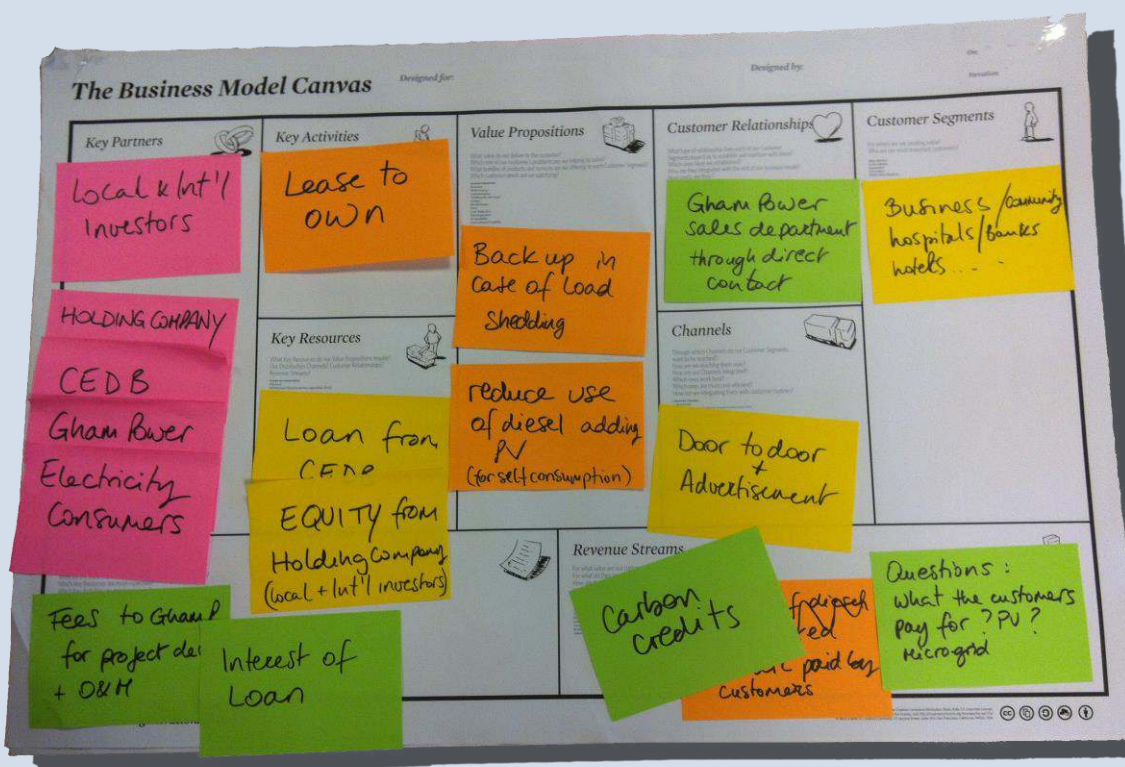




Innovative Business Models and Financing Mechanisms for PV Deployment in Emerging Regions



PVPS

PHOTOVOLTAIC
POWER SYSTEMS
PROGRAMME

INTERNATIONAL ENERGY AGENCY
PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

Innovative Business Models and Financing Mechanisms for PV Deployment in Emerging Regions

IEA PVPS Task 9, Subtask 5
Report IEA-PVPS T9-14: 2014
December 2014

ISBN 978-3-906042-27-5

Author: Dr. Thomas Meier, Switzerland, tmeier@bluewin.ch

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Foreword

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organization for Economic Co-operation and Development (OECD) that carries out a comprehensive programme of energy co-operation among its 23 member countries. The European Commission also participates in the work of the Agency.

The IEA Photovoltaic Power Systems Programme (IEA-PVPS) is one of the collaborative R & D agreements established within the IEA and, since 1993, its participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The 23 participating countries are Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), China (CHN), Denmark (DNK), France (FRA), Germany (DEU), Israel (ISR), Italy (ITA), Japan (JPN), Korea (KOR), Malaysia (MYS), Mexico (MEX), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), Turkey (TUR), the United Kingdom (GBR) and the United States of America (USA). The European Commission, the European Photovoltaic Industry Association, the US Solar Electric Power Association and the US Solar Energy Industries Association are also members. An Executive Committee composed of one representative from each participating country or organization heads the overall programme. The management of individual Tasks (research projects / activity areas) is the responsibility of Operating Agents. Information about the active and completed tasks can be found on the IEA-PVPS website www.iea-pvps.org.

Task 9, Deploying PV services for regional development, addresses the use of PV as a means to enhance regional development – both for rural electrification applications and more broadly in the urban environment. The Task achieves this by developing partnerships with appropriate regional and national organizations plus funding agencies, and carrying out work on specific applications of interest and relevant business models.

This paper, developed by Task 9, addresses the problem of high upfront costs of PV technology which remains one of the key challenges that needs to be overcome to achieve a faster and greater deployment of PV technology, particularly in emerging regions. A number of selected case studies of innovative business models and financing mechanisms are presented, with the intention to provide the reader with ideas about how the issue could be addressed.

Acknowledgements

This paper received valuable contributions from IEA-PVPS Task 9 members and other international experts. Many thanks to:

Anjali Shanker, Silvia Puddu, Taric de Villers, Grégoire Lena (IED France), Peter Ahm (PA Energy, Denmark), Alex Arter (Entec AG, Switzerland), Erik Lysen (LYSEN Consulting Engineer Netherlands), Jean-Christian Marcel (MJC PV Consulting, France), Caroline Bastholm (Dalarna University, Sweden), Masanori Ishimura (NEDO, Japan), Friedemar Schreiber, Adnan Al-Akori, Georg Bopp (Fraunhofer Institute, Germany), Vicente Salas (Universidad Carlos III de Madrid, Spain), Bozhil Kondev (GIZ, Germany) for sharing their valuable practical experience with business models, for reviewing this paper, and for participating without grumbling in an unannounced work session on business models.

A very special thanks is due to the representatives of the case study companies for their readiness to share details about business models in interviews, and for reviewing and editing case studies:

- Kieran Reynolds, VP Operations, Azuri Technologies Ltd., United Kingdom
- R. Mikkhelsen, Director Global Partnerships, Bettina Brynaa Nielsen, Marketing Manager – Lifelink, Grundfos LIFELINK, Denmark
- Sammy Waite: Business Development Manager, Chloride Exide Kenya Ltd., Kenya
- Sandeep Giri, CEO Gham Power, Nepal
- Mr. Manu, Site Manager at Tirunelveli Solar Park, SunEdison, India

Abstract

Like other renewable energy technologies, photovoltaic (PV) systems face the problem of high upfront costs. This problem is particularly pronounced in emerging economies where limited purchasing power and a lack of suitable financial products constitute additional obstacles for a broader dissemination of PV technology. The present publication is a collection of case studies of business models and financing mechanisms which show possible ways how such obstacles can be addressed and overcome in innovative ways.

Different business models are presented, both, from grid-connected as well as off-grid areas ranging from large scale systems to pico-sized systems being installed in urban as well as rural areas. Despite the striking differences between the presented PV systems, it is shown that business models play an important role in all cases. The case studies underline that the development of a business model is not a simple task but often requires long preparation time and a lot of devotion to details. Business models evolve over time and there is a lot of creativity required from entrepreneurs to develop suitable packages for PV products. Six interesting packages are presented as case studies.

Executive Summary

“PV technology faces the problem of high upfront cost. This problem is particularly pronounced in emerging regions where purchasing power is low and most people do not have access to commercial financing.”

“Business models must appear to be clear and simple, even if sophisticated processes run below the surface.”

Like most renewable energies PV technology faces the problem of high upfront cost. This problem is particularly pronounced in emerging regions where purchasing power is low and most people do not have access to commercial financing. Under such conditions, PV technology can only spread when innovative business models and financing mechanisms are available, which are adapted to the specific conditions in these regions.

The paper intends to provide the reader with ideas about how the issue could be addressed. Six case studies of innovative business models and financing mechanisms are presented, ranging from pico-sized systems to large-scale PV plants including grid-connected as well as off-grid PV systems:

1) A pay-as-you-go business model, developed by Azuri Technologies, UK, shows how thousands of low-income households in Africa can get access to affordable lighting and phone charging systems.

Two examples of large manufacturing companies, (2) Grundfos, Denmark, and (3) Chloride Exide, Kenya, show different ways to spread PV technology and services to new application areas using existing distribution networks and service partners.

4) A business model developed by Mosaic, United States, shows how crowdfunding can be used to offer individual people investment opportunities in PV installations.

5) Gham Power, Nepal, has developed a business model for urban hybrid micro-grids as an answer to unreliable electricity supplies from the public grid.

6) A business model from SunEdison, India, offers individuals the possibility to own a power plant in the MWp range, allowing them to hedge against raising electricity tariffs.

The case studies illustrate that the generation of successful business models is not an easy task that can be done in just a couple of days. The specific regulatory, economic, social and cultural situation in a region has to be well understood and addressed in business models.

Successful business models usually include a financing component. This is particularly important for the mass market in rural areas of emerging regions where most people do not have access to commercial financing, or are overwhelmed in dealing with loan applications. Furthermore, to be attractive for potential customers, business models must appear to be clear and simple, even if sophisticated processes run below the surface.

1 Introduction

PV technology requires substantial upfront capital expenditures. Declining prices for PV panels over the past years have mitigated this problem to some extent but the basic problem remains: Virtually the whole energy costs for the lifespan of a PV system must be prepaid at the time of an investment which reaps the benefits only over the next 10-20 years. These high upfront costs are and will remain one of the main challenges which need to be overcome to achieve a faster and greater deployment of PV technology, particularly in emerging and developing regions where large-scale subsidy programs are usually absent.

Task 9 has addressed this problem in a separate Subtask focusing on innovative business models and financing mechanisms. The rationale of this Subtask is based on the insight that the driving forces in the energy sector are not the technologies but the business models. Innovative business models and financing mechanisms are therefore needed to achieve a greater deployment of PV technology in emerging regions. A number of interesting and successful business models, such as leasing, PPA systems, and solar mortgage, have recently been developed in industrialized countries mainly related to grid-connected PV systems. While these business models may be replicated in grid-connected areas of developing regions, different models are needed in off-grid areas.

Task 9 does not aim to develop new business models on its own but to systematically collect information about successful business models, evaluate the experiences made with these models, and to disseminate information on new and innovative business models as economically sustainable alternatives for PV deployment in emerging regions.).

1.1 Current State of Research

A variety of reports and papers were published in recent years dealing with new business models for renewable energies and green growth. The bulk of this literature is focusing on the situation in OECD countries (FORA, 2010; Nordic Innovation, 2012; OECD, 2013). The findings and recommendations of these recent papers are also relevant for emerging regions but they cannot simply be transferred to these regions where considerably different socio-economic and political frameworks exist.

The specific situation of emerging regions is addressed in a publication of the UN Global Compact (2012): "Policy Measures to Support Inclusive and Green Business Models". The paper emphasizes the need to include the poor as consumers or producers as well as aspects of green business in business models. Two of twelve case studies are related to Solar Home Systems. However, their description is rather general and not sufficient to draw conclusions regarding recommended practices.

From 2002 to 2004, Task 9 has published valuable recommended practice guides about business models and financing mechanisms, among others. The guides are mainly related to the implementation of solar home systems in developing countries. While the key recommendations from those publications are still relevant today, the scope of PV deployment has considerably broadened over the past ten years. In the off-grid areas, the focus has shifted from electricity generation to PV powered services, e.g. in the field of water supply, irrigation, health, and productive uses. In the urban environment, building integrated PV has become more important.

The present paper is a first step in an attempt to systematically collect and analyze a range of experiences with business models and financing mechanisms which are addressing today's challenges. The paper is intended to provide an overview about different business models in the form of case studies without the aim to express recommendations related to the suitability of these models. The intention is to convey ideas how such as business models can be designed. It is hoped that the examples presented will have a stimulating effect on energy entrepreneurs and encourage them to further develop the models and to adapt them for their own purpose.

1.2 Methods of Preparation and Analysis of Case Studies

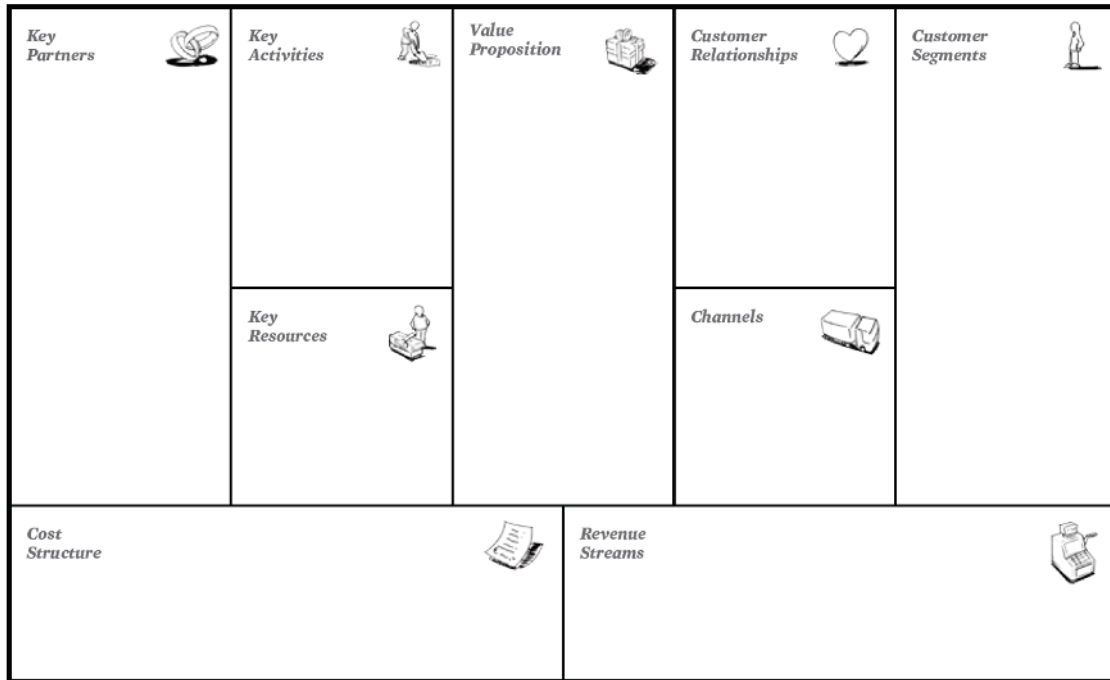
The case studies were identified based on a comprehensive literature/internet research. From a broad range of documents, twelve business models were identified and studied (see list below). For six of these business models (printed in bold) a detailed case study was prepared. The six business models were selected on the grounds of their innovativeness and the readiness of company representatives to give an interview. For each case a specific questionnaire was developed and a telephone interview conducted. Based on this information the case studies were formulated.

1. SELCO – India – Solar lighting for vulnerable, poor and remote populations through joint liability groups, restructuring crop loans, and solar light agents.
2. **Chloride Exide – Kenya – Achieving PV Sales by using an Existing Distribution Network.**
3. **Grundfos Lifelink – Denmark – Innovative PV powered water supply system in off-grid areas.**
4. Sundaya – Indonesia – Modular Pico PV Systems.
5. Grameen Shakti – Bangladesh – 700 Technical Centres Sell, Install and Maintain Small PV systems.
6. **SunEdison – India – Medium-scale PV Investments as a Hedge against Raising Electricity Tariffs.**
7. Mera Gao Power – India – Microgrids as a business opportunity for rural entrepreneurs.
8. **AZURI Technologies – United Kingdom – Pay-As-You-Go Model to Make PV Affordable for Low Income Households in Africa.**
9. Greenleads – Kenya – Green electricity services with low risk for clients.
10. **Gham Power – Nepal – Urban Hybrid PV Microgrids as an Answer to Load-Shedding.**
11. OneRoof Energy – United States – PV leases as part of new roofing or re-roofing projects.
12. **MOSAIC – United States – Crowdfunding model to solar energy installations.**

The Business Model Canvas was selected as a method to analyze the case studies. This method was recently developed at EPFL Lausanne by Osterwalder et. al. (2010). Figure 1 shows the Business Model Canvas. The tool resembles a painter's canvas – preformatted with nine blocks – which can be used to draw new or existing business models.¹

¹ The easiest way to get familiar with these blocks is by watching a two-minute video under the link: <http://www.youtube.com/watch?v=QoAOzMTLP5s>.

Figure 1 The Business Model Canvas (Source: Osterwalder et. al, 2010:44)



The analysis of the case studies was done jointly by the Task 9 Experts during a specially designed working session. After a brief introduction on the subject, the Experts were divided into different groups. Each group had to choose a business model and then map this model in the Business Model Canvas. After one hour, the groups came together again and presented and explained the business model they worked on followed by a plenum discussion.



The colourful results of the BM canvas method should not be regarded as results to be published. Much more important is the process and the discussions that come up when working with the canvas. It becomes clear quite quickly which Business Models are already well-elaborated and which still need to be further developed. In particular, it became also clear that there are a multitude of detailed questions to be answered in order to develop a business model, and that this requires a fairly large amount of work.

The business model canvas was found a good tool to develop and analyze business models in a structured way. The method is good to clarify a vision and it forces people to expand their thoughts. It is a hands-on tool that fosters understanding, discussion, creativity, and analysis. It is important to mention that the business modal canvas method is a tool to conceptualize a business and does not replace the other planning steps required to develop a business plan such as market and financial analysis for example.

In Chapter 2 to 7 the six case studies are presented. Chapter 8 provides a short synthesis of the key findings made when analyzing the case studies with the business model canvas.

2 Pay-As-You-Go Business Model to make PV Affordable for Low-Income Households

2.1 Case Study Azuri Technologies

Background

More than 1.3 billion people still do not have access to electricity. The situation is worst in rural Sub-Saharan Africa with a rural electrification rate of only 14% (WEO-2011). The high up-front costs of PV technology have been the major factor prohibiting the wider uptake of small solar systems in these regions. Prices of small solar home systems for off-grid homes have fallen rapidly over the past decade. Good quality two-light systems are now available for under US\$70 down from over US\$200 some years ago. However, this price is still too high for most off-grid households to pay upfront. To overcome this, the U.K.-based startup, Azuri, applies an innovative model combining mobile phone and solar technology to provide solar-as-a-service, enabling users to pay for the usage of the solar system through the purchasing of weekly scratchcards.

The Technology

The Indigo Duo solar home system is the basic starter kit offered by Azuri. It consists of a 2.5 Wp PV module and a long-life 3.3 Ah Lithium Iron Phosphate battery and is supplied with two 60-lumen LED lights. The battery and Indigo controller are housed in a bright yellow case with a keypad on the front, along with sockets for the PV module and lights and a USB socket for phone charging. The system meets Lighting Global quality standards and Lighting Africa performance targets. Prototypes of the Indigo Duo products were produced by Azuri. For mass production, Azuri has partnered with the Swiss-based company ESCATEC who have helped commercialise the product by manufacturing the units in large volumes in its own factory in Malaysia.



How does it work?

The Indigo pay-as-you-go controller allows power to the sockets only when the system has been unlocked by entering a valid code on the keypad. The code is obtained by sending a top-up number along with the serial number of the Indigo unit by SMS to an Azuri in-country gateway that relays the information to the Azuri central server. A return SMS then provides the code. Top-ups are either physical cards bought for cash, or codes bought by mobile phone, using a mobile money system. They can be purchased for one-week or four-week activation.



How much does it cost?

Users pay an initial fee of about US\$10 to have the Indigo Duo system installed in their home, and in average around US\$1.50-\$2.00, dependent on the exact territory, for each weekly top-up. In Africa,

customers can save up to 50% of the money previously spent to operate kerosene lamps. Additionally, they can save many hours of walking to the market for mobile phone charging. After around 80 payments, again dependent on the exact territory, users can pay a fee of about US\$10 to have their system permanently unlocked. The specific economic model depends on the local territory and is influenced by local taxes, duties and market forces.

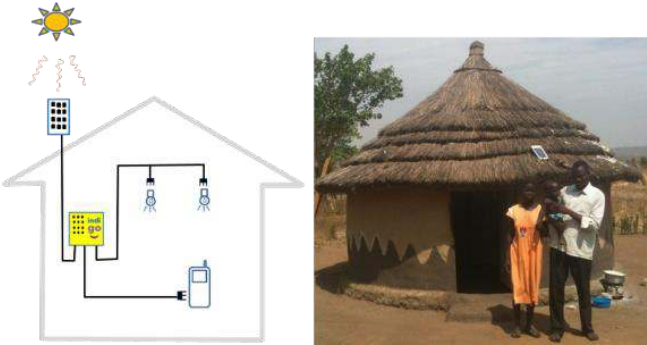
The Business Model

Azuri does not sell its products directly to end-users and does not intend to develop its own distribution channels. Hardware and service – in the form of top up codes – are sold to distribution partners in developing countries. These distributors are usually locally based businesses that are well established in the local market and have a distribution network reaching out to remote off-grid areas. The distributors are responsible for installing systems, selling top ups and providing after-sales services in their area of coverage. Azuri provides them with detailed specifications on how systems should be marketed and installed, the level of support to be provided and detailed reporting on the customer behaviour. Distributors are also provided with distinctive brand guides for shops and advertising.

The cloud-based Azuri database stores the details of each customer and their Indigo system. Each top up sold to a distributor is recorded and the date of redemption and the system on which it is used is automatically added to the database. Thus, both Azuri head office and the local distributor can keep track of customers, allowing problems (and irregularities) to be rapidly identified. Azuri has spent a lot of resources in the development of this administrative system, which is a crucial piece of infrastructure required to manage large numbers of end-users.

The ownership of the hardware remains with Azuri or the distributor, depending on the exact commercial relationship between Azuri and the distributor, until the systems have been permanently unlocked. There is no loan agreement requiring customers to pay a certain number of installments, but if a customer stops buying top ups this will be detected in the database and eventually the unit will be taken away and redeployed.

From the viewpoint of an end-user, the top up system is similar to a hire purchase. After around eighty installments they can permanently unlock and own the system without having any further payment obligation. Azuri, on the other hand, does not consider the business model as a retail of the hardware but energy service provision, due to the ongoing customer management. The hardware is seen as something which enables the service to be delivered. The payments made through the purchase of the top ups do not only cover the costs of the hardware but also the costs of operating the system, installation and after-sales services, as well as taxes and duties. Incomes and profits are generated through a carefully designed margin structure on the top up sales allowing Azuri and the distribution channels to make enough money to make the business worthwhile. Azuri emphasises that the business model is for profit, not for profiteering. This is also the reason why they included the possibility to unlock the system because they find it unethical to charge the people forever for energy provision from a relatively small system.



Requirement of a large customer base

The business model is designed for a mass market with small margins from each top up sale. To reach the profit zone, Azuri requires selling tens of thousands of systems to end-users. The fact that end-users can permanently unlock their systems means that Azuri has to keep on acquiring new customers all the time. Azuri is optimistic that the market is large enough to continuously expand

their customer base since there are still more than 600 million people without access to electricity in Sub-Saharan Africa.

Those who have reached the point of unlocking their systems, have the possibility to continue their business relationship with Azuri. Azuri offers the option to upgrade the customers system for a larger, more powerful unit, for example with more lamps and a radio, and the customer can continue to use the pay as you go top up payment route. Like everywhere in the world, people in off-grid Africa do not only want two lights and mobile phone charging in their house but would also like to have a radio or a TV and so on. As long as Azuri can maintain a high service quality, there is a good chance that first time customers remain loyal for a long period, taking progressive steps up to larger systems that provide more functionality. This energy escalator offers a route to not only more power, but also the devices which can maximize the impact of the increased power.

Financing

From August 2012 to March 2014, Azuri has around 30,000 units in the distribution channel, with around 15,000 units installed and operational in customers' houses. Azuri is scaling up quickly and plans to distribute tens of thousands of starter kits in the near future. The company funds the business through a variety of routes including equity, working capital loans and loans from donors. Of course, the financing of such large amounts of credit sales is the main challenge for Azuri, and this challenge is increasing with growing sales.

The company

The Indigo technology was originally developed by the Cambridge spin-off company, Eight19. Azuri Technologies was launched in August 2012 as a spinoff from Eight19 to promote the Indigo technology at scale in Africa and elsewhere in the developing world. Azuri currently has 15 members of staff.

The Indigo pay-as-you-go model has won the International Ashden Award 2013 for Innovation. Azuri was elected among the 'world's top 10 most innovative companies in energy' 2014 by Fast Company.

Competitors

Several African companies compete in the same market. Most notable to mention is Kenya's leading mobile operator Safaricom. After Safaricom has partnered with the mobile technology company M-Kopa, their customers can purchase solar home lighting solutions on hire purchase via the mobile money transfer service M-Pesa. To access the solar home system, supplied by 'd.light', subscribers have to make a US\$31 deposit and pay daily installments of US\$0.50 via M-Pesa for one year. (<http://www.itwebafrica.com>).

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3 Increasing PV sales by supporting innovative solutions for water supply

3.1 Case Study – Grundfos Lifelink

Background

Over the past two decades, a remarkable number of 2.3 billion people have gained access to safe water. However, there remain around 800 million people who still depend on water from unsafe sources. Many of these people are living in off-grid areas of sub-Saharan Africa (United Nations, 2014). The notorious unsustainability of rural water supply infrastructure in Africa makes it a kind of Sisyphus work to further reduce that number. Against this backdrop, Grundfos has developed a solution which combines proven pump technology, PV panels and an automatic water dispenser with revenue collection system. The solution termed Grundfos Lifelink addresses the sustainability problems in water supply for low income communities in the developing countries.

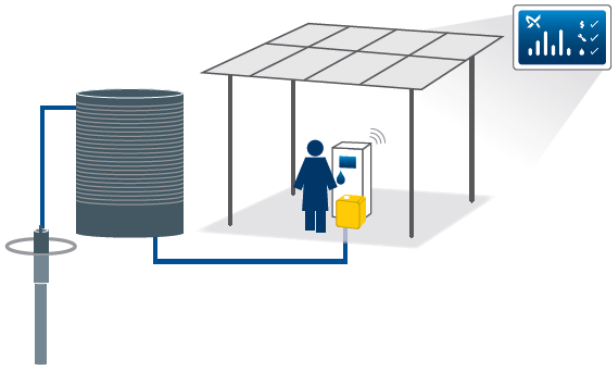
HOW DOES IT WORK?

The Technology

Grundfos Lifelink solutions can be designed to match small or large water schemes in both rural and urban areas. The foundation of each Lifelink system is the automatic water dispenser unit with an integrated system for revenue collection and water management.

For the 40 demonstration projects in Kenya, the Lifelink system consists of a submersible pump which is operated by PV panels. Safe water is pumped from a borehole into an overhead tank. System sizes range from 50Wp to 9.2kWp with pumping heads up to 200m.

The PV panels also power the dispenser unit where consumers can tap water using a water card with water credits.



Professional Service and Support

The water revenues collected from the Lifelink systems can be used to cover the costs of professional service and maintenance of the water projects. A network of local Grundfos service partners with the required spare parts in stock will support the water service providers in keeping the water systems up and running. Various service options, from service contracts to training sessions are available to the water service companies, NGOs, or community-based associations. The common feature is an online water management platform which allows the remote monitoring of each system. Each dispenser unit feeds the platform with operational data via the GSM network. A



system failure can immediately be detected and repaired by a service team. The actual water consumption at each Lifelink installation can also be followed via the same system.

Revenue collection system

A key challenge to sustainability in water supply is the financial viability. Lifelink solutions supports continuous revenue streams thanks to the integrated revenue collection system. Users tap water from the dispenser by using a WaterCard with pre-paid credits. In Kenya, the water users transfer water credits to their WaterCards through M-Pesa. M-Pesa is the successful mobile phone payment system developed by Safaricom and now available in various African countries (and recently also in India and Europe). This cash free pre-paid system eliminates the problem of fund mismanagement as funds can be directly transferred into a bank account reserved to cover for operation and maintenance costs.



PPP BASED BUSINESS MODEL IN KENYA

Since 2009, Grundfos has implemented more than 40 demonstration projects in Kenya based on the Lifelink solution and in collaboration with partners across various sectors. The results demonstrate a new model for financially, self-sustaining water supply projects where user fees pay for service contracts with the local service provider.

Under this business model based on a public private partnership approach, the public partner (donor organization) has funded the initial investment on a grant basis and provided community development and training where needed. The private partner (Grundfos in Kenya) has installed the systems and provides monitoring and maintenance services on a commercial basis. The demonstration projects in Kenya are implemented in the arid and semi-arid regions of Kenya, where surface water is scarce most of the year. They provide a reliable access to safe water for approximately 100'000 people.

Water Usage Data as Value Proposition

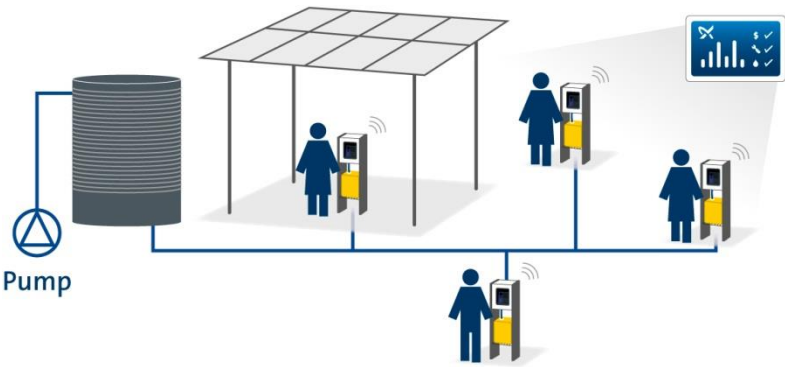
Each Grundfos Lifelink system is systematically collecting water usage data which is transferred wireless to a central server accessible to all partners. This data collection functionality is a key selling point making the Lifelink system interesting to donor agencies because reliable water use data are very difficult to obtain in rural Africa.



Outlook

Having proven the concept of the Lifelink solutions, Grundfos is now paving the way for water service providers in prioritized sub-Saharan African countries to invest in the technology. To lower the investment cost, Grundfos has developed a new dispenser unit which is competitively priced. The new dispenser called AQtap will be available from June 2015. The significant cost reduction means that commercial business models will become increasingly feasible in the future. It also means that more dispenser units can be installed bringing water closer to the people and thus increasing the revenues from water sales.

Combining multiple dispenser units in mini grids requires the setting up of additional PV generation capacity either at small single points or larger PV arrays feeding a mini electricity grid. As we say, "the appetite comes with the eating",



the appetite comes with the eating", the installation of PV powered water supplies is triggering demand for additional electricity services. In Tanzania, Grundfos is already involved in a pilot project where the PV array has been over-designed to also feed a mini grid. This will give momentum to the development of new innovative business models in the future.

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4 Achieving PV Sales by Using Existing Distribution Networks

4.1 Case Study Chloride Exide

Introduction

Chloride Exide Ltd was first established in Kenya in 1963 as part of the UK-based Chloride Group PLC to retail and distribute Chloride Exide batteries. In the 1980s the Chloride Group sold its shares and Chloride Exide became a fully Kenyan-owned company. In the following years, the product range was diversified. Today, Chloride Exide is the largest battery, solar PV, and backup systems operation in East Africa with three sister companies in Tanzania, Uganda and Rwanda. They have over 20 years of experience in PV installations which contribute 40% of the company turnover.

The product

The products most often sold are solar home systems for rural households in the pico PV range which powers below 30 Wp. A smaller market exists for systems for the 'middle-class' in the range of 50 to 100 Wp. A big customer is the government who is doing a numerous PV projects for schools, hotels, and other governmental institutions. Some of the largest projects were solar backup systems in hotel chains and for Telecommunication companies. In 2013, the total capacity of systems installed was in the range of 700kWp.

Although the grid is not stable, there is little demand for PV backup system in urban areas, according to Chloride Exide. Residents in urban areas usually opt for a diesel generator or for a battery backup system which is charged when the grid is available and not via PV panels.

The business model

The business model of Chloride Exide is not revolutionary innovative. Their success is based on the fact that they are making best use of existing resources and infrastructure from the battery business, in particular their vast distribution system as well as their reputation for quality products. Chloride Exide has 13 branches across Kenya, 3 in Tanzania, 1 in Uganda and 1 in Rwanda. Each branch is fully equipped with spare parts and trained technicians who can install systems. Furthermore, they have over 500 dealers countrywide who sell their products even in remote areas. Chloride Exide does only direct sales. Those people who would like to pay in installments are referred to banks or microfinancing institutions.

Lessons learned, Success factors and outlook

An important problem in the PV market is that end-users are often not well-advised regarding system design. Many distributors are only trying to sell as much as people can afford without looking at their power requirements. The results are poorly designed PV systems that frequently fail after short operation period. This has created a negative image about PV products among some people.

Since a couple of months the PV sector is thriving in Kenya. Most important was a governmental initiative in 2013 revoking import duties and VAT on PV products.

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5 Peer-to-Peer Financing of Renewable Energy through Crowdfunding

5.1 Case Study Mosaic, United States

Introduction

Mosaic is an online solar marketplace connecting investors with solar projects in need of financing. Mosaic is a US-company based in Oakland. The platform is currently focusing on projects in the United States. The financing mechanism is discussed here as it has potential to be developed and may also be considered as a possible solution for project financing in emerging regions.

The Product

Mosaic is one of the first platforms where people can directly invest in tangible projects. Projects are listed on Mosaic's website 'joinmosaic.com'. Interested people can create an account which allows them to browse through a list of investment projects. Each project is described in a Prospectus that is prepared in accordance with the Securities and Exchange Commission's (SEC) disclosure requirements and contains all of the important details. Once the projects are operational and

Project Name	Yield	Term	Invested	Status
1,575 kW on Prairie View Solar Park in Gainesville, FL	5.6%	120 months	\$371,775	PROJECT IS FULLY FUNDED
47 KW on Youth Employment Partnership, Oakland, CA	6.38%	60 months	\$40,325	PROJECT IS FULLY FUNDED

generate revenues the investors are being paid back their capital over a certain period plus interest. Interests achieved are in the range of 4.5 to 6.5% annually. The minimum investment is US\$25. The project sizes range from less than 50kW to more than 1MW. The information on the webpage informs about the interest

people can get and the term of investment. According to Billy Parish, Founder and President of Mosaic, "people enjoy that they can invest in projects that they can see, which is giving them a good feeling to have invested their money in something useful and environmentally friendly. If they want, they can even visit the locations. Many investors are excited about the transparency, tangibility and social and environmental impact."

The business model

The Mosaic team spent several years to develop the business model and work with the regulators to structure the model in the right way until they got the approval to offer US\$ 100 million worth of solar power investments. The company functions like a virtual renewable energy bank, soliciting investments for solar projects and making loans to be paid back, typically, over about 10 years. Investments can be made by all 'accredited investors'² and people of the states of California and New York above the age of 18. Mosaic is one of the first companies in the US that has designed a model where not only accredited investors can participate.

² In the aftermath of the Great Depression, the US Government tightened the regulation of the stock market among others to protect individual investors from fraudulent practices. Under the Securities Act of 1933, a company that offers or sells its securities must register the securities with the Securities and Exchange Commission (SEC) or find an exemption from the registration requirements. Offerings to accredited investors are exempt from the registration requirements on the theory that accredited investors are sophisticated enough to protect their own interests. Accredited investors are wealthy individuals as well as certain types of businesses and organizations.

Mosaic is taking an upfront fee of 2 to 3% of the loan they are making. And then they charge an annual fee of 1% on the principal of the investment, meaning if they make a loan for 7%, they are offering it on the platform for 6% net of fees. So what investors see on their webpage is the real rate of return.

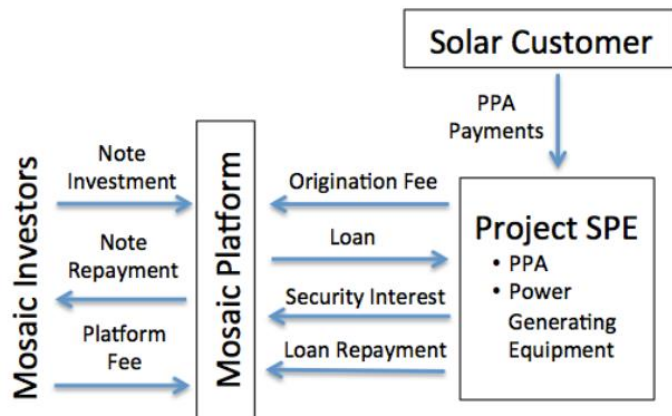
The solar projects funded typically consist of rooftop or ground-mounted installations that either (a) generate on-site electric power for small businesses or other organizations or (b) generate power for sale to an electric utility or other “off-taker.”

Mosaic is providing the loans to Special Purpose Entities (SPE), controlled by local developers. The SPE are the formal owners of the solar power infrastructure.

The SPE typically repays the loan primarily out of cash flow generated by the sale of electricity to the solar customer or off-taker and, in many cases, the sale of Solar Renewable Energy Certificates (SRECs) to local utilities or other purchasers.

The loans are secured by the assets of the project owned by the SPE as well its contractual rights with respect to the sale of electricity or SRECs.

The 'roof provider' has the option to buy out the SPE at the end of the lease agreement and thus, own and operate the infrastructure as long as the system lasts.



The website joinmosaic.com provides very detailed descriptions of the projects, the infrastructure, the expected performance, the financial flows, and the fees obtained by Mosaic.

Although Mosaic is carefully assessing the solar projects and selects those with least risks, crowdfunding investments include higher risks than standard investments in bond markets. As shown in the diagram above, investors could suffer losses by, both, a default by the solar customer/SPA as well as the Mosaic Platform. Their investment is furthermore bound for 25 years and there is no secondary market where investors can sell their bonds prior to maturity (for more details see Berger, 2014).

Company development

Mosaic was initially launched in 2010. In its seed rounds, the company raised \$3.4 million from venture capitalists. In 2012, Mosaic received a \$2 million grant from the Department of Energy. Lending operations were launched in 2012, Mosaic has crowdfunded around 8 million in investments for various commercial solar projects.

In addition to the commercial projects, Mosaic has recently launched ‘Home Solar Loans’ for residential roof top projects. Mosaic strongly believes that the lease model with third party ownership will soon be passé and that residential customers prefer a loan model with personal

ownership. To make such loans attractive, Mosaic offers zero down payment and a repayment period of 20 years. Mosaic's goal is to offer the simplicity of a lease with the benefits of ownership.

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-Interview with Billy Parish, Founder and President of Mosaic

<http://www.forbes.com/sites/devinthorpe/2013/09/04/mosaic-uses-crowdfunding-to-finance-solar-projects-learn-how-to-participate/>

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6 Urban hybrid PV business microgrids as an answer to load-shedding

6.1 Case Study Gham Power, Nepal

Introduction

The electrical grid in Nepal reaches out to 76% of the population. However, having access to the grid does not mean that these people have always access to electricity. The country's installed generation capacity is in the range of 800 MW but to satisfy the electricity demand it would require 500 MW more. This is resulting in massive load-shedding for an average of 12 hours per day and more.³ There are new hydropower projects in the pipeline, but historically they have had a pretty dismal track record for timely completion. Even the state utility NEA admits that there is likely no end to load-shedding in next 5 to 10 years.

Many businesses and organizations rely on diesel generators for backup (530 MW of electricity is generated from diesel), but suffer from increasingly high diesel costs (prices tripled in last 10 years to US\$1/liter which may double again after on site transport) and frequent fuel shortages.

In 2010, when load shedding hours for the first time went beyond 12 hours a day, Gham Power was established with a vision to provide PV solutions to curb diesel use and reduce the overall cost of self-generated electricity. The company provides complete solar project development, EPC and O&M services to businesses, rural communities and residences. As of 2013, Gham Power installed 334 kW of PV systems for 438 clients including urban industries, rural communities/organizations, and many small businesses and households.

The focus of this case study is on products and services related to microgrids which were recently developed by Gham power for urban as well as rural areas.

The Product

Starting in 2013, Gham Power started developing larger Business Microgrid projects that focus more on businesses incurring huge diesel generator costs. PV is integrated with the existing diesel grid, with or without battery storage. The design of the hybrid grid is done by the engineers of Gham Power in Nepal. Currently, Gham Power has developed a 4 MW pipeline of Business Microgrid projects ready to be funded. This includes about 30 organizations like hospitals, banks, hotels, and factories that are incurring huge costs in running their diesel generators.



Rooftop solar array installed by Gham Power at Maiti Nepal.

³ for a load shedding schedule see http://www.myrepublica.com/portal/index.php?action=pages&page_id=8

The business model

At the core of the business model developed by Gham Power there is a holding company which receives funds from local and international investors. The holding company acts as the investor and becomes the legal owner of the PV systems installed.

Gham power is in charge to identify project, develop the system design, obtain permits, prepare contracts, construction of systems, and O&M of the system after commissioning.

The electricity consumers (businesses, village communities) are usually offered a lease-to-own model where they have the option to purchase the system for a nominal amount at the end of the lease term.

The lease period is usually 10-years and runs parallel to a bank loan from Nepal's Clean Energy Development Bank (CEDB) which is the financing partner of Gham Power. CEDB finances max. 70% of project costs, so 30% have to be provided by the holding company. The physical infrastructure is accepted as collateral.

The lease payments are paid to the holding company which pays the interest of the bank loan, and pays Gham Power one-time fees for project development, and EPC services.

For O&M, Gham Power is paid recurrent fees on an annual basis. Additional revenues can be created by selling carbon credits. The holding company envisages a net return in the usual range of Impact Investment Funds (10 to 15%).

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-Phone interview with Sandeep Giri, CEO Gham Power, March 27, 2014

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7 Medium-scale PV investments as a hedge against raising electricity tariffs

7.1 Case Study SunEdison, India

Due to rapid economic expansion, India has one of the world's fastest growing energy markets and suffers from a growing energy deficit. Over the past years, power tariffs have grown on average by 5% per year and the trend is expected to continue. India's energy policy is focusing on developing alternative sources of energy including solar and wind energy. The government plans to add about 20GW of solar power capacity by 2022. For this purpose, a set of incentives were introduced by the federal and state governments, consisting of investment subsidies, generation based incentives, tax incentives, and quota obligations.

Based on selected incentives, SunEdison India has developed a business model which is designed to help commercial and industrial businesses to hedge against raising electricity tariffs by investing in their own solar park without having to become solar experts. The model is being applied for the first time in the 18 MW Tirunelveli solar power plant in Tamil Nadu which started full-time operations in February 2014. SunEdison India selected the site, obtained permits, designed and built the solar park.

The model is not based on feed-in tariffs but Accelerated Depreciation Benefits (tax incentive) and India's Open Access program (quota obligations). The Accelerated Depreciation Benefit allows businesses in India to receive 100% depreciation on solar assets in the first year after purchase. The Open Access program allows developers to sell Renewable Energy Credits to large energy consumers with Renewable Purchase Obligations. Businesses that purchase part of the Tirunelveli Solar Park can typically expect payback of their equity investment as a tax credit within the first year.

The park has a capacity of 18 MWp which is split into 12 blocks @ 0.75MWp and 9 blocks @ 1MWp. These blocks can be purchased separately by investors. The AC-side of the park consisting of inverters, meters, transmission lines, compound walls, security, and monitoring stations is already fully installed and operational. The DC-side of the park is expanded piece-by-piece when investors have signed up for a block. As of March 20, 2014 2.5MWp have been commissioned.

For the utility, each investor is treated like an individual power producer. SunEdison is managing the whole park through its Renewable Operation Center (ROC), which provides global 24/7 asset management, monitoring and reporting services. The model is therefore suitable for investors who have no expertise in PV plant operation and also do not want to acquire that expertise.

The model is based on a kind of net-metering system. Since consumption and generation is taking place at different locations it is not possible to use bidirectional meters in this case. For each block in the power plant there is a meter measuring the electricity fed into the grid. SunEdison and the utility do a joint meter reading to determine how much has been fed into the grid by each investor. Then SunEdison raises an invoice to the utility on the investor's behalf and the utility subtracts this amount from the total consumption in the electricity bill of each investor.

Besides tax incentives and the possibility to sell Renewable Energy Certificates (RECs), the model is interesting for investors because it locks in electricity generation cost over the projects life-span of around 25 years. The generation costs of the solar park are already close to grid-parity. This means that during the initial years an investor does neither make nor lose money by selling electricity to the utility (without considering income from RECs). But the investors' energy cost will remain constant while public electricity tariffs are expected to increase significantly over the coming years.

Sunedison has the role of a renewable energy service provider. Their revenue model in the case of the Tirunelveli solar park consist of a one-time margin for the design and development of the solar park and recurring annual payments for asset management and maintenance services.

According to SunEdison, there are many potential investors interested in the model, particular industrial and commercial entities. Besides the financial incentives, increasing power tariffs is of major concern and many want to have captive power generation. The Tirunelveli solar park addresses their needs by offering suitably sized investment packages. It is planned to setup additional solar parks in India based on this pilot model.

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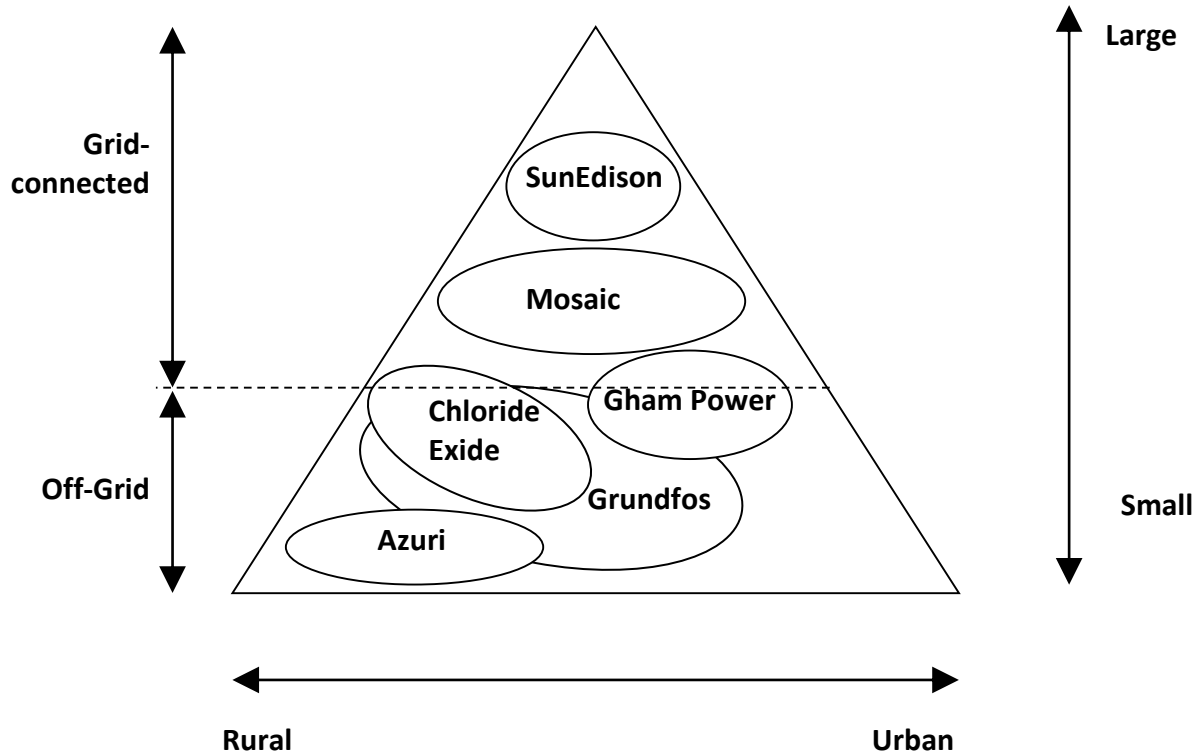
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8 Analysis

As mentioned earlier, the objective of this paper is to present case studies and not to conduct an in-depth analysis of business models. For the formulation of conclusions and recommendations, a more detailed analysis would be needed based on a larger number of case studies. However, in the workshop where the Task 9 experts mapped the business models using the business models canvas method some general patterns were recognized which are worth to be presented in this concluding chapter.

To compare different business models and to identify commonalities and differences it is useful to categorize the different models. Suitable categories are the size of the PV systems, whether they are installed in urban or rural areas as well as whether systems are grid-connected or not. Figure 2 shows the result of the categorization in a pyramid diagram. The PV system sizes decrease from the top to the bottom of the pyramid. The increasing width of the pyramid symbolizes that with decreasing system size more systems need to be sold to make the business model economically successful. In addition to this quantitative feature, the horizontal direction is also used in a qualitative way to distinguish between applications in rural and urban areas. Furthermore, the PV system sizes correlate with the feature 'grid-connected' and 'off-grid' which is also relevant for the discussion below.

Figure 2 Categorization of Business Models Discussed



8.1 Characteristics of medium to large systems

The business models of SunEdison and Mosaic focus on the installation of medium to large scale PV systems. These systems are connected to the public electricity grid which requires specific legislation to be in place defining the terms and conditions of grid-connection and payment mechanisms.

Business models of grid-connected systems have a major advantage compared to off-grid systems. The buyer of the electricity is usually a public utility which is obliged by law to purchase the renewable electricity from independent power producers. Thus, plants can be operated at maximum load factors and the revenue streams can easily be forecasted.

The companies need to keep the cost of financing and operating expenses within limits to achieve profitability. While the operating expenses are largely fixed cost related to system size, the challenge is clearly to obtain financing at reasonable cost. The interest of people to invest in PV-plants varies between regions and depends on different country specific factors and desires.

Desire for environmentally friendly investments

Where commercial financing or other solar financing mechanisms such as PPA, solar lease, solar mortgage, home equity loans, etc. are not available, peer-to-peer funding through crowdfunding platforms may be an option. The business model of crowdfunding is to help potential investors finding interesting projects be it for ecological or social reasons. There is a growing desire among individuals in western countries for directly investing in environmentally friendly or socially responsible projects. Thus, in crowdfunding business models, the clients are the eco-conscious investors while the PV projects are the means to attract clients. Besides MOSAIC who is only active in the United States there are a number of other crowdfunding platforms such as Kiva.org that offer investments in emerging regions, including investments in renewable energy.

Desire for energy security and cost predictability

In countries with high grid availability there are usually no concerns about energy security. However, in emerging countries where utilities cannot match growing electricity demand energy security is a major concern, in particular in the manufacturing and service sectors. Lengthy hours of load shedding and growing electricity tariffs are producing a growing interest in renewable energy investments from local entrepreneurs and public service organizations. In this case, the potential investors are the electricity consumers themselves. Besides energy security these wealthy investors are looking for investment opportunities which allow them to make best use of existing incentive schemes such as appreciated depreciation, tax credits, renewable energy certificates, among others. SunEdison has realized this desire and developed a specific business model for India combining financial predictability and tax incentives.

The commonality of the business models of Mosaic and SunEdison is that they are selling investment opportunities and not PV Hardware. In both cases the investors are not in charge of operating the PV-Infrastructure but they can benefit from the revenues generated. Design, construction, operation and maintenance is done by fully professional third party companies. Generating such business models requires a profound understanding of the regulatory framework as well as the socio-economic and cultural setting in a specific country. All legal requirements and available incentives have to be studied in detail and integrated in the business models. Product guarantees, insurances, investment laws, etc. have to be considered which often requires the cooperation with lawyers over a long preparation periods.

The importance of the legal framework can be shown at the example of Gham Power which is also addressing energy security concerns. Their medium-sized PV installations belong to the same category as the above business models but are only operated in island mode as back-up during load shedding hours. Thus, the electricity from the PV installation is not maximally utilized which, of

course, is of limited interest to investors. The lack of power generation capacity in Nepal would be a perfect background to develop business models for grid-connected PV. However, in Nepal there is no legal framework for grid-connected PV as of today. Chianese, et.al. (2014) estimate the short-term potential of small rooftop systems across Nepal above 100 MWp, which could significantly contribute to improve the power supply situation. For Gham Power and many other solar companies in Nepal, the growth of their businesses will depend on the political will of their legislators to implement a feed-in regulation for PV power.

8.2 Characteristics of small systems

As shown in Figure 2, the smaller systems presented in the case studies are usually off-grid systems to be used in non-electrified rural areas. These PV systems are not for general electricity generation like in the case of large systems but have a specific purpose such as lighting, phone charging, refrigeration, operating consumer electronics, or water pumping. These systems are usually DC systems equipped with batteries to allow night operation.⁴

To allow companies to achieve profits, business models for smaller systems have to be designed for the mass market. This means that the business models have to pay particular attention to the distribution channels and marketing activities to reach a large customer base. It also means that the hardware has to be well designed to allow easy installation by customers or local technicians with limited technical skills. Ideally systems are easy to operate and largely maintenance free. If maintenance is required, much attention has to be paid to put in place effective maintenance service structures to allow sustainable operation. Appropriate financing mechanisms addressing the limited purchasing power of rural dwellers are equally important to achieve high sales volumes.

Importance of marketing and distribution channels

The Indigo pico-PV systems provided by Azuri fulfil the above criteria. The hardware is designed as a mass product with plug and play functionality and is virtually maintenance free. Azuri is using a pay-as-you go business model with a well elaborated payment mechanism and affordable down payment by customers. The main challenge faced by Azuri is that they cannot count on an existing distribution system and must develop cooperation with local distributors and traders who are reselling and installing systems. Establishing such a distribution network is a work intensive process that requires a lot of time and patience. It is quite possible that the sales figures will be below expectations during the initial years until the network reaches a certain size. Azuri's competitor, the mobile phone company Safaricom who is selling similar products, has certainly a comparative advantage in terms of marketing and distribution since they can rely on an existing distribution network, can directly promote their product with mobile phone users, and can use their well-established mobile money services M-Pesa for financial transactions.

The business model of Chloride Exide is selling hardware. Their core products are batteries for which they have developed a vast distribution network. PV related hardware such as charge controllers, panels and inverters are simply additional products sold via the stores in their distribution network. The fact that PV related hardware sales make up 40% of the total sales underlines the importance of a distribution network for successful business models. However, the installed capacity of 700kWp is still rather small for a company like Chloride Exide. A limiting factor to achieve higher sales volumes may be that products are only sold on a cash basis. Offering attractive financial services would allow them to serve a broader customer segment which could boost PV sales significantly.

⁴ This does not apply for basic water supply systems where the solar energy is stored as potential energy in overhead water tanks.

To increase outreach, Grundfos Lifelink has chosen a strategy of setting up local sales and service partners in their focus markets to be able to work through their already existing organizations for sales, service, spare parts etc. Some of these partners are already well-known partners to Grundfos. To further support water service providers in developing financially sustainable business models, Grundfos Lifelink also developed a new more competitively priced water dispenser suitable for different applications, from grid-connected water kiosks in urban areas to rural community points with decentralized water supply.

8.3 Conclusions

The case studies presented and discussed in this publication have shown that the generation of successful business models is not an easy task that can be done in just a couple of days. The specific regulatory, economic, social and cultural situation in a region has to be well understood and addressed when generating new business models. Fine-tuning a business model can easily take several months or even years.

To be attractive for potential customers, business models must appear to be clear and simple, even if sophisticated processes run below the surface. Of course, customers should be given a guarantee that the systems function properly.

Successful business models usually include a financing component. This is particularly important for the mass market in rural areas of developing countries where most people do not have access to commercial financing, or are overwhelmed in dealing with loan applications. Traditional trading companies seem to have trouble with this fact. In contrast, younger firms with a concern for economic and sustainable development seem to be able to manage this.

The importance of a simple financing component for business models is also reflected in the success of third party ownership models in the residential PV sector in western countries. Such lease models may not be the most attractive option in financial terms, but they are definitely the most comfortable option for the customer in administrative terms.

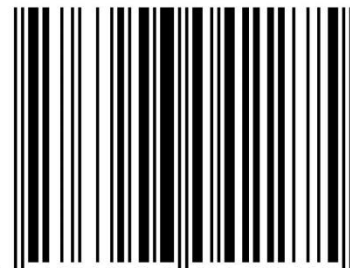
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Note: Case study specific references are listed at the end of each cast study report.



ISBN 978-3-906042-27-5



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