox with the help of a keypad. The PowerBox recognises the code and activates itself for the appropriate amount of time. (Ibid.)

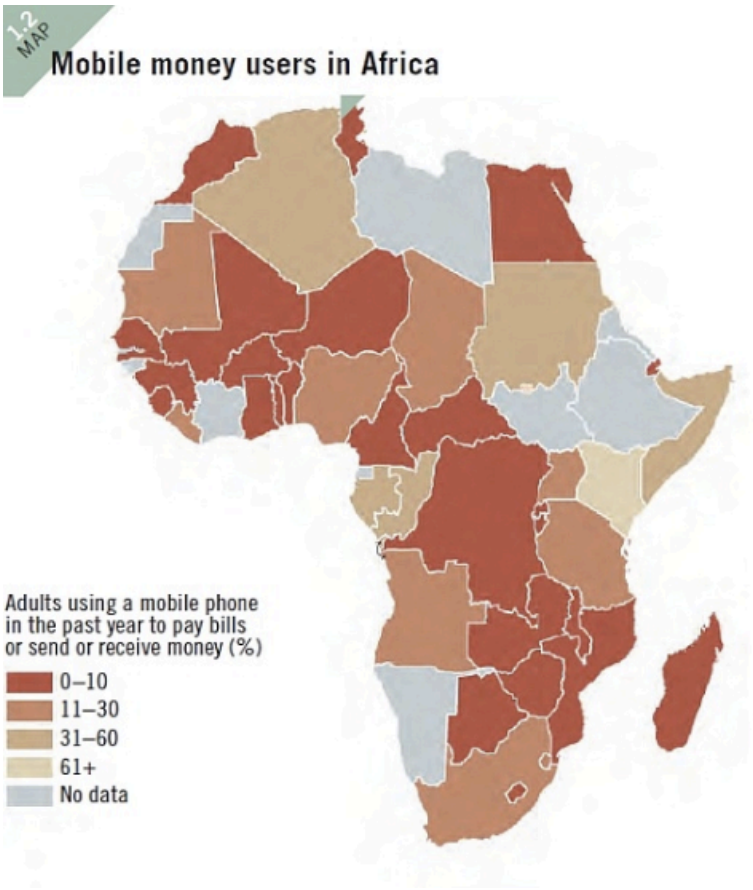
The 'Direct SMS' version works as follows: The customer sends the money via mobile banking directly to PowerBox. (The PowerBox is mobile banking enabled). The PowerBox activates itself for the duration corresponding with the payment and also transfers the money to a central mobile banking account. (Ibid.)

The third version 'Direct Centralized SMS' works like this: First, he customer sends the money via mobile banking service to a centralized server. Then the central server sends an activating SMS directly to the PowerBox. The PowerBox then works for the pre-paid time period. (Ibid)

The Pay By Phone systems have several advantages. First of all, they are very convenient for the customer because he/she can top up their oolux account directly from home and at any time, without having to visit a shop. The fact that customers do not need to have a shop nearby greatly increases flexibility in terms of the geographical distribution of the oolux lighting kit. Second, a partnership with mobile phone companies could also greatly benefit the SmartLight Project in general. (Ibid.) For example is often suggested that piggy-backing on mobile phone companies' distribution networks would be a very smart way to assure efficient distribution. (IFC 2012a) Finally, this system allows for more flexibility in terms of the top up amounts compared to the scratch cards where the amounts are fixed and printed on the scratch cards. (Smartlight 2012c)

The key challenges and drawbacks of the Pay By Phone payment system are the following: First of all, they completely depend on an existing and well functioning mobile banking infrastructure. (Ibid.) And even though mobile banking is growing very fast, it is still far from being universal. (Must & Ludewig 2010)

Figure 6: Mobile Banking in Africa



Source: Demirguc-Kunt and Klapper 2012

Second, two of the Pay By Phone payment systems, Direct SMS and Direct Centralised SMS necessitate quite substantial modifications to the PowerBox. Building in a GSM chip/antenna increases the cost of the PowerBox. The third Pay By Phone System only requires an inbuilt keypad, which only slightly increases the overall cost of the PowerBox. (SmartLight 2012c)

Third, another potential drawback is that the Pay By Phone systems completely bypass the local retailer. This would mean losing all the benefits in terms of marketing, after-sales service and market intelligence the local entrepreneur is likely to provide. This would be lost and other solutions would have to be found to replace it. Closely related to this is that it may be more difficult to convince customers to trust the payment system and the whole value proposition of the oolux power kit if transactions are made exclusively by phone and at great distances. Having no direct contact point customers can approach whenever necessary may significantly reduce customers trust and therefore their willingness to buy the oolux power kit. Finally, assuring that the system is user friendly and can also be managed by illiterate people is again another aspect that needs consideration. (Ibid.)

In comparison to each other, the different Pay By Phone payment systems also have some advantages and drawbacks. The first system, Centralized SMS has the advantage that it needs little modification and is therefore less expensive compared to the other two. The main difference between the other two is that Direct SMS has the advantage that it is more flexible and will work also when the centralized server is temporarily out, whereas the Direct Centralized SMS version has the advantage that the PowerBox does not need to send data, which makes things easier. (Ibid.)

At the moment mobile banking is not yet sufficiently widespread to justify modifying the whole SmartLight project completely towards mobile banking. However, the mobile banking sector is projected to make significant progress in the near future. So, for this reason, it could be a promising alternative in order to not lose the benefits of having a local retailer with a payment system that is a mixture between the Pay By Phone and the Cash/Retailer system. This would allow people to do business where mobile banking infrastructure is not yet in place and to benefit from the advantages of the Pay By Phone system in areas where mobile banking is already widespread. This would also allow for a smooth transition when the mobile banking sector is growing further. (Ibid.)
More precisely, the idea is that the customer could pay the retailer either in cash at the local shop or via mobile banking from home. Or, the customer could pay at the local shop and the retailer would then activate the PowerBox from a distance using a mobile phone of a computer with a GSM modem. However, not all technical aspects of this payment system are completely clear yet, so it will need some further thought and research. (Ibid.)

Custom Card

The Custom Card payment system works as follows: The customer buys a Custom Card, which is like the cards used for photocopying, ski lifts or modern gift vouchers. He/she then holds the Custom Card next to the PowerBox or inserts it into a slit, depending on how the PowerBox will read Custom Cards. The PowerBox then recognises the Custom Card, activates itself for the purchased duration and “breaks” the Custom Card so that it cannot be used again. A possible alternative would be rechargeable Custom Cards. (SmartLight 2012c)
The advantages and challenges of the Custom Card payment system are almost identical to the Scratch Card system. The advantages are that almost any entrepreneur can sell and stock them because he/she neither requires any additional technical equipment, nor any technical expertise and that they are very convenient for the customer because he/she does not need to

bring the PowerBox to the local retailer each time he/she wants to top up his/her oolux account but can simply buy a Custom Card in passing. The main challenge is again, like with the Scratch Card system, to find a way to assure a sufficient supply of Custom Cards at all times and in all relevant locations and to prepare efficient remedies or alternatives in case of a shortage of Custom Cards. Also, the price adjustment is, like with the Scratch Cards, a little more complicated. (Ibid.)

However, despite all the similarities, the Custom Card has both an advantage and a disadvantage compared to the Scratch Cards: The advantage is that the Custom Card is more user friendly because it is very easy to handle and it does not require sending an SMS or tapping a code into the PowerBox. The disadvantage is that the necessary modifications to the PowerBox are more expensive than what is required for the Scratch Card system. (Ibid.)

Conclusion

All of these payment systems have advantages and drawbacks that need to be weighed against each other. The decision on the future payment system will depend on the importance placed on the role of the local retailer in terms of marketing and after-sales service, the future developments of the costs associated with the different payment systems, the evaluation of customer preferences during the field tests and the evolution of the mobile banking sector.

The Field Tests

Introduction

This section is based mainly on the 'Market Creation Toolbox, a guide to entering developing markets', from the BOP Learning Lab. The Market Creation Toolbox is "a set of well-described activities that could support companies with practical guidelines on how to undertake market research in developing countries with a strong inclusion of target groups." (Mollebaek Larsen & Flensborg 2011, p. 12) It is a combination of traditional well known market research activities and best practices and methods from development work and design. "This 'methodology' of the Toolbox has been labelled as 'participatory market research', which defines the approach companies should apply to develop successful commercial projects in developing markets." (Ibid.)

Planning the field tests

The Market Creation Toolbox recommends the following procedure when planning field research: First, clear goals should be established, the key challenges need to be identified, and the target groups need to be defined. Second, partnerships with local organisations should be established and expectations from both sides need to be aligned. Third, a schedule for all tasks, activities, and appointments should be defined. The schedule needs to be well developed and precise, so that research is carried out with efficiency and rigour, but it is very important that it is flexible enough to allow for unplanned activities. Fourth, the activities and the necessary supporting material need to be prepared. (Mollebaek Larsen & Flensborg, 2011)

The SmartLight Project is currently negotiating contracts for the field tests with local partners in 4 or 5 pilot countries. Because this part of the preparation of the field test is still in progress, the tasks of aligning expectations with the local partners (point two of the procedure), and the preparation of a schedule (point three of the procedure) depend significantly on the local partners and on-going negotiations, these points of the procedure will not be treated here and the focus is placed on points one and four, that is to say the identification of the goals, challenges and target groups, and the preparation of the toolbox activities and material.

Goal, challenges and target groups

According to the Market Creation Toolbox planning the field research should start with getting focused. This means developing a clear goal, defining the challenges, and defining the target groups. (Mollebaek Larsen & Flensborg, 2011) The goal, challenges and target groups for the SmartLight Field Research are as follows:

The goal:

> The goal of the SmartLight field research is to validate the project before scaling up and creating a social enterprise.

The challenges for the SmartLight field research are:

> To test the acceptance of the oolux power kit among target beneficiaries and to find out whether there is a sufficient demand for the oolux power kit to justify going through with the plan of scaling up and creating a social enterprise.
>
> Assess the socio-economic impact of the oolux light on customers and retailers in order to evaluate its contribution to poverty alleviation.
>
> To inform future technical developments of the product and the payment system, based on technical performance and feed-back from customers, retailers and local partner organisations.
>
> To inform the future development of the business model, especially regarding distribution and suitable partnerships.

(SmartLight 2012a)

It is vital to stay open to new challenges throughout the process. It is likely that the knowledge gained during the field research will lead to different challenges. (Mollebaek Larsen & Flensborg, 2011)

There are three main target groups that the SmartLight field test should examine:

> First of all, the (potential) oolux customers. This includes both families who have use for improved lighting and charging of small devices at home and micro-entrepreneurs who benefit from better light and charging of small devices for their work. It is likely that many will fall under both of those target group categories. The second target group are local retailers, who (could) distribute oolux and manage the payment system. Third, the field test should look at workers and experts who work for the local partner organisation and who are involved in this project.

Having identified the goal, challenges and target groups the next two steps the Market Creation Toolbox suggests for the preparation of the field research, establishing partnerships

and preparing a schedule, are not treated here, but the following one, the preparation of toolbox activities and material, is treated below.

Adapting the Tools to the SmartLight Project and creating supporting material

The Market Creation Toolbox consists of a set of 15 tools (deep dialogue, self-documentation, activity map, social map, resource flow, follow & observe, learning by doing, customer segmentation, creating scenarios, price mapping, designing value proposition, prototyping, concept assessment, and product in market) that can be useful in gathering information on 7 business model dimensions (rapid market assessment, customers and end-users, including end-users, distribution system, pricing and financing, marketing and communication and service and maintenance). The tools can be mixed and matched, but not all tools are useful for all business model dimensions. Two of the tools, 'deep dialogue' and 'follow & observe', however are recommended for gathering information on all business model dimensions. Mollebaek Larsen & Flensborg 2011) 'Deep dialogue' is essentially conducting semi-structured interviews and 'follow & observe' is about observing people from the target group "in their activities, environment, or during the specific use of a product." (Mollebaek Larsen & Flensborg 2011, p. 68) The next section proposes activities and materials for the SmartLight field tests mainly based on the 'Deep Dialogue' tool, but also containing some elements of other tools, more precisely, 'Follow & Observe', 'Price Mapping', 'Ranking Values', 'Product in Market', 'Activity Map' and 'Social Map'.

The first step in the 'Deep dialogue' tool is to identify the topics of the field research and to define what information and knowledge should be gathered and which questions the field research should address. (Mollebaek Larsen & Flensborg 2011, p. 68) These questions are not the questions that will be asked in the semi-structured interview but questions that the field researchers pose themselves and ideally should be able to answer at the end of the field tests. Since the field tests can also be considered case studies, this distinction of different levels of questions can be illustrated by case study research design.

Yin (2009) distinguishes between 5 different levels of questions. Levels 1 to 3, and possibly 4 are relevant for the SmartLight field tests.

Figure 6: Levels of Interrogation according to Yin

Level 1:	questions asked of specific interviewees;
Level 2:	questions asked of the individual case (these are the questions in the case study protocol to be answered by the investigator during a single case, even when the single case is part of a larger, multiple-case study);
Level 3:	questions asked of the pattern of findings across multiple cases
Level 4:	questions asked of an entire study – for example, calling on information beyond the case study evidence and including other literature or published data that may have been reviewed; and
Level 5:	normative questions about policy recommendations and conclusions, going beyond the narrow scope of the study.

Yin 2009, p. 87

Thus, for the SmartLight project, the interrogation levels can be defined as follows:

Figure 7: SmartLight Field Research Interrogation Levels

Level 1:	the questions posed to individuals from the target groups in semi-structured interviews;
Level 2:	questions directed at each researcher of each field test
Level 3:	questions asked across all findings from the 4 or 5 SmartLight field tests
(Level 4:	questions asked of the entire study, if SmartLight decides to conduct an entire study based on the 4 or 5 case studies.)

Source: own illustration based on Yin (2009)

Level 3 questions can be considered as roughly equivalent to the challenges of the field research identified at the beginning of this chapter.

> Is there a sufficient demand for the oolux power kit to proceed with the plans for scale?
>
> Does the oolux power kit have a poverty alleviation impact?
>
> How should the product and the payment system be adapted and further developed?
>
> What are potential distribution channels, partners and further developments of the business model?

Level 2 questions will be more numerous and detailed. Examples of possible level 2 questions are:

With what aspects of the oolux lighting system are customers satisfied with and with which not?

Are customers, retailers and partner organisations satisfied with the payment system?

Which type of customers are interested in buying oolux?

What are successful marketing strategies

How did the distribution work?

Are there other possible distribution networks imaginable?

How well did the pricing work?

How could the oolux lighting system be improved?

How could the payment system be improved?

Has the local partner been valuable?

These are just examples of possible level 2 questions. The precise questions will depend on the development of the business models in the lead up to the field tests and also on the local partners.

A suggestion of possible material to support and guide the researcher in gathering the information necessary to answer level 2 questions is presented in Annex 1. As previously stated the material is based mainly on the 'deep dialogue' tool and complemented by elements from other tools of the Market Creation Toolbox, more precisely 'Follow & Observe', 'Price Mapping', 'Ranking Values', 'Product in Market', 'Activity Map' and 'Social Map'.
(Mollebaek Larsen & Flensborg, 2011)

Instructions for the researcher are in italics and suggestions for level 1 questions are in normal writing. The questions are on the left and on the right hand side is stated what type of information the questions seek to obtain. Or in other words, in what topic the answer to the question will hopefully offer new insights.

The following guidelines on the preparation of a semi-structured interview have informed the preparation of the material for the SmartLight field tests in Annex 1: First, questions aimed at obtaining general information about the person should be included. Asking these questions first, before addressing the research topics, shows interest and is therefore a good way to start. Second, the questions should be organised under research topics. Third, the document should

include guidelines for the researcher. Fourth, it is advisable to document additional key points directly after the interview. And finally, whenever possible open ended questions should be favoured and leading questions avoided. (Mollebaek Larsen & Flensborg, 2011)
In addition to the instructions on how to prepare a semi-structured interview, the Toolbox also recommends the following practices for the person who conducts the interviews: First, it is important not to want to control the dialogue but to listen. The questions do not have to be asked in the order in which they are on the document and researchers are encouraged to ask additional questions to follow up on interesting topics and facts that come up during the conversation. Second, hiding the list of questions and learning key questions by heart can help to make the dialogue more dynamic and more fruitful.

Of course the material proposed in Annexe 1 will probably have to be adapted and refined as more and more information on the local partners and on the plans for the future business model becomes available in the lead up to the field tests.

Conclusion

Replacing fuel-based lighting with solar off-grid lighting solutions has substantial benefits. It reduces health hazards, enables children and adults to study and read in the evenings, allows longer and more flexible working and shop opening hours, leads to household savings on energy expenditure and reduces people's vulnerabilities to the fluctuations in kerosene prices due to fluctuations in the world oil prices. Improved health results in both higher productivity and household savings due to lower health expenditures. An increase in productivity and savings is known to have a significant positive impact on poverty alleviation. Longer studying hours improve education, which in turn has been proven to be a way out of the poverty trap. Both, the higher productivity from longer working hours and the savings made on energy expenditure result in higher disposable incomes, which in turn is crucial to get out of poverty. Since the proportion of energy expenditure in poor people's household budgets is substantial, reducing their vulnerability to price fluctuations and even enabling savings significantly improves their situation. Also, the possibility to charge mobile phones can significantly improve the lives of the poor. ICTs help to reduce the poor's vulnerabilities by improving their access to information. All this shows that solar off-grid lighting and charging solutions have multiple positive influences on poverty reduction. If, in addition to all this, poor people are integrated at various points in the value chains of solar off-grid lighting and charging solutions, a private sector approach to poverty alleviation in the solar off-grid lighting and charging sector has the potential to translate into a very high poverty alleviation impact.

The potential of a business approach to poverty alleviation in the solar-off grid lighting and charging sector in terms of economic viability is not as clear as the potential in terms of poverty alleviation impact. On the one hand, poor people collectively already spend billions of dollars on traditional lighting and charging services, which shows that there is a substantial amount of money in the lighting and charging market. On the other hand, this market is only addressable if consumer financing to spread the costs of solar lighting solutions over time can be offered. This, the distribution challenge, and the need for customer education make endeavours in the solar off-grid lighting and charging market costly. So, in conclusion it can be said that a business approach to poverty alleviation in the solar off-grid lighting and charging sector has the potential to be economically viable, but it will require funding in the initial stages and it will take some time to break even.

A business approach to poverty alleviation in the solar off-grid lighting and charging sector has also the potential to contribute substantially to environmental sustainability because the replacement of fuel based-lighting with solar solutions significantly helps to reduce CO2

emissions. There is however one aspect that could relativize this. So far, little consideration is so far placed on the recycling of the batteries of the solar lighting solutions.

So, overall a business approach to poverty alleviation in the solar off-grid lighting and charging sector is very promising.

The implications for the SmartLight project are that the project can be expected to be very successful in terms of poverty alleviation impact. Especially since it the retailer payment system also consciously integrates poor entrepreneurs into the value chain. Also, since, with the offer of an integrated microfinance mechanism in the oolux lighting system, the project is already very well placed in terms of overcoming the number one challenge in the solar off-grid lighting and charging market: consumer financing. So, if the project successfully addresses the two other challenges, distribution and customer education it can be expected to also be economically viable. However, this projection will first have to be confirmed in the upcoming field tests.

References

Achwal N. (2010). Getting BoP Products in Consumers' Hands-MFIs and Micro-dealers Can Help. Next Billion 2.0. development through entreprise. 7 May 2010. Available at: http://www.nextbillion.net/blogpost.aspx?blogid=1796 (Accessed 14 July 2012)

Anisuzzaman, M. and Urmee, T. (2006). Financing Mechanisms of Solar Home Systems for Rural Electrification in Developing Countries, International Conference on Energy for Sustainable Development: Issues and Prospects for Asia, Phuket, Thailand, March 2006. Available at:http://www.researchgate.net/publication/228412560_Financing_Mechanisms_of_Solar_Home_Systems_for_Rural_Electrification_in_Developing_Countries (Accessed 9 September 2012)

Antenna Technolgies (2012). Rapport Annuel 2011 Antenna Technologies. Genève: Antenna Technologies.

Avato, P. and Madeira, L. (2010). Innovative marketing and business models for the rapid development of off-grid lighting markets in Africa. *Boiling Point*, issue 58, p. 6-8. Available at: http://www.hedon.info/View+Article&itemId=10201 (Accessed 13 July 2012)

Banerjee, A. and Duflo, E. (2011). Poor Economics. New York: Public Affairs.

BMZ (2009). Geschäfte für Entwicklung, Bewertung des BoP-Ansatzes aus entwicklungspolitischer Sicht. BMZ Diskurs 016, Stand September 2009. Bonn: Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ).

Glemarec, Y. (2012). Financing off-grid sustainable energy access for the poor. *Energy Policy*, vol. 47 (s1), p. 87-93. Amsterdam: Elsevier Science.

Gradl, C. and Knobloch, C. (2011). Energize the BOP! Energy Business Model Generator for Low-Income Markets - A Practitioner's Guide. Berlin: endeva UG.

Hammond A. et al. (2007). The Next 4 Billion, Market Size and Business Strategy at the Base of the Pyramid. Washington: World Resource Institute (WRI) and International Finance Corporation (IFC).

Hammond, A. (2011). BoP Venture Formation for Scale. In: London, T. and Hart, S.L. (ed.). Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press. p. 193-215.

Hart, St. (2011). Taking the Green Leap to the Base of the Pyramid. In: London, T. and Hart, S. L. (ed.) (2011). Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press. p. 79–102.

Hart, St. and Christensen, C. (2002). The Great Leap, Driving Innovation From the Base of the Pyramid. *MIT Sloan Management Review*, vol. 43, Fall 2002, p. 51–56.

Heierli, U. (2000). Poverty alleviation as a business. Berne: Swiss Agency for Development and Cooperation.

Heierli, U. (2008). Market Approaches that Work for Development. Berne: Swiss Agency for Development Cooperation.

IEA (2003). Summary of Models for the Implementation of Photovolataic Solar Home Systems in Developing Countries, Part 1 and 2. IEA. Available at: http://www.iea-pvps.org/index.php?id=9&no_cache=1&tx_damfrontend_pi1[pointer]=2 (Accessed 13 July 2012)

IEA (2008). Renewable Energy Services for Developping Countries. IEA. Available at: http://www.iea-pvps.org/index.php?id=9&no_cache=1&tx_damfrontend_pi1[pointer]=1 (Accessed 13 July 2012)

IEA/UNDP/UNIDO (2010). Energy Poverty, How to make modern energy access universal?. Paris: OECD/IEA.

IFC (2007). Selling Solar, Lessons from more than a decade IFC experience, Washington DC: IFC, Available at: http://www1.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publications/publications_loe_sellingsolar__wci__1319577385747 (Accessed 14 July 2012)

IFC (2012a). From Gap to Opportunity: Business Models for Scaling Up Energy Access. IFC. Available at: http://www1.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publications/publications_report_gap-opportunity (Accessed 11 Sept. 2012)

IFC (2012b). Lighting Asia: Solar Off-Grid Lighting. New Dehli: IFC, Available at: http://www1.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/publications/publications_report_lightingasia (Accessed 4 September 2012)

Jenkins B.et al. (2008). Supporting Entrepreneurship at the Base of the Pyramid, Report of a Roundtable Dialogue June 10-12, 2008, Rio de Janeiro, Brazil. Washington, DC: International Finance Corporation, International Business Leaders Forum, and the CSR Initiative at the Harvard Kennedy School. Available at: www.hks.harvard.edu/m-rcbg/CSRI/publications/report_31_Business%20Linkages%20Rio.pdf (Accessed 2 July 2012)

Jose, P. D. (2008). Rethinking the BOP: New Models for the New Millennium, Academic Perspective. *IIMB Management Review*, June 2008, p. 198–202.

Kandachar, P. and Halme, M. (2006). Introduction. *Greener Management International*. Summer 2008, Issue 51, p. 3-17

Karnani, A. (2007). The Mirage of Marketing to the Bottom of the Pyramid: How the Private Sector Can Help Alleviate Poverty. *California Management Review*, vol. 49 no. 4, Summer 2007, p. 90-110.

Karnani, A. (2009a). The Bottom of the Pyramid Strategy for Reducing Poverty: A Failed Promise. UN/DESA Working Paper No. 80. New York: UN/DESA. Available at: http://www.un.org/en/development/desa/papers/2009/index.shtml (Accessed 14 July 2012)

Karnani, A. (2009b). Romanticizing the Poor. *Stanford Social Innovation Review*, Winter 2009, p. 38–43.

Klein, M. (2008). Poverty Alleviation through Sustainable Strategic Business Models. Rotterdam: Erasmus Research Institute of Management, Erasmus University of Rotterdam

Kennedy, R. and Novogratz, J. (2011). Innovation for the BOP: The Patient-Capital Perspective. In: London, T. and Hart, S. L. (ed.). Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press. p. 45–76.

Lighting Africa (2010). Solar Lighting for the Base of the Pyramid, Overview of an Emerging Market. IFC. Available at: http://www.lightingafrica.org/resources/market-research.html (Accessed 10 September 2012)

Lighting Africa (2011). The Off-Grid Lighting Market in Sub-Saharan Africa: Market Research Synthesis Report. Lighting Africa. Available at: http://www.lightingafrica.org/resources/market-research.html (Accessed 26 September 2012)

Lighting Africa (2012). Lighting Africa Progress Report, 1 July 2010 – 30 June 2011. IFC. Available at: http://www.lightingafrica.org/report-for-the-financial-year-2011.html (Accessed 14 July 2012)

London, T. (2011) Building Better Ventures with the Base of the Pyramid: A Roadmap. In: London, T. and Hart, S. L. (ed.). Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press. p. 19–44.

London, T. and Hart, St. (2011a). Creating a Fortune with the Base of the Pyramid. In: Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press. p. 1–16.

London, T. and Hart, St. (2011b). A Continuing Journey, In: Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press. p. 217–232.

London, T. and Hart, St. (ed.) (2011). Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press.

Møllebæk Larsen, M.L. and Flensborg A. (2011). Market Creation Toolbox. Rodovre: Kailow express, Available at: http://www.boplearninglab.dk/bop-learning-lab/trends-markets-cases/market-creation-tool-box/get-the-toolbox.html (Accessed 28 October 2012)

Must, B. and Ludewig, K. (2010). Mobile Money: Cell Phone Banking in Developing Countries. *PolicyMatters Journal*, vol. 7 (2), Spring 2010, p. 27-33. Available from: http://policymatters.net/?p=536 (Accessed 11 Sept. 2012)

OECD/IEA (2010). World Energy Outlook 2010. Paris: International Energy Agency (IEA).

Pode, R. (2009). Solutions to enhance the acceptability of solar-powered LED lighting technology. *Renewable and Sustainable Energy Reviews* 14, 2010, p. 1096–1103, Amsterdam: Elsevier Science.

Practical Action (2010). Poor people's energy outlook 2010: Energy for earning a living. Rugby: Practical Action Publishing.

Practical Action (2012). Poor people's energy outlook 2012: Energy for earning a living. Rugby: Practical Action Publishing.

Prahalad, C. K. (2005). The Fortune at the Bottom of the Pyramid. Upper Saddle River NJ: Wharton *School* Publishing.

Prahalad, C. K. (2010). The Fortune at the Bottom of the Pyramid: Eradicating Poverty Through Profits. Upper Saddle River NJ.: Prentice Hall, Pearson Education Inc.

Prahalad, C. K. and Hammond, A. (2002). Serving the World's Poor, Profitably. *Harvard Business Review*, September 2002, p. 4–11.

Prahalad, C. K. and Hart, St. (2002). The Fortune at the Bottom of the Pyramid. *Strategy + Business*, issue 26, first quarter 2002. p. 1-14.

Rangan, V. K. et al. (2011). Segmenting the Base of the Pyramid. Harvard Business Review 89, no. 6, June 2011, p. 113-117.

Reiche, K. et al. (2011). Que peut apporter un système pico PV? Eschborn: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).

Simanis, E. (2009). At the Base of the Pyramid. MIT Sloan Management Review, Oct. 2009, p. 1-5, Available at: http://sloanreview.mit.edu/executive-adviser/2009-4/5144/at-the-base-of-the-pyramid (Accessed 2 October 2012)

Simanis, E. (2011). Needs, Needs Everywhere, But Not a BoP Market to Tap. In: London, T. and Hart, S. L. (ed.). Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press. p. 103–126.

Simanis, E. and Hart, St. (2008). The Base of the Pyramid Protocol: Toward Next Generation BoP Strategy, 2nd ed. Available at: http://www.bop-protocol.org/docs/#protocolv1 (Accessed 29 June 2012)

Simanis, E. et al. (2005). Strategic Initiatives at the Base of the Pyramid, A Protocol for Mutual Value Creation, Version 1.0. Available at: http://www.bop-protocol.org/docs/#protocolv1 (Accessed 22 September 2012)

Stewart, L. et al. (2011). Do micro-credit, micro-savings and micro-leasing serve as effective financial inclusion interventions enabling poor people, and especially women, to engage in meaningful economic opportunities in LMICs? London: Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre).

Tracey, J. and Jacobson, A. (2012). The True Cost of Kerosene in Rural Africa. Lighting Africa. IFC. Available at: http://www.lightingafrica.org/resources/market-research.html (Accessed 13. Sept. 2012)

UNDP (2008). Creating Value For All: Strategies For Doing Business With the Poor. New York: United Nations Development Programme (UNDP).

UNDP (2010). The MDGs: Everyone's Business, How inclusive business models contribute to development and who supports them. New York: United Nations Development Programme (UNDP).

UNDP (2011). Universal Energy Access. UNDP Fast Facts, July 2011. Available at: http://www.undp.org/content/undp/en/home/librarypage/results/fast_facts/fast_facts_universalenergyaccess.html (Accessed 2 October 2012)

UNDP/UNCDF (2012a). Financing Energy Access fort the Poor, Policy Brief, Rio de Janero, June 2012. Available at: http://www.uncdf.org/en/practitioners-guides (Accessed 2 November 2012)

UNDP/UNCDF (2012b). Clean Start, Microfinance Opportunities for a Clean Energy Future. Available at: http://www.un-energy.org/publications/3504-cleanstart-microfinance-opportunities-for-a-clean-energy-future (Accessed 2 November 2012)

UNDP/WHO (2009). The Energy Access Situation in Developing Countries, A Review Focusing on Least Developed Countries and Sub-Saharan Africa. New York: UNDP and WHO.

UNEP/WHO (2010). Healthy environments for healthy children: key messages for action. Geneva: WHO Press.

U.N. General Assembly (2011). Resolution 65/151, International Year of Sustainable Energy for All. 16 February 2011, Available at: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/65/151 (Accessed 9 November 2012)

U.N. General Assembly (2012). International Year of Sustainable Energy for All, 2012, Report of the Secretary General. 16 August 2012, Available at: http://daccess-ods.un.org/TMP/8188697.09968567.html (Accessed 9 November 2012)

UNIDO (2009). Scaling Up Renewable Energy in Africa. Vienna: UNIDO.

Viswanathan, M. (2011). A Microlevel Approach to Understanding BoP Marketplaces. In: London, T. and Hart, S. L. (ed.). Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press. p. 129–164.

Whitney, P. (2011). Reframing Design for the Base of the Pyramid. In: London, T. and Hart, S. L. (ed.). Next Generation Business Strategies for the Base of the Pyramid: New Approaches for Building Mutual Value. Upper Saddle River N.J.: Pearson Education, Inc., FT Press. p. 165–192.

Yin, R. (2009). Case Study Research Design and Mehods (4th ed). Thousand Oaks: SAGE Publications, Inc.

Annex 1: Field Test Material

Customer

Date	Orientation
Location	Orientation
Customer Name(s)	Orientation
m/f?	Orientation
Customer Number	Orientation

General Information/Background Information

How does the customer live? (Observations)

Give a short description

• *Rural or urban area?*	*Background information* *Customer profile*
- *What is in the neighbourhood?*	*Background information* *Customer profile*
- *Shops/kiosk or infrastructure nearby?*	*Infrastructure* *Distribution*
- *Type and size of housing?*	*Customer profile*
- *Other impressions?*	*Additional observations*
→ *if the customer is completely ok with it please take a **picture***	*Additional information*

Occupation and Income

• What is your occupation/How do you earn a living?	Customer profile
• Where do you work? (At home, near home or far away?)	Customer profile Distirbution
• *Try to find out about income and income pattern (e.g. seasonal)?*	*Customer profile* *Pricing*

Who else lives in the same household and what do they do?

• Adults, Schoolchildren, small children? Gender?	Customer profile Socio-economic impact

Oolux specific Questions

Oolux Functioning

• Does it work well?	Product performance Customer satisfaction
• What doesn't work well? Which problems did you encounter?	Product performance Further product development Customer satisfaction
• Were you able to find a solution for the problems (if yes which) or do you still have the problem?	Product performance Further product development
• What do you like most about oolux?	Customer satisfaction Value proposition Marketing strategies
• Could you please show/demonstrate/explain us how and where you use oolux? Please show us all different uses	Product performance Value proposition Socio-economic impact
→ *if the customer is completely ok with it please take **pictures** – otherwise give a short description and/or draw*	
→*Please Note in particular whether the customer uses oolux merely for home activities or also for income generating activities? Are children using it for studying?*	
• Who in your household uses oolux most/benefits most? Why?	Socio-economic impact Marketing strategies
• Have you charged it merely with sunlight or also at a power station?	Product performance Value proposition

Payment System

• What do you think about the payment system? Is it good?	Customer satisfaction Future payment system
• Do you think the price (upfront payment, weekly/monthly payment) is adequate?	Customer satisfaction Pricing
• How long do you have to work to come up with this amount of money?	Pricing Customer profile Socio-economic impact
• What else could you buy with the same money? (upfront payment, weekly/monthly payment)?	Pricing Customer profile

Top Up Location (Shop/Village Kiosk where the customer pays for oolux)

• Where do you top up your oolux account?	Orientation
• How far from home/work is the top up location? (km? time?)	Distribution Customer profile
• How does the customer go there? (e.g. on foot, bike, …)	Distribution Customer profile
• Did you habitually go there before or do you go especially to make your oolux payment?	Distribution Background information
• What else do you buy/do at the shop/top up location?	Distribution Customer profile
• How often do you go there? Has this changed with oolux?	Background information Distribution
• When do you usually go to there? Would it be a problem if you had to go there at a different time/day of the week? (e.g. because of working hours)	Customer profile Distribution
• In general is the top up location convenient?	Distribution Customer satisfaction
• Do you trust the shop owner/person who manages your oolux account?	Distribution Customer satisfaction Furure payment system
• "If you could choose to top up your oolux account somewhere else, where would you prefer to go?"	Distribution

What has changed for the customer since having oolux?

• What is better now that you have oolux?	Socio-economic impact Customer satisfaction Value proposition Marketing strategies Product performance
• What was better before?	Socio-economic impact Customer satisfaction Further product development
• Do you use more artificial lighting than before? (hrs/day)	Socio-economic impact
• Has oolux brought about changes in what you do in the evening?	Socio-economic impact Marketing strategies
• Has oolux influenced your working hours or what	Socio-economic impact

you do in your free time?	Marketing strategies
• Does oolux help you to earn or save money? How?	Socio-economic impact Marketing strategies
• Have neighbours/visitors/friends asked you about oolux? What did they ask you?	Marketing strategies

Suggestions for Improvement

• What would you change about oolux? How could we improve it?	Further product development Customer satisfaction
• If you could have oolux in a different colour which one would you choose? Please rate first three preferences → *show picture with examples*	Further product development Customer satisfaction
Among the following changes, what would you appreciate most? Please rate the first three preferences:	Further product development Pricing Distribution Future payment system Customer profile
- top up location nearer to your home/workplace	Distribution
- lower price per week/month	Pricing
- lower upfront cost	Pricing
- Payment in smaller instalments (e.g. per day)	Pricing
- top up with scratch card (like mobile phone) → not necessary to take the powerbox to the top up location	Future payment system
- an oolux representative comes by your house once a week to collect your payment and activate your powerbox → not necessary to take the powerbox to the top up location	Distribution Future payment system
- you can pay by mobile phone	Future payment system
- you can power a radio/small television… with the power box	Further product development

Energy access, use and knowledge pre oolux

• What did you use for lighting before? (kerosene, grid, solar lantern,…)	Background information Customer profile Socio-economic impact
• How did you charge your mobile phone?	Background information
• How much did you spend on lighting before? (per week)	Socio-economic impact Customer profile Pricing
• Have you access to grid electricity? How reliable is it? How expensive?	Background information Customer profile
• Were you familiar with solar lighting before? - Have you made experience with solar lighting before? - did you know someone who uses solar lighting? - Had you heard about solar lighting before? - Were these experiences/stories you heard positive or negative?	Customer profile Marketing strategies

Oolux potential

• Do you think there are other people who would be interested to buy oolux?	Demand
• How many people/families do you know who you think would like to buy oolux too?	Demand

Oolux Test Participation

• What was your motivation to participate in the test?	Customer profile Marketing strategies
• What did you like about the proposition?	Marketing strategies Customer satisfaction
• What did you worry about in the beginning?	Marketing strategies

Additonal Information

Ask the customer about general plans for the future, wishes, worries etc.?	*Additional information* *Customer profile*
What else did the customer tell you/ask you/want to show you etc.?	*Additional information*
Please note other impressions/observations/ideas/concerns you think are important.	*Additional information*

Top Up Location/Local Retailer – Interview and Observations

Date	Orientation
Location	Orientation
Name Entrepreneur	Orientation
m/f	Orientation
Shop Name	Orientation
Oolux Retailer Number	Orientation

General Information

Description of the shop/entrepreneur

Give a short description

• *Type and size of shop*	*Background information* *Distribution* *Retailer profile*
• *Rural or urban area?*	*Background information* *Retailer profile*
• *What is in the neighbourhood?*	*Background information* *Distribution*
• *Shops/kiosk or infrastructure nearby?*	*Background information* *Distribution*
• *What other products does the entrepreneur sell/What other services does the entrepreneur provide?* *- Opening hours?* *- Other impressions?* → *if the entrepreneur is completely ok with it please take a **picture***	*Retailer profile* *Distribution* *Marketing strategies* *Retailer profile* *Distribution* *Additional information*

About the Shop/Entrepreneur

• What products do you sell?	Retailer profile
• What products do you sell most?	Retailer profile Distribution Customer profiles
• What is the cheapest/most expensive product you sell?	Retailer profile Customer profile Pricing
• From where do you get the products you sell?	Distribution

• *If the entrepreneur sells other lighting products, please list them separately and in more detail*	*Background information* *Pricing* *Further product development*
• Do you have internet access nearby?	Background information Future payment system

Oolux specific Information

Experiences with oolux

• In general, are customers satisfied with oolux?	Customer satisfaction Product performance
• What kind of complaints from customers have you had concerning oolux?	Customer satisfaction Product performance Further product development
• What questions do customers have about oolux?	Marketing strategies Customer profiles
• How many oolux customers do you currently have?	Demand Retailer profile
• How far away do your oolux customers and your customers in general live?	Distribution Retailer profile
• What else do oolux customers buy at your shop?	Customer profiles Distribution
• How did/do you identify potential oolux customers?	Marketing strategies Customer profiles
• Are they coming to your shop more frequently now?	Socio-economic impact
• What were the main/most frequent concerns of customers when deliberating whether to buy oolux/participate in the test?	Marketing strategies Background information Customer profiles

Opinion on oolux

• What is your opinion on oolux?	Product performance Value proposition
• What do you think are potential problems/challenges of oolux?	Product performance Further product development

• *If the entrepreneur stocks other lighting products:* - What is better about oolux than the other lighting products? - What is better about the other lighting products?	*Product performance* *Marketing strategies*
• Do you have suggestions how to improve oolux?	Further product development
• Do you think there would be more customers here interested in oolux? Do you think you could sell more oolux lights? How many in the next two months?	Demand

Prepaid System and Software

• Do you think the pre-paid system is good?	Payment system Value proposition
• Do you think the price is adequate?	Pricing
• Did the payment software work well?	Retailer satisfaction Payment system
• What were the problems you encountered?	Retailer satisfaction Further product development Future payment system
• Was it easy or difficult to learn how to use the interface?	Retailer satisfaction Further product development Future payment system
• How frequently do most customers pay?	Pricing Customer profile
• In what amounts do customers usually pay? Does it vary much?	Pricing
• Do you think this system would also work for other products or services? Which ones, ideas?	Further product development
• Do you think it would be better if customers could pay in smaller instalments?	Pricing Payment system
• Do you think it would be better/easier if it was possible to top up oolux the same way as mobile phones? (You sell scratch cards and the customers activate the PowerBox themselves)	Future payment system

• Or do you think it would be better if the customers got a microloan and paid the whole amount at once?	Payment system Value proposition

Additional Information

Ask the entrepreneur about plans for the future/wishes/concerns for his/her business	*Additional information*
What else was the entrepreneur eager to tell you/ask you about or show you?	*Additional information*
Please note any other observations/ideas/concerns you think are important.	*Additional information*

Partner Organisation

Date	Orientation
Location	Orientation
Name	Orientation
m/f	Orientation
Position	Orientation
Duties/Responsibilities	Orientation

Oolux Project

• What is your opinion on the oolux project? - potential/strengths? - challenges/problems? - Quality/technical aspects? - Payment System - Price (upfront cost and weekly/monthly fee)	Potential Challenges Further product development Payment system Pricing
• What would you change about oolux? Do you have suggestions for improvement?	Further product development Future payment system
• Do you think there is a potential for more oolux sales in this area (or another region you are familiar with)?	Demand
• What would be your suggestions/recommendations to promote oolux on a larger scale?	Background information Marketing strategies

Similar Products

• Have you had experience with products similar to oolux?	Background information Partner selection
• If yes, which ones?	Background information
• How does oolux compare to these products?	Product performance

Local Partners	
• How do you/did you choose your local partners/distributors/customers - in general? - for the oolux project?	Distribution Partner
• (Why did you choose these particular locations/partners among your all your partners to test oolux?)	Distribution Partner
• Could you please describe in detail how your relation with your local partners/distributors works?	Distribution Partner Marketing strategies
Oolux test	
• Is your/our approach to promoting/testing oolux different from your usual activities? If yes How?	Marketing strategies Partner Background information
• What made you agree/want to participate in the oolux field tests?	Partner Marketing strategies
Microfinance	
• Have you had experience with microcredits?	Background information
• What are in your eyes the advantages and disadvantages of the oolux prepaid system as opposed solar lighting purchases financed by microcredits?	Payment System
Please ask about plans for the future/wishes/conerns for the organisation/their particular project/position/department.	*Additional information*
What else did the employee want to tell you/ask you/show you?	*Additional information*
Please note any other observations/ideas/concerns you think are important	*Additional information*

General Research, Background Information and Preparation for Findings Summary

- *Put together general background information on the area/region*

- *Make a list of local prices of other goods (with measurements/package size!) for each area where oolux is tested (e.g. food staple like rice, fuel, water, soap, mobile phone top up card, ...)*

- *List Products/Brands/Companies you encounter in many different places (→ good distribution network)*
  - *If possible take a **picture** of the Product/Brand/Company*
  - *Try to find out how they are distributed/who distributes them*
  - *If you think they may be of interest for oolux (e.g. potential partner) put together a very short profile (half a page max.) including contact information*

- *Are there microfinance institutions active in the area? If yes note their names and contact details*

- *Please write a short description/profile about the partner organisation (type, size, activities, local partners, etc.*

- *Please draw a schematic representation of the partner organisation and their local partners/distributors etc.*

- *Link Customer Interview Forms to Top Up Location Forms*

- *Please find a geographical Map of the Area and put all interview locations and any other locations relevant to the oolux project on the map*

- *Write a journal with very short accounts of your daily work (just keywords/bullet points)*

Ich erkläre hiermit,

- dass ich die vorliegende Arbeit ohne fremde Hilfe und ohne Verwendung anderer als der angegebenen Hilfsmittel verfasst habe,
- dass ich sämtliche verwendeten Quellen erwähnt und gemäss gängigen wissenschaftlichen Zitierregeln nach bestem Wissen und Gewissen korrekt zitiert habe.

19. November 2012

Der / Die Unterzeichnende verpflichtet sich, die von der befragten Unternehmung/Verwaltung erhaltenen Informationen streng vertraulich zu behandeln. Insbesondere darf nur mit ausdrücklicher Einwilligung sämtlicher Auskunftgeber anderen Personen als den Referenten Einblick in die schriftliche Arbeit gewährt werden.

Er / Sie nimmt zur Kenntnis, dass seine / ihre Arbeit von der Universität St. Gallen mittels einer Plagiatssoftware auf allfällige Plagiate überprüft werden kann und dass die befragte Unternehmung/Verwaltung entsprechend zu orientieren ist.
Datum und Unterschrift

19. November 2012