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Revenue Models and Pricing Strategies in Solar-Based Decentralized Micro-Grid Rural Electrification Companies in India.

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Problem Description

The thesis subject is revenue models and pricing strategies in the context of solar-based decentralized micro-grid companies operating in rural India. The task is to investigate how a revenue model can be developed in this context.

This will be done by performing a literature review, and a qualitative case study in India.

Preface

This Master Thesis is written by Stian Angelsen and Dag Håkon Haneberg at the Norwegian University of Science and Technology (NTNU) School of Entrepreneurship, in Trondheim, Norway, June 2015.

This Master Thesis is supported by the Centre for Sustainable Energy Studies (CenSES), which is a national research center for sustainable energy. Through CenSES' support, the authors were given the opportunity to travel to India for performing interviews for a qualitative case study. The personal interactions between the authors and micro-grid operators and customer provided unique insight for this study.

The authors wish to thank the case companies for the cooperation during the qualitative study. These are Mera Gao Power, Naturetech Infrastructure, TARAurja, and OMC Power. In addition, the authors wish to thank the interviewed customers in the villages of Bheldi, Bansdih, Kalyanpur and Raghunathpur for their cooperation. The authors also wish to thank their supervisor Vivek Sinha for his feedback and guidance in the process of performing this study.

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Abstract

Rural India needs electricity. Solar-based decentralized micro-grid operators in rural India strive for higher operational profits to attract more investors, and speed up the electrification process. This paper seeks to address this problem by suggesting a tool for revenue model development, as the existing literature on the subject is insufficient. General and contextual revenue model literature is reviewed, and a qualitative case study of four companies in India is performed and presented. A key finding is that the process of the revenue model development varies. The authors address this by introducing learning into the revenue model development tool. The tool further consists of a revenue model structure, and a set of revenue model ideas to address the contextual challenges. This study contributes to the revenue model theory in the context by proposing (1) a revenue model structure, (2) a learning-based mechanism for revenue model development, and (3) that revenue collection (transaction method, collection method, and control method) is part of the revenue model structure. Through a discussion of generalizability, the authors suggest that the tool is applicable for renewable energy decentralized micro/mini/village-grid operators in rural India.

Sammendrag

Forfatterne har utviklet et verktøy for inntektsmodeller i solenergibaserte desentraliserte mikro-nettselskaper for elektrifisering av rurale områder i India. Grunnlaget for verktøyet, "Revenue Model Development Tool", er et literaturstudie etterfulgt av et kvalitativt case-studie. Dette case-studiet inkluderte fire private selskaper som opererer med mikro-nett i India. Det foreslåtte verktøyet for utvikling av inntektsmodeller er ment å bli benyttet av bade nye og eksisterende selskaper som ønsker å utvikle sin inntektsmodell.

Det er et stor behov for å utvikle finansielt bærekraftige løsninger for å tilby elektrisitet til de 450 millioner menneskene i rurale India som idag ikke har tilgang til strøm. Tilgang på elektrisitet er sentralt for sosio-økonomisk utvikling. Desentraliserte systemer fremstår som den best egnede løsningen på grunn av relativt lave kostnader, i tillegg til en bedre kvalitet på elektrisitetstilførselen til brukerene. Idag benytter de fleste mikro-nett diesel som energikilde, men fornybare ressurser slik som vannkraft, vindkraft, biomasse og solenergi er ønskelig. Solenergi har det største vekstpotensialet i India.

Idag har mikro-nett basert på fornybar energi store utfordringer med sin finansielle bærekraftighet, og er derfor i stor grad avhengige av subsidier. Dette forsinker utviklingen av mikro-nett og dermed tilførsel av strøm til store deler av det rurale India. En mate å løse disse store utfordringene på, er å utvikle egnede inntektsmodeller for selskapene som driver med slike mikro-nett, slik at de gir økonomisk avkastning og dermed får videre investeringer.

Studiet som presenteres i denne masteroppgaven benytter seg først av eksisterende teori om forretningsmodeller, inntektsmodeller og prisningstrategier. Strukturene fra dette settes i kontekst ved en gjennomgang av kontekst-spesifikk litteratur. Gjennom litteraturstudiet presenteres et konseptuelt utgangspunkt for en inntektsmodell.

Den konseptuelle modellen danner grunnlaget for et case-studie i India, hvor forfatterene intervjuer fire selskaper som opererer mikro-nett. Funnene fra dette case-studiet bekrefter og videreutvikler elementer fra den konseptuelle modellen. Et sentralt funn var at forfatterene fant det hensiktsmessig å ikke kun studere inntektsmodellen i seg selv, men også prosessen som den utvikles gjennom. På dette området var det stor variasjon mellom de fire selskapene. Denne prosessen har mange likhetstrekk med læring, og forfatterene inkluderer derfor læringsmekanismer i det presenterte verktøyet for inntektsmodeller. Denne læringsmekanismen kalles her "Revenue Model Development Loop".

Verktøyet for utvikling av inntekstmodeller blir delt i to deler; Inntektsmodellens struktur (Revenue Model Structure) og ideer til inntektsmodellens innhold (Revenue Model Ideas). Gjennom en diskusjon angående generaliserbarhet foreslår forfatterene at strukturen kan generaliseres til selskaper som leverer strømtilførsel, vanntilførsel, og så videre. Det foreslås også at innholdet i verktøyet kan generaliseres til desentraliserte mikro/mini/landsby-nett I India som drives av fornybar energi.

Studien bidar teoretisk ved å foreslå en ny struktur for inntektsmodeller der mekanismer for å hente inn betaling er inkludert. I tillegg bidrar forfatterene ved å presentere en læringsbasert modell for inntektsmodeller, der den kontekstuelle komponenten kan erstattes med annet kontekstuelt innhold.

Executive Summary

A development tool for revenue models and pricing strategies in solar-based decentralized micro-grid rural electrification in India is developed by the authors. The basis for the ***revenue model development tool*** is an extensive literature review followed by a qualitative field study of four case companies in India, including interviews of customers in a total of four villages. The proposed development tool may be used by existing and new micro-grid companies that wish to develop their revenue model in the context of rural India.

There is a need to develop financially sustainable solutions that can provide 450 million people in rural areas of India with electricity. Decentralized systems pose as the most viable solution due to lower costs and higher quality of electricity in rural areas. Most current systems use diesel generators, but renewable energy technologies such as hydro, wind, biomass, and solar are better solutions, where solar has the largest unutilized potential in India. Renewable energy rural projects currently are highly subsidy dependent and object to considerable challenges related to financial sustainability, slowing the development. Higher operational profits are expected to attract more businesses and speed up the electrification process. This is often done by reducing costs or increasing revenues, which can be addressed by the revenue model of the company.

The study starts by reviewing literature in two main fields of interest: The first field is existing theories regarding revenue models and pricing strategies. The second field is contextual literature on solar-based decentralized micro-grid rural electrification. The result of the literature review is an initial construct that acts as a guideline for the qualitative case study.

The findings from the qualitative case study confirm and elaborate the initial revenue model construct. The authors found that the process of revenue model development varies between the case companies, and that the companies continuously change and improve their revenue model. The authors have therefore created a tool that allows learning and changes in the revenue model. The tool consists of two parts; the revenue model structure, and a set of revenue model ideas to address contextual challenges.

The contextual study has led to revenue model implications that contribute to the theory on revenue models in the context. Through a discussion on generalization, the authors suggests that the revenue model structure can be generalized to the context of utilities, and that the revenue model ideas can be generalized to the context of renewable energy decentralized micro/mini/village-grids in India.

The authors propose a learning-based model that can be adapted to different contexts. This study contributes to the revenue model theory in this context by proposing (1) a revenue model structure, (2) a learning-based mechanism for revenue model development, and (3) that revenue collection (transaction method, collection method, and control method) is part of the revenue model structure.

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List of Abbreviations

kWh = Kilowatt hours = the energy required to run a 1000 watt appliance for 1 hour.
kWp = Kilowatt peak = the maximum power output of a power plant.
Rs = Indian Rupee, national currency of India.
ATP = Ability to pay
WTP = Willingness to pay
NGO = Non-governmental organization

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1. Introduction

"If we don't change direction soon, we'll end up where we're heading."

IEA (2011)

According to International Energy Agency, rural areas represent the large majority of people that do not have access to *modern* energy sources (IEA, 2011). In this context, modern refers to use of energy sources that is non-traditional, where traditional sources are for example kerosene or biomass, as defined by IFC (2012). Achieving the goal of universal modern energy access by 2030 requires yearly investments of between $30 billion to $100 billion (Bazilian et al., 2012). The International Energy Agency has estimated that the investments in off-grid electricity between 2010 and 2030 will be about $14 billion per year (Bhattacharyya, 2013). Recent studies bring up the "poverty-loop" where people in developing countries do not have efficient work methods and tools to take part in economic development. One of the influencing factors is electricity, and through access to electricity, one will both gain time which can be devoted to paid work and income-generating activities based on electricity (Biswas, Bryce, & Diesendorf, 2001).

Non-access to electricity can be seen as both cause and effect of rural poverty (Ahlborg & Hammar, 2014). 87 percent of the people who lack electricity live in rural areas in developing countries (IEA, 2011). In India alone, 450 million do not have electricity access (Kemmler, 2006). Providing electricity to these areas is a major challenge, and has traditionally been seen as the role of state-owned utilities and governmental initiatives, through centralized generation and distribution. However, in 2003, the Government of India issued the Electricity Act, which allows participation of actors from the private sector into supplying electricity to the rural population for the first time (Govt. of India, 2003). Because of this, the authors choose to focus on India as the geographic context of this study.

"Energy poverty hinders economic and social development."

Gradle and Knobloch (2011)

1.1 Electricity for the Poor: Decentralized Micro-Grids

Rural electrification approaches may be divided into the centralized approach, or the decentralized approach (Chaurey, Ranganathan, & Mohanty, 2004). The centralized approach is the extension of an existing grid of electricity originating from a central source. This is the most common way of distributing electricity in the world, as large plants are efficient power producers. However, there is also an acceptance for the fact that the grid-based systems cannot meet the demands for universal access to modern energy (Zomers, 2014). For rural and inaccessible areas, a grid extension introduces problems of high transmission and distribution losses, unreliable supply, practical difficulties, and financial unviability (Kumar, Mohanty, Palit, & Chaurey, 2009). In such places, off-grid electrification has proven a viable solution. Such local grids are often called mini-grid, micro-grid, or village-grid, generating energy from distributed generators (Gradle & Knobloch, 2011). Friebe, Flotow, and Täube (2013) states that off-grid electricity supply is the most suitable starting point for the majority of the rural population that currently have no access to electricity.

"The socio-economic significance of the distributed generation scheme based on mini-grids is much higher in remote and distant rural areas, forest areas, and islands..."

Chaurey et al. (2004)

It is also a consensus that distributed village grids are regarded as more promising in terms of a development impact because they allow for productive use of the generated electricity. They are expected to outperform the often unstable national grids in developing countries (Schmidt, Blum, & Sryantoro Wakeling, 2013). The grids are often expandable and can later be connected to other micro-grids and/or a centralized grid.

The most common equipment for producing electricity in rural villages has traditionally been diesel-fueled generators. However, off-grid electrification using diesel generating sets are neither environmentally friendly nor economically cost-effective, due to high cost of transportation of fuel to remote areas (Kumar et al., 2009). The use of renewable systems makes the system independent of volatile fuel prices, underperforming grids, and can lead to lower energy prices in the long term (Loka et al., 2014).

1.2 Renewable Energy Options

Renewable energy may be defined as driven by energy sources that are fully replenished by nature (Luthra, Kumar, Garg, & Haleem, 2015). Examples are sunlight, geothermal heat, rain, waterfalls, waves, tides and biomass.

The renewable energy sources may be divided in two parts:

1) Energy that is harvested through burning, combustion, etc. in a similar manner to fossil fuels such as oils and coal. Energy input to the generator is physical units that may have to be transported to the power plant. This is true for biomass systems that are based on agricultural residues such as husk or material such as firewood.
2) Energy that is harvested from natural forces, such as sunlight, wind and water. This energy is gathered at or near the power plant or system. Although transportation and distribution costs are less apparent, the installations are sometimes more expensive per produced amount of power. The technology is also often more different from traditional fossil methods.

According to Luthra et al. (2015), there are seven renewable energy sources in India. These are presented in Table 1.

RE Source	Available	Utilized	**Growth Potential Ratio** ***(Higher is better)***
Solar	700-2100 GW	2.20836 GW	317 - 951
Wind	102 GW	21.1363 GW	4,83
Hydro	150 GW	39.788 GW	3,77
Geothermal	10.6 GW	-	-
Biomass	23 GW	1.285 GW	17,9
Tidal	8 GW	-	-
Wave	40 GW	0.001 GW (prototype)	-

Table 1: Renewable energy sources available in India and their utilization. *Source: (Luthra et al., 2015).*

Apparent from Table 1, solar has clearly the largest potential to harvest today unutilized energy.

1.3 A Need for Entrepreneurship

The potential opportunity for the private sector is significant, with an estimated potential of $2 billion per year in decentralized renewable energy services in India (IFMR/WRI, 2010). A general conclusion from decades of rural electrification experience is that compared to urban electrification, rural electrification through grid extension is significantly more expensive, and thus national utilities have proved to be reluctant to provide electricity services to rural areas (Zomers, 2014). To cover the investments required, electricity service providers have traditionally been supported by up to 50 percent subsidies of initial investments and including low-interest or interest-free loans (Zomers, 2014). Regarding private organizations, the rate of return is often 10 percent or less and there are high risk levels associated with rural electrification projects.

"Most people living in rural areas of developing countries are poor, but they are nevertheless usually willing to pay a substantial part of their incomes for reliable electricity."

Zomers (2014).

Experience shows that local entrepreneurs and community organizations are able to deliver electricity services access to rural areas, given a viable financial basis. The aim should be to support these local initiatives rather than foreign development participants (Zomers, 2014).

Although it is often spoken about *availability* of electricity, it is not alone sufficient. A more appropriate term is *access*, which depends on both availability - that an electricity service is present and available for use, and *affordability* - that the target user and customer groups can afford to utilize the available service. Access is a product of availability and affordability (Ranjit & O'Sullivan, 2002). A household may be within the geographical areas where an electricity connection is possible but do not have the financial resources to pay for it, or the other way; A household may have strong financial resources but there is no service available. Electricity access therefore demands both factors. In addition, there will be no available services if operators are not able to make an income from them. This interdependency is illustrated in Figure 1.

$$Access = Availability \times Affordability$$

Ranjit and O'Sullivan (2002)

Figure 1: The *access-demand-business* loop. Illustrates the interconnectedness of electricity access and facilitation of off-grid electrification businesses. *Source: Authors.*

One of the key challenges in rural electrification is the lack of suitable and adequate business models that will provide sustainable revenue to reach a scale that is sufficiently large to do an impact (Zerriffi, 2011). Revenues can stem from three different levels: the *local* (village) level, the *national*, and the *international* level (Schmidt et al., 2013). Local level revenue is what the customers and users of the electricity pay the utility, while national and international level refers to subsidies and governmental financing. The financing problem is hence divided into two main revenue sources: (1) National and international subsidies and financing, and (2) payments received by the customers – the local revenue.

In order to have a sustainable delivery model for electricity in rural India, there is a need to develop business models where the consuming population can pay for electricity at the price it actually costs (Loka et al., 2014). Data on potential revenues through electricity sales on the local level has not been thoroughly documented (Schmidt et al., 2013). This indicates the need to explore how to use revenue models more effectively in off-grid rural electrification projects, to create operationally profitable and sustainable businesses at the local revenue level. This need is the practice-oriented motivation for the authors to perform this study.

1.4 Value Capture: Revenue Models

The sustainability of a business is dependent on its business model. Although there is no generally accepted definition of a business model (Morris, Schindehutte, & Allen, 2005), it is consensus that a business must create, deliver, and capture value (Osterwalder & Pigneur, 2010). This paper focuses on the latter, the value capture, which is crucial for the success and sustainability of any company (Richardson, 2008).

A business model sets the limits for the total value that is created, the overall "size of the pie", which can be considered an upper limit of the possible value capture of the company (Amit & Zott, 2012). Hence, it is the task of a revenue model or pricing strategy to capture as much of the total value as possible (Amit & Zott, 2012). It is therefore critical for the success of a company, to design, implement, and refine commercially viable architectures for revenues and costs (Teece, 2010). According to Corley & Gioia (2011), theoretical constructs should be dynamically improved and developed by testing theory in contexts to uncover weaknesses and implications from the context. As there is no literature applying the general revenue model and pricing theory into the context of this study, the authors' theory-oriented motivation for performing this study is to assess the implications of the context on the general revenue model and pricing theory, and how that theory can be developed by going through contextualization.

1.5 Research Scope: Solar-Based Decentralized Micro-Grids in India

Bhattacharyya (2013) argues that choice of technology and demand estimation is essential for the sustainability of any business model. Typical technologies are solar, hydro, wind, and biomass. The local conditions can benefit one technology more than others, meaning that one technology cannot successfully be applied at all locations. Different types of technologies have different opportunities in local revenue generation, and hence different challenges. Due to limited amount of time, a more focused study on revenue models can be done by limiting to one type of technology. The thesis will limit the focus to those who use photovoltaic solar panel technology, as it is the technology with the largest unutilized potential in India (Luthra et al., 2015).

To summarize the pathway to narrow down the focus of this work, an illustration is presented in Figure 2. Note that some challenges about subsidies will be discussed shortly, but is not here a focus.

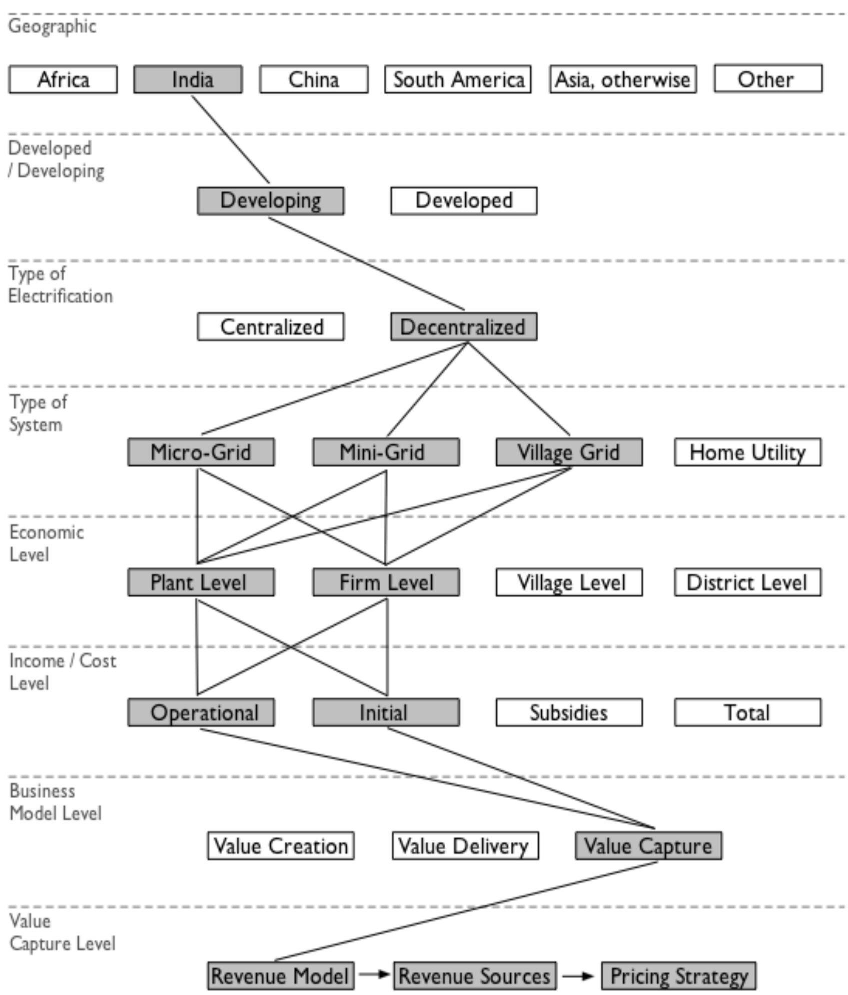

Figure 2: Graphical summary of the focus in this work. *Source: Authors.*

1.6 Thesis Outline

The purpose of the thesis is to fulfill both the practical and theoretical needs stated by the authors' motivations above. To guide this work, the authors set the following research question.

Research Question: How can a revenue model be developed for solar-based decentralized micro-grid rural electrification companies in India?

In order to answer the research question, the authors specifically address three sub-questions:

a. What are the elements and structure of a revenue model?

b. What are the revenue model challenges in the context and how can the challenges be addressed?

c. How do companies within this context go about developing their revenue model?

This thesis defines the components of a general revenue model, and elaborates theory on challenges relevant to revenue models in the context of solar-based decentralized micro-grid companies doing rural electrification in India. The authors use this theory to build a context-specific initial construct of a revenue model. By doing this, the authors have studied to which extent literature may answer the research questions. The initial construct forms the basis for a qualitative case study, from which a proposed revenue model development tool for the micro-grid operators is developed through abductive reasoning. Following the presentation of the revenue model development tool, the authors assess the generalizability of the tool to divide between general and context-specific components. This is done to further enhance the contribution from this study.

Through this study, the authors find both coherence with the general revenue model theory, but also new components that the authors suggest should be included into the general theory. The authors develop a model where focus is not only on the content of a revenue model, but on the process through which it is built.

1.7 Thesis Structure

This thesis proceeds in the following way. Initially, a review of revenue model and pricing strategies literature is presented followed by contextualizing material relating the revenue model and pricing strategy literature to the context of solar based decentralized micro-grid rural electrification companies in India. Based on this, the general revenue model elements are linked with the challenges, solutions and results found in context-specific literature to build an initial construct. The initial construct forms the foundation to develop a qualitative case study.

The method applied in this study is then described. This is followed by the results from the case study, presented as an integrated analysis assessing the findings in the same sequence as in the initial construct. The analysis is divided between correlating findings to the initial construct and new findings, as compared to the initial construct. The analysis summarizes the most significant *findings* from the case study.

The findings are discussed in the main discussion chapter. The discussions on the different findings converge into *implications*. These implications also form the basis of a revenue model development tool, in combination with the theoretical inputs from literature. The logic of this structure is summarized in Figure 3.

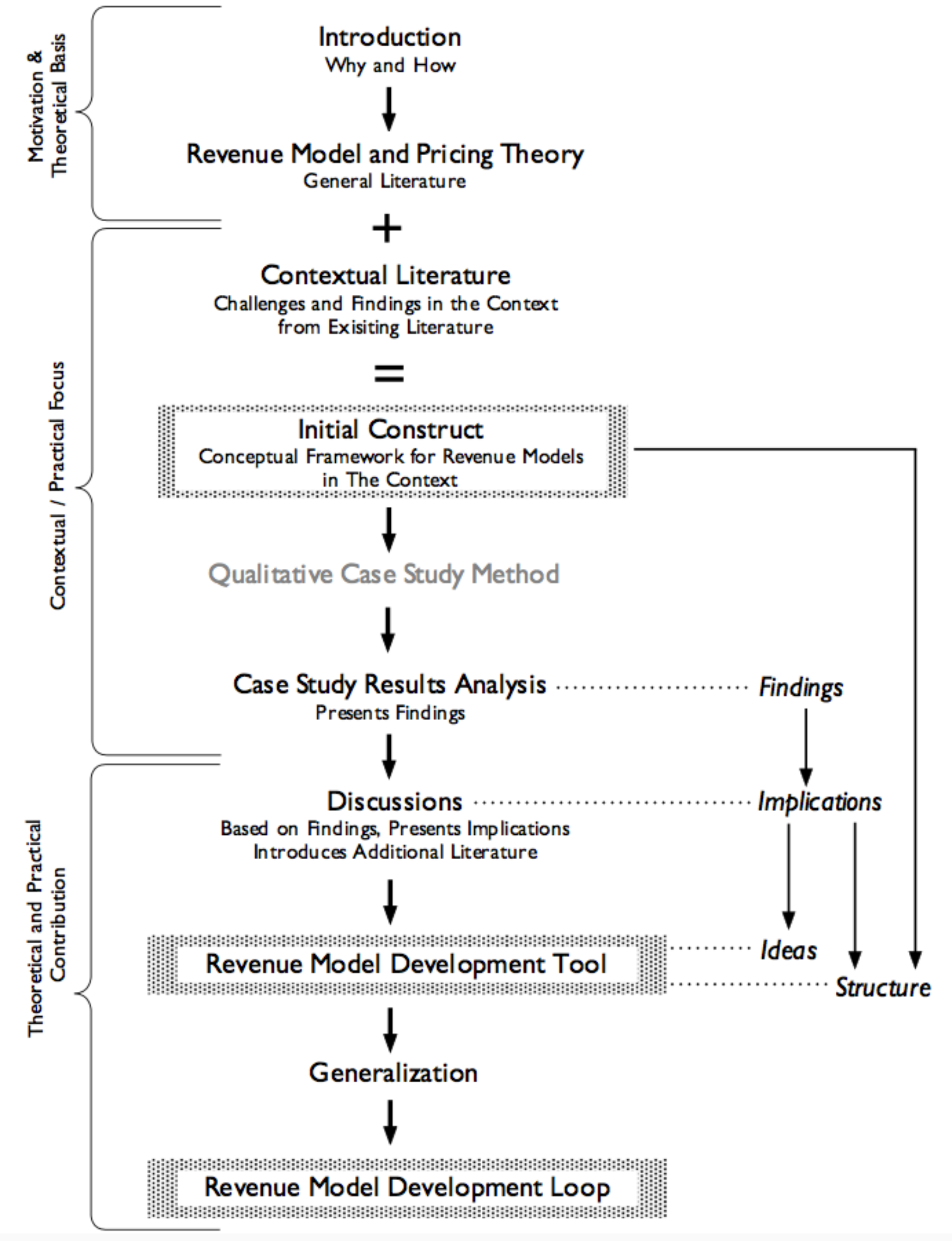

Figure 3: Illustration of the structural logic of this thesis. *Source: Authors.*

2. Theoretical Background and Constructs

This chapter presents the theoretical background required to define what a revenue model is, and which elements it consists of. Relevant *business model, revenue model* and *pricing* literature is presented. The intention is to build a revenue model construct that can be applied to the contextual theory of solar-based decentralized micro-grid rural electrification in India, which will be done in Chapter 3. The theory reviewed in this chapter sheds light on the revenue model's role in a business model, and investigates its two main elements.

2.1 Revenue Model vs. Business Model

Every organization has a business model (Casadesus-Masanell & Ricart, 2010). Despite recent developments in research on business models, scholars do not agree on what a business model is (Amit & Zott, 2012), and there is also no formal definition for business models in the off-grid electrification sector (Bhattacharyya, 2013). The definition of Osterwalder and Pigneur (2010) states: "A business model describes the rationale of how an organization creates, delivers, and captures value". This functional definition of the business model encapsulates the three key dimensions of value creation, delivery and capture, which most authors agree upon. Looking at the different definitions, there is also consensus that a business model must be seen as a system with several sub-components (Seidenstricker, Scheuerle, & Linder, 2014). One of these components is how the company captures value through revenue models, which the authors elaborate on. According to Amit & Zott (2012), however, when designing a revenue model, managers need to consider the interdependency between a company's business model and its revenue model meaning they cannot be looked upon as entirely isolated elements.

2.2 The Revenue Model: Definitions

Revenue models are quite closely related to the concept of a business model, but they are still conceptually distinct (Amit & Zott, 2012). As with different definitions of business models there are different definitions of revenue models as well. However, there is some consensus on its main components. By looking at the definitions, a revenue model can be divided into two subcomponents: *Revenue sources*, and *pricing mechanisms*. Below, an overview of the description of revenue models from five authors is presented. This is also summarized in Table 2.

1. Osterwalder and Pigneur (2010) use the term Revenue Streams, which is different **sources** and methods of collecting revenues. For each stream, there is a **pricing mechanism**, which can be either fixed or dynamic. The choice of pricing mechanism can make a considerable difference in the total revenues generated.

2. Teece (2010) has two components in his business model related to revenue model, namely:
   - Confirm available revenue **streams**
   - Design **mechanisms to capture value**

3. Richardson (2008) defines business model components in a broader perspective, and uses the term "Value Capture", which consists of the revenue model and the economic model. The revenue model is defined to describe the **sources of revenues**, or the different ways that the firm receives money in exchange for its services.

4. Morris et al. (2005) use a business model component called "Economic Factors", of which revenue model is a sub-component. The revenue model includes flexibility in **revenue sources** and **prices**.

5. Amit and Zott (2012) highlight how the revenue model is connected to the pricing strategy, which is the specific modes in which a business model enables revenue generation. "*How much of the total value the firm captures, however, depends on its **pricing strategy, or revenue model.***"

Authors	**Revenue model elements**
Osterwalder and Pigneur (2010)	"Revenue Streams, each with a pricing mechanism"
Teece (2010)	"Confirm available revenue streams. Design mechanisms to capture value."
Richardson (2008)	"Value capture. Revenue model"
Morris et al. (2005)	"Economic factors. Flexibility in revenue sources and prices"
Amit and Zott (2012)	"Pricing Strategy/Revenue model"

Table 2: Revenue model elements definitions. Different authors name the revenue model component differently.

The focus in the literature appears to be weighted towards pricing. For instance, Amit and Zott (2012) use the term "pricing strategy" as equivalent to "revenue model". The extent of a pricing mechanism is substantial. Revenue sources on the other hand are described in a briefer manner, as in Teece's "Confirm available revenue sources". However, they are both important factors. Summing up the different views, the authors conclude that the revenue model consists of the elements in the text box below, where the identification of the sources of revenue and the development of an appropriate pricing mechanism for each source, in particular, is key to ensure value capture for the firm.

- **Revenue sources**
- **A pricing mechanism for each revenue source**

In the following two sections, the aspects and issues related to these two elements of the revenue model are described.

2.3 The Revenue Model: Revenue Sources

Theory on revenue sources is handled briefly in the literature, and usually limited to identifying broad 'types' of revenue sources. This is primarily because depending on context and industry, there are many different ways of organizing the revenue sources. Multiple revenue sources are available. However, the important factor is to apply creativity to find new, undiscovered, and profitable revenue sources for the business. Here, in line with the literature, the authors limit the review to describing the broad types of revenue sources identified. The context-specific sources of revenue are dealt with in later chapters where the context is discussed. The two main groups of revenue sources, identified in literature are:

- **Transactional revenue sources:** One-time customer payments
- **Recurring revenue sources:** Ongoing payments for providing a service or customer support.

A selection of ways to generate revenue sources is presented in Table 3.

Revenue source	Description
Asset sale	Transferring an asset/product to the customer at a certain price. The customer is free to do whatever the customer wants with the asset, for example re-selling it to a third party.
Usage fees	The customer pays for a service proportional to the amount of usage. For example charging the customer for number of minutes on the telephone, or charging a customer for the amount of electricity used.
Subscription fees	The customer gains continuous access to a service by paying periodic fees.
Lending/ Renting/ Leasing	The customer gains access to an asset for a certain amount of time, and avoids the costs of full ownership. The lender can get recurring revenues on single assets.
Licensing	The usage of intellectual property is granted in exchange for licensing fees. The licensor can enjoy revenues from their property without having to manufacture and sell the product or service.
Brokerage fees	Fees are paid to a company providing a service of value exchange. For example, VISA provides the service of transferring money from the buyer to the seller at many arenas, at a certain fee.
Advertising	Revenue streams can be generated by advertising a particular brand, product or service. This has been revenue model for many TV-companies, and is increasingly important for modern software, Internet, and service companies.

Table 3: Methods of organizing the revenue streams. *Source: Osterwalder and Pigneur (2010)*.

The revenue sources above may be transactional or recurring depending on how they are applied. Typical recurring revenue are subscriptions, usage fees, and advertising. A typical transaction-revenue is asset sales. However, an agreement may be made with the customer to perform repeated transactional revenues, and hence converting the practical definition to recurring revenue. A license agreement may for example take either role. It may be configured as a one-time sale of the license, recurring revenue with royalties, or a combination of both.

In every context, there might be potential revenue sources that have not been thought of previously, which underlines the importance of applying an investigative and creative mind when looking for and setting up revenue sources. Once found, each revenue source needs a pricing mechanism. This is presented next.

2.4 The Revenue Model: Pricing Mechanism for The Revenue Source

Each revenue source needs a pricing strategy or mechanism. The terms pricing mechanisms and pricing strategy is often used interchangeably in the literature, describing the same processes. To develop successful strategies it is essential to understand the forces that determine the success of a pricing strategy (Nagle, et al., 2010). Pricing is a maturing subject, but is still not successfully utilized by all managers. Ingenbleek and van der Lans (2013) have found that some firms do not pursue any of the strategies indicated by pricing theory, and that others engage in practices for no clear strategic reasons. Lastly, some firms also fail at implementing a pricing strategy successfully. Pricing is one of the most difficult marketing decisions performed by managers (Ingenbleek & van der Lans, 2013).

Basic pricing theory focuses at certain principles for successful pricing. The authors have found two major literature sources describing a pricing process.

- **Morris and Calantone (1990)** have developed a strategic pricing program for price determination consisting of four components: price objectives, strategy, structure, and levels/tactics. This is similar to the basic pricing principles stated by Piercy, Cravens, and Lane (2010): Pricing objectives, situation analysis, and price determination.

- The Strategic Pricing Pyramid by **Nagle et al. (2010),** consisting of five components: Value creation, price structure, value communication, pricing policies, and price levels.

Further, sub-components of pricing are described by Ingenbleek and van der Lans (2013), Kortge and Okonkwo (1993), and Osterwalder and Pigneur (2010).

The articles cover many of the same pricing elements. Therefore, the authors present the literature by the *structure* of Morris and Calantone (1990), *elaborating each component with theory from other researchers*. At the end, the components related to value-driven pricing is presented. The final result is a conceptual revenue model construct applicable for contextual studies.

In sub-sections 2.4.1 to 2.4.4, the elements in the strategic pricing program by Morris and Calantone (1990) is presented one by one, and in sub-section 2.4.5, the value-based approach by Nagle et al. (2010) is presented. Then, in section 2.5 these elements are synthesized into a revenue model construct to be used as the theoretical basis for a revenue model in this study.

2.4.1 Price Objectives

Managers should have clear objectives of what they want the pricing strategy to achieve. In other words, the goal(s) the company aims to achieve by the pricing. Companies can have a number of different pricing objectives, and examples are presented in Table 4.

Pricing Objectives	
1. Target rate of return on investment	13. Maintain loyalty and sales support to middlemen
2. Desired share of the market	14. Avoid excessive demands from suppliers
3. Maximize long-term profit	15. Be regarded as fair by customers
4. Maximize short-term profit	16. Create interest and excitement for the item
5. Sales growth	17. Use price of one product to sell other products in line
6. Stabilize the market	18. Discourage others from lowering prices
7. Convey a particular image	19. Recover investment in product development quickly
8. Desensitize customers to price	20. Encourage quick payment of accounts receivable
9. Be the price leader	21. Generate volume as to drive down costs
10. Discourage entry by new competitors	
11. Speed exit of marginal competitors	
12. Avoid government investigation and control	

Table 4: Price objectives. *Source: Morris and Calantone (1990)*.

2.4.2 Price Strategy

Pricing strategies will generally fall into two groups, cost-based and market based (Morris & Calantone, 1990). This is summarized in Table 5.

The Cost-based approach is much more prevalent among industrial firms than market approaches. This strategy usually uses a formula where the costs are fully allocated to units of production, and a mark-up or rate of return is added to this total (Morris & Calantone, 1990). The method is easy to implement and manage, is intuitive, and makes sense to most managers. However, the price is often too high or too low given current market conditions, and only return mediocre performance (Nagle et al., 2010).

Market-based approaches tend to focus either on the competition, customer demand, or both (Morris & Calantone, 1990). These methods can be divided into customer-driven prices, which adapt the need for pricing to reflect market conditions, and share-driven pricing that depend on the company's market share (Nagle et al., 2010). Share-driven pricing is to price depending on the company's market share. Managers believe that more market share usually produces greater profit. Priorities are although confused when managers reduce the profitability of each sale just to achieve the market share goal.

Cost-based strategies

a) **Markup pricing / cost-plus pricing** - variable and fixed costs per unit are estimated, and a standard mark-up is added. The mark-up is frequently either percentage of sales or of costs.
b) **Target return pricing** - variable and fixed costs per unit are estimated. A rate of return is then taken times the amount of capital invested in the product, and the result is divided by estimated sales. The resulting return is added to unit costs to arrive at price

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Market-based strategies

c) **Floor pricing** - charging a price that just covers the costs, usually in order to maintain a presence in the market
d) **Penetration pricing** - charging a price that is relatively low to the average price of competitors, or what customers usually pay.
e) **Parity-pricing** - charging a price that is about the same as the average of the competitors
f) **Premium pricing (skimming)** - charging a relatively high price compared to competitors or what customers usually pay
g) **Price leadership pricing** - involved a firm setting the standard for competitors to follow. Limits price wars and lead to fairly stable market shares.
h) **Stay out pricing** - Discourage competitor entry
i) **Bundle pricing** - Combining a set of products, to sell cheaper in the bundle than if sold separately
j) **Value-based pricing** - different prices are set for different market segments based on the value each segment receives from the product or service.
k) **Cross-benefit pricing** - To maximize profitability of an entire line of products or services, rather than individual items.

Table 5: Table of possible strategies. *Source: Morris and Calantone (1990).*

2.4.3 Price Structure

The pricing structure determines how each product/service will be priced, how the price vary for different customers and product/services, and the time and conditions of payment (Morris & Calantone, 1990). The structure can be to charge a standard fixed price for a product, which is simple to administer and easily understood by customers. However, it may lack flexibility as markets become more competitive. A company may for example utilize its resources more completely by charging less during low demand, and higher during high demand, called dynamic pricing. Examples of fixed and variable prices are presented in the Table 6.

Static pricing	Dynamic pricing
List price. Fixed priced for individual products, services, or other value propositions. **Product feature dependent.** Price depends on the number or the quality of the value proposition features. **Customer segment dependent.** Price depends on the type and characteristic of a customer segment. **Volume dependent.** Price depends on the quantity purchased.	**Negotiation.** Price dependent on negotiation. **Yield management.** Price depends on inventory and time of purchase. **Real-time-market.** Price is established dynamically based on supply and demand (e.g. airline industry) **Auctions.** Price determined by outcome of competitive bidding

Table 6: Static vs. dynamic pricing. *Source: Osterwalder and Pigneur (2010).*

Dynamic pricing models have long been used by utilities and other capacity-constrained service providers, to encourage customers to buy in off-peak hours to balance capacity utilization. As a company moves towards pricing differently for the peaks and valleys, its average price decreases, but its profit and return on capital invested will increase. Dynamic pricing also makes it possible to consistently segment prices based on estimates of willingness to pay (Nagle et al., 2010).

Complicated price structures serve to capture the best possible price for each customer segment, and certain tactics for pricing can be employed differently across segments. Except for pure commodities, a single price per unit is rarely the best way to generate profit (Nagle et al., 2010).

A segmented structure can be created when revenues vary with differences in (1) the economic value that customers receive, and (2) the incremental cost to serve them, which ultimately determine profitability (Nagle et al., 2010). There are three mechanisms that can be used to maintain such a segmented structure:

1. **Price-offer configuration** splits the segments into different offers for the customer.

2. **Price metrics** are the units to which price is applied, which is what exactly that the buyer will receive per unit of price paid (charge per hour of use, per visit, per some measure of benefit, etc.) It is a problem that most price metrics are adopted by default or tradition, which limits innovation.

3. **Price fences**, which are a type of quantity discount tactic, such as volume discounts, order discounts, two-part prices, and step discounts. All these tactics can be used when dealing with differences in price, sensitivity, costs, and competition.

2.4.4 Price Levels

Price levels refer to the actual price charged. Price setting is challenging, requiring the collection and analysis of information about the company's business goals and cost structure, the customer's preferences and needs, and the competition's pricing and strategic intent. The goal of the price-setting process is to set profit-maximizing prices by capturing the appropriate amount of differential value in each of the served segments (Nagle et al., 2010).

Costs represent a minimum level for setting price in order to break even, and so represent a beginning point of pricing (Kortge & Okonkwo, 1993). The price can then be raised up to a price ceiling, which is determined by what the product is worth to the customer, the customer value (Ingenbleek & van der Lans, 2013). Market competition can limit the maximum price possible to charge, below the actual ceiling (Kortge & Okonkwo, 1993).

When putting the price objective, price strategy, price structure, and price level together, the manager must continually evaluate a number of critical price determinants: Overall company objective and marketing strategies, costs, demand, competition, and legal issues (Morris & Calantone, 1990).

2.4.5 The Value-based Approach – Strategic Pricing

Classic pricing approaches are the cost-based and market-based. However, Nagle et al. (2010) criticize classic cost-based and market-based approaches as underperforming in terms of optimal revenue capture, and emphasizes the value based approach as the most logical strategy to pursue.

The definition of the value-based approach is to configure value-based offerings that provide only the value the customer is willing to pay for, at the maximum willingness to pay. This requires a thorough understanding of how the product/service provides value to the customers. The value-based approach differs from the cost-based approach where the focus is to cover the cost, plus a premium, and the market based approach where the focus is on competition and customer demand. The value-based approach created by Nagle et al. (2010) is summarized here.

Strategic pricing requires ensuring that services include just those features that customers are willing to pay for. The differentiated benefits that a company can offer must be translated into customer perceptions of a fair price premium for these benefits. Creativity is required in how revenue is collected so that customers receive more value and pay more for it. Lastly, it requires varying price to use fixed costs optimally.

Three principles follow successful pricing strategies:

1. **Being value-based**, meaning that the price should be adjusted to reflect changes in time and differences across value to customers.
2. **Being proactive**, anticipating future events and develop strategies to deal with them.
3. **Being profit-driven**, meaning that the company should evaluate its success by what it earns relative to alternative investments.

The strategic pricing can be summarized in the 'strategic pricing pyramid' in Figure 4.

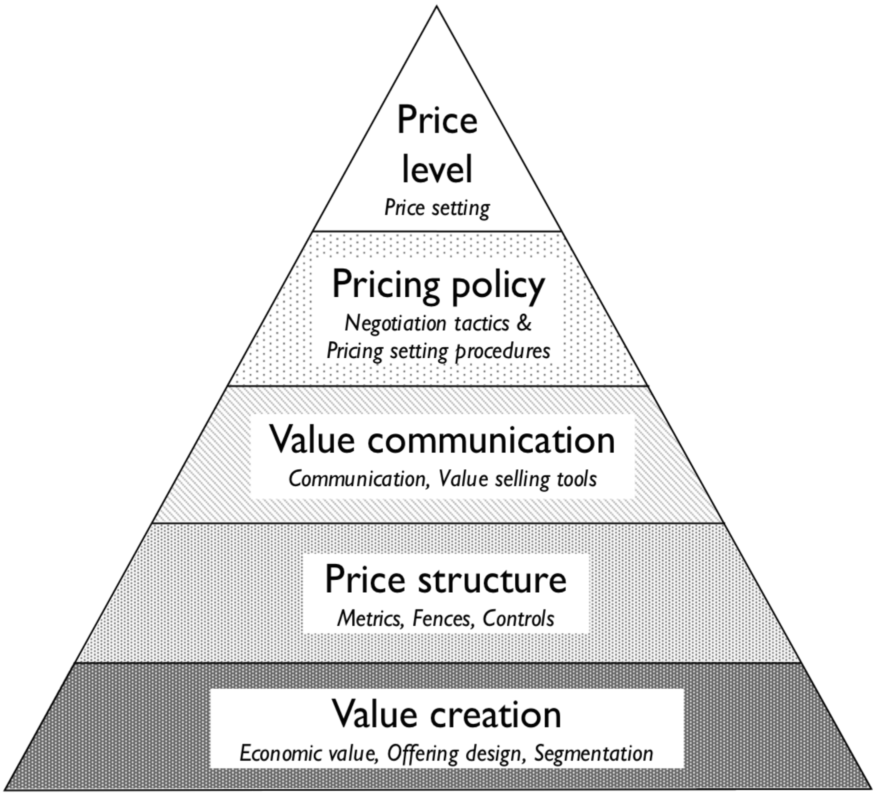

Figure 4: The strategic pricing pyramid. *Source: Nagle et al. (2010).*

Value Communication

People do not necessarily evaluate prices logically. Depending on how it is communicated, customers can perceive the same price for the same value differently. There are at least three aspects of price perceptions and their implications for price communication (Nagle et al., 2010):

1. **Proportional price evaluations.** Psychologists call the tendency to evaluate price differences proportionately the Weber-Fechner effect. For example: Hotel chains have found it more effective to offer "free breakfast" or "free internet access" with their rooms rather than offer a slightly lower price.
2. **Perceived fairness.** What is a fair price? The perception of fair prices seems to be unrelated to supply and demand. It is subjective, but manageable. It also appears to be related to whether the price is paid for a necessity, or as an improvement for the standard of living. Charging high prices for necessities is considered unfair. Electricity is today a perceived necessity in the developed world, but for rural electrification it is an improvement for standard of living.
3. **Gain-loss framing.** People place more importance on avoiding losses than on equally profitable gains through charges. For example, a gas station that offers payment by cash and credit card at different rates, should communicate a discount for cash-payments instead of an extra charge for credit card payment.

In most cases, communicating the values of the service is much more profitable than reducing prices (Nagle et al., 2010).

As mentioned in section 2.1, the authors identify that in the literature on business models and revenue models, there seem to be overlapping topics. Pricing theory is a mature field of research, while business models is a newer field of research, first gaining considerable traction in the 21st century. The two research fields have been developing side by side over the past years, and discuss many similar topics. The value-based approach of Nagle et al. (2010) is not very different from the definitions of *creating, delivering, and capturing value* of the business model theory (Osterwalder & Pigneur, 2010). While the business model theory focuses more on the logistics and operations of the business and the pricing theory focuses more on sales and marketing, the discussion about value and value creation is found in both fields. To recall, in section 2.2, revenue models were commonly defined as the part of a business model that captures value.

However, the value-based pricing strategy is also concerned with value creation. Therefore, the business model and revenue model definitions overlaps. As pointed out by Amit and Zott (2012); even though they are conceptually distinct, revenue models are quite closely related to the concept of a business model. Allowing the inclusion of value creation in revenue models is therefore reasonable to the authors.

2.5 Theoretical Construct: The Revenue Model Construct

Based on the above, the authors develop a conceptual construct for the development of a revenue model. The construct is basically a four-step process:

Step 1: Establish a revenue source.

Step 2: Design a pricing mechanism for that revenue source.

Step 3: Focus on value creation and communication in designing and using the revenue source.

Step 4: The revenue model may consist of several revenue sources, each with its pricing mechanism.

The authors integrate the models presented in this study by identifying that the price level and pricing policy elements in the pricing pyramid by Nagle et al. (2010) are corresponding to the price level component by Morris & Calantone (1990). Similarly, the price structure of Nagle et al. (2010) is corresponding to the element with the same name in the model of Morris & Calantone (1990). The two models also contain elements that are not included in the other. The two may then be integrated into a model where the elements of both are included; The value creation & communication from Nagle et al. (2010) and the pricing mechanism from Morris & Calantone (1990).

The authors also apply the definition of section 2.2 that the revenue model consists of revenue sources and a pricing mechanism for each revenue source. The synthetization is illustrated in Figure 5 and the resulting general revenue model construct is presented in Figure 6.

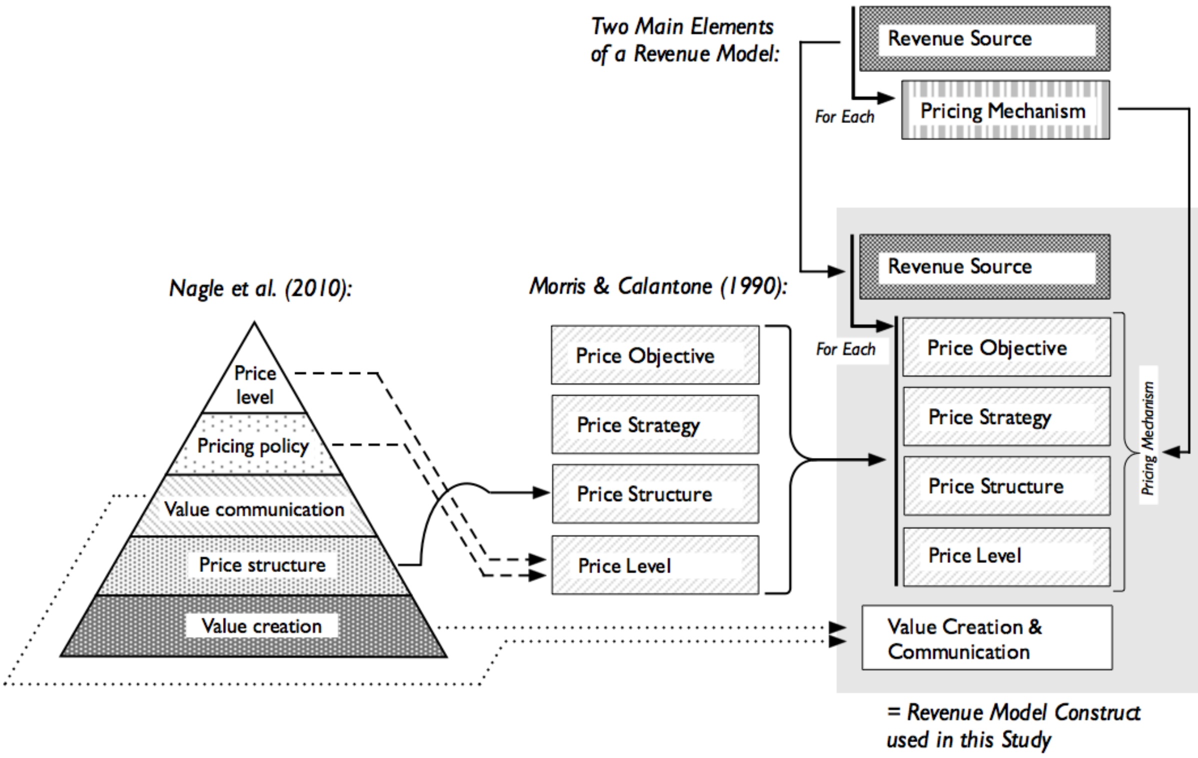

Figure 5 (above): Illustration of the revenue model construct used in this thesis and how it is formed based on Nagle et al. (2010), Morris & Calantone (1990) and the two elements of a revenue model presented in section 2.2. Arrows show how the three models are synthesized. *Source: Authors.*

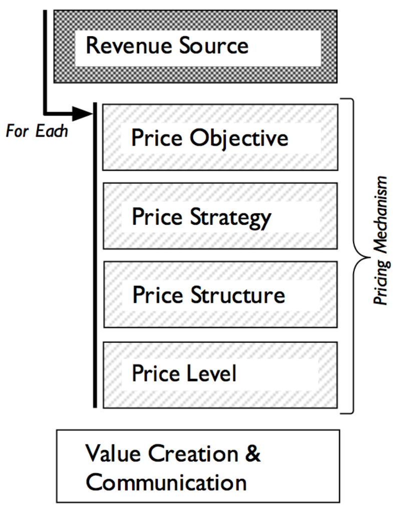

Figure 6 (left): The resulting general revenue model construct, which will be used throughout this thesis. *Source: Authors.*

3. Understanding the Context

Understanding the context is necessary to identify the contextual elements that are likely to have an impact on a revenue model development tool in the context. This chapter contains three types of context-related literature relevant for revenue model development:

- Articles identifying challenges, barriers and success factors – Section 3.1
- Existing frameworks – Section 3.2
- Case studies of rural electrification projects – Section 3.3

This review of contextual literature leads to a discussion of how the context and contextual challenges affects the revenue model of micro-grid operators in India, which is the objective of chapter 4. As the literature presented here is comprised of current and extensive reviews, they are used as starting points for the development of an initial construct of the revenue model.

3.1 Challenges: Renewable Energy Decentralized Rural Electrification

This part on challenges introduces perspectives on barriers, challenges and important factors influencing the establishment and operations of rural electrification using renewable energy. There is a focus on economic and financial factors, which may be met by developing suitable revenue models. The objective is therefore to identify the set of challenges that revenue model theory is challenged by in the context, in order to develop a revenue model suitable for the context of this study.

From the context definition "solar-based decentralized micro-grid rural electrification companies in India", the authors find that there are not many studies matching the context exactly, and the authors therefore choose to make use of literature covering only parts of the context. The findings from these articles are presented one article at a time in this section, for later to include them in a set of challenges that are likely to be relevant for revenue models for the complete context of this study. Even though these articles are not directly addressing solar-based decentralized micro-grid rural electrification in India, the issues identified here are relevant for developing an understanding of the general context of our study and start building a framework for a revenue model construct.

Based on these fields, three sets of challenges and barriers are presented below, relating to the topics. The last of these three is focusing on low-income markets, which is a characteristic of rural India and thus considered highly relevant. As a fourth set, success factors for rural electrification projects are included to present a suggestion from literature on the characteristics of a successful electrification effort in rural areas. Together, these acts as four perspectives that set revenue model and pricing issues into the context of this study.

The literature presented in this section focus on the following contexts:

- ***Rural electrification*** - Urmee, Harries, and Schlapfer (2009).
- ***Renewable energy in India*** - Luthra et al. (2015).
- ***Electrification in low-income markets*** - Gradle and Knobloch (2011).
- ***Rural electrification (Success factors)*** - Ilskog (2008).

3.1.1 Urmee, Harries, and Schlapfer (2009): Challenges in Rural Electrification

Urmee, Harries, and Schlapfer (2009) classifies the core challenges to rural electrification, with focus on south and Southeast Asia into three categories:

- Economic
- Legal and regulatory
- Financial and institutional

Through their extensive literature review, they connected the challenges they found into three categories. The classification is done by Urmee, Harries, and Schlapfer (2009), and the authors of this thesis have presented the most relevant challenges for revenue models in Table 7.

Issues	**Category**
High capital cost	*Economic*
Lack of financing	*Economic*
Lack of access to credit for the customer	*Economic*
No link with income generation	*Economic*
Lack of policy and legal framework	*Legal and regulatory*
Improper use of subsidies	*Legal and regulatory*
Donor dependency	*Legal and regulatory*
Unrealistic political commitment	*Legal and regulatory*
Lack of institutional capacity	*Financial and Institutional*
Lack of technical knowledge	*Financial and Institutional*

Table 7: Issues for rural electrification. *Source: Urmee et al. (2009).*

3.1.2 Luthra et al. (2015): Challenges for Renewable Energy in India

Through an extensive literature review, Luthra et al. (2015) concluded that there are seven dimensions of challenges to renewable energy utilization in India, and identify the most important factors for each of these.

1. **Economical & Financial;** The need for, and the lack of, high initial capital for new projects.
2. **Market;** Lack of sufficient market base and lack of consumer awareness to (new) technology.
3. **Awareness & Information;** Unavailability of solar radiation data.
4. **Technical;** The general (added) complexity of renewable energy technologies.
5. **Ecological & Geographical;** Ecological issues regarding dams for hydropower. The least important factor in this dimension is issues with geographic conditions such as amount of wind, rain or sunlight.

6. **Cultural & Behavioral;** Challenges connected to rehabilitation and maintenance of large installation such as hydropower dams.
7. **Political & Government Issues;** Lack of political commitment.

3.1.3 Gradle and Knobloch (2011): Challenges for Electrification in Low-Income Markets

Gradle and Knobloch (2011) structures this topic into a more business model oriented approach and presents some challenges in receiving customer payments and proposed ideas for assessing these challenges in electrification in low-income markets. Those related to economic or financial issues are presented in Table 8.

Affordability Challenges	**Propositions**
The availability of tools and instruments for income generating activities that will benefit from electricity access is often lacking, hindering the possibility for return of investments for customers. This can make electricity unaffordable to potential customers.	● Provide productive tools alongside electricity, such as machinery. ● Create economic opportunities through establishing activities such as food processing or sewing.
Liquidity Challenges	**Propositions**
Up-front expenses such as initial fees may be too high for the customer to handle, even if the use of electricity is cheaper in the long term compared to customers' current energy usage.	● Offer flexible payment schedules. ● Provide links to microfinance institutions.
Enforcement of Payment Challenges	**Propositions**
The formal enforcement mechanisms regarding unpaid claims are sometimes not adequately powerful in areas for rural electrification. Banking mechanisms are also in many cases not satisfactory developed. The payment mechanisms may therefore solely rely on local personal relationships and social norms.	● Employ local representatives for payment collection. ● Build on existing social structures such as co-operatives and groups. ● Partner with microfinance institutions for financial control.
Lack of Understanding Challenges	**Propositions**
For rural customers, the cost structures may be difficult to understand. Examples of such cost structures are payment plans. If illegal tapping of electricity is done, customers may not understand why they should pay for a proper connection.	● Make the local community responsible for payments collection.

Table 8: Challenges and propositions for electrification in low-income markets. *Source: Gradle and Knobloch (2011).*

3.1.4 Ilskog (2008): Success Factors for Rural Electrification

Ilskog (2008) presents a framework of indicators for evaluating a rural electrification project. There are 39 indicators sorted by the following development classes: **1)** Technical, **2)** Economic, **3)** Social/ethical, **4)** Environmental **5)** Organizational/institutional.

The financial aspects are assumed the most relevant for this research, and are therefore further elaborated. While technical indicators focus on the feasibility of the energy source and technical solutions, the economic indicators are about the survival of the service beyond the economic lifetime and the initial investments (Ilskog and Kjellström, 2008). These economic indicators are presented in Table 9.

Key variable	Indicator
Financial perspective	Profitability
	Costs for operation and maintenance (O&M)
	Costs for capital and installation
	Share of profit set aside for re-investment in electricity service business
	Tariff lag
Development of productive uses	Share of electricity consumed by businesses
	Share of electrified households using electricity for income-generating activities
Employment generation	Business development
Competition	Number of electricity service organizations in the area

Table 9: Economic indicators for rural electrification. *Source: Ilskog (2008)*.

3.1.5 Summarizing Challenges and Success Factors

Through the review of the four articles in this section, the authors have found both overlapping findings between the different authors, but also differences. The challenges are only presented here, as the authors are presenting existing frameworks and case studies that are relevant for the context in the two next sections (3.2 and 3.3) of this chapter. Then, in chapter 4, the results from chapter 3 will be discussed together to form an initial construct of a revenue model. This is done to include contextual information when synthesizing into an initial construct.

The challenges presented in this section are summarized in the left column of Table 10. The other columns show which articles the topics are included in, and are likely to indicate the significance of the challenge, barrier, or issue in the context of solar-based decentralized rural electrification in India.

Challenge / Barrier / Issue	Urmee, Harries, and Schlapfer (2009): Rural Electrification	Luthra et al. (2015): Renewable Energy	Gradle and Knobloch (2011): Low Income Markets	Ilskog (2008): Success Factors in Rural Electrification
High capital cost / High capital needs	X	X	X	X
Lack of initial financing/capital	X	X		X
Profit set aside for re-investment in new projects				X
Lack of access to capital or credit for customer	X		X	
Insufficient links to income generating activities in businesses / households	X / X		X / -	X / X
Insufficient market base		X		
High transaction costs, e.g. in payment collection	X		X	
Lack of information for market decision making	X	X		
Lack of revenue/profit	X			X
Operational costs		X		X

Table 10: Summary of challenges, barriers or factors emphasized in the different elements or fields of the context. For businesses and households in row number five in the table, there is one marking for each; Left = businesses, Right = households. *Source: Authors*.

3.2 Existing Frameworks: Revenue Models and Pricing Strategy

As presented in the previous section, many of the challenges may be met by developing suitable revenue models. Success factors of rural electrification projects are also found to be connected with the existence of suitable revenue models.

In this section, the authors present existing literature for the purpose of outlining the current state of frameworks that can be utilized for revenue model and pricing in the context of this thesis. There is a limited number of existing frameworks in the literature that is directly relevant for solving revenue model-related challenges in the context of this study. Therefore, the authors choose to present the frameworks one by one for later discussion in chapter 4.

The three frameworks of this section focus on the following:

1. Tariff, in other words *price level*, determination framework in **solar-based off-grid** solutions - Kumar et al. (2009).
2. A business model framework, including revenue structures, for **rural electrification** - Schillebeeckx et al. (2012).
3. Tariff setting and revenue maximizing in **renewable energy off-grid rural electrification** contexts - Kobayakawa and Kandpal (2014b).

The frameworks are presented to utilize existing constructs in the process of developing the initial revenue model construct. They will also be relevant for identification of which factors related to revenue model that are considered the most important by the authors of the frameworks. This adds perspective to the authors of this thesis, and supports the identification of revenue model-related challenges in the context.

3.2.1 Kumar et al. (2009): Financial Framework for Tariff Determination

Kumar et al. (2009) present a method of determining the tariff (price level) for solar-based electricity in off-grid solutions.

The high capital cost is considered the foremost barrier to renewable energy systems scaling problem, even though costs over the entire lifetime of renewable energy technologies are much less than the conventional alternatives. The cost elements are presented as capital costs, grant/capital subsidy, debt and equity, annual operation and maintenance costs, fuel costs, annual escalation of costs, renewable energy-based incentives, and revenues from carbon credit.

A mathematical formula uses the annual electricity generation in kWh together with costs to find a static tariff. A monthly tariff should be collected from each beneficiary, to cover operational costs. Depending on the type of tariff structure (fee for service or fee per unit), billing and metering should be done. Based on the structure and the institutional arrangement, a collection of revenue would take place.

The financial framework of Kumar et al. (2009) is very basic. Although it does not provide specific revenue model design proposals, it does provide an actual method to calculate costs.

3.2.2 Schillebeeckx et al. (2012): An Integrated Framework for Rural Electrification

Schillebeeckx et al. (2012) attempts to build an integrated replicable business model by linking four "focal lenses" - technology, institutional, viability, and user-centric - that are generally used separately to discuss rural electrification projects. The viability lens addresses the revenue structure of the consortium's business model. The term *revenue structure* shows the financial flows, which include the revenue sources. They finally develop a generic business model checklist that could act as a framework for practitioners, which is intended to be a toolkit that can help turn the sustainability challenge into a business opportunity. This conceptual model is presented in Figure 7.

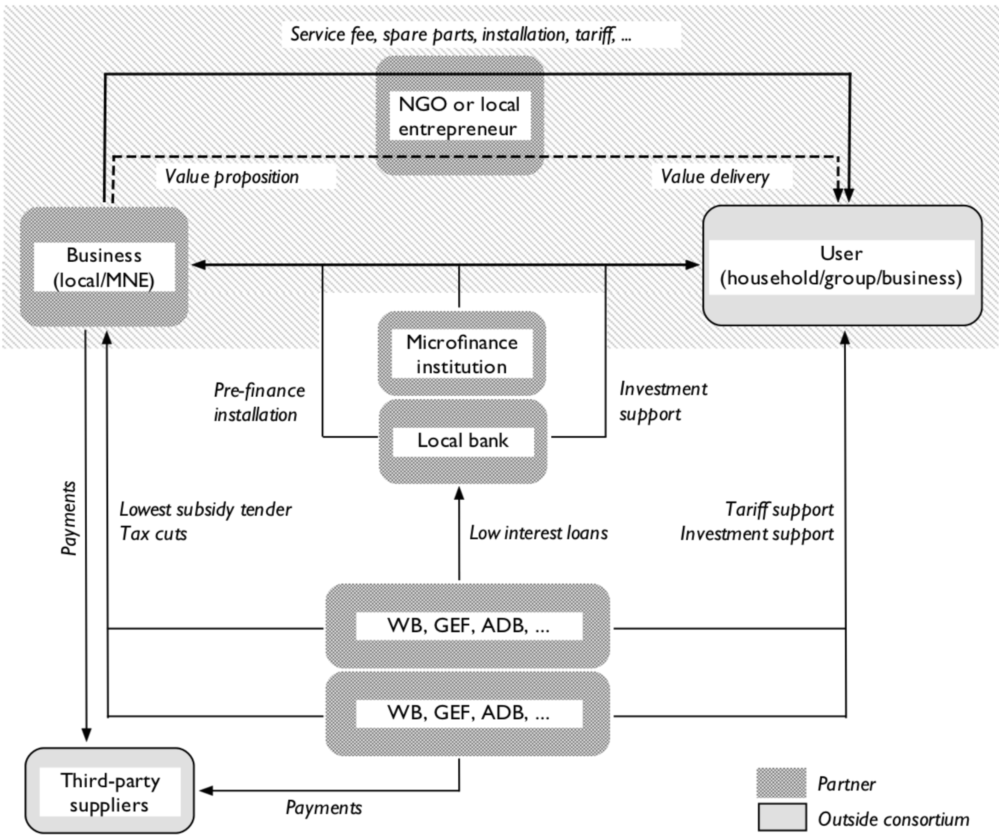

Figure 7: Conceptual model of financial flows among the members of the consortium (dark gray) and potential third parties and customers (light gray). Solid arrows: financial flows. Dashed arrows: Depict the direction of value proposition. The marked area at the top indicates the most relevant flows for this study. *Source: Schillebeeckx et al. (2012)*.

The approach chosen by the initiating partners is situated between completely commercial (no subsidies at all) and completely social (100 percent subsidized).

The user-centric lens is considered the most important factor, as understanding the underlying user needs is essential to increase the economic success rate of rural electrification projects. Three core concepts that are fundamental to understanding user needs were found: *affordability*, *reliability*, and *local embeddedness*.

Affordability

Schillebeeckx et al. (2012) point to the problem of capital access, periodic payments, and risk shifting for the poor.

1. The poor have low income, few savings, and lack of experience in purchasing durable goods, which is necessary to invest in electricity generating technologies.
    a. In Bolivia, a small local grid doubled its number of customers when it started to spread connection cost payment over five years.
    b. In Malawi, the electricity company demands a full upfront payment of the 30-year cost of line extension, resulting in a rural electrification rate of only two percent.
2. Vital drivers for affordability are the combination of periodic charges (the size, timing and duration of periodic payments), operation and maintenance, spare parts and interest. It seems reasonable to set the price no higher than what people already are spending on energy needs (about 25 percent of regular income). Also, longer payback periods are preferred over higher periodic fees. The moment of payment can be adapted to local needs. In Zimbabwe, payments were on a yearly basis, following the annual cotton sale.
3. Depending on the revenue structure, periodic payments can be fixed or (partially) variable. Variable costs add considerable risk to the investment. When ownership is transferred the risk can shift to the customer who suddenly needs to bear the operation and maintenance risks and associated costs.

Reliability

Reliability is concerned with making sure the system is working correctly, in terms of quality, service level, and sufficiency. The functionality of the system is an important parameter of the customer's decision to connect.

Local Embeddedness

It is considered highly important to relate to how people in the target communities experience change in their environment. The participation of locals in the designing, planning, implementation and operations of rural development programs is crucial to ensure the sustainability. Benefits include overcoming cultural barriers, acceptance of new technology, and creating a sense of ownership. Further, educating the rural people can reduce operational costs and increase learning effects, increase the amount of collected payments, and increase the accountability of the community.

Business Model Framework Related to Viability

A complete business model framework is proposed. Below, the components related to revenue and pricing are listed.

Approach

- Does the project have an explicit poverty alleviation and social impact goal?
- Does the project set tariffs that are pro-poor and pro-business?
- Does the project support economic growth by livelihood creation?
- Does the project create an enabling environment for local commercial businesses to invest?
- If there are subsidies and tax breaks built into the costing have they been agreed by all partners?
- What kind of financial (incentive) structures have an impact on total cost?

Revenue Structure

- What is the total expected project cost?
- What % of the total project cost is subsidized externally and internally?
- What % of the project cost is borne by users?
- Is the expected periodic payment below the revenue boundary of the target community?
- Is there a short-term and long-term plan to sustain O&M costs?
- How is the revenue collected?
- Is there a microcredit or low interest lending system set up for users?
- Are the possible financing risks considered and mitigated?

The framework is question-based, and covers some basic elements of costs and pricing structure. The framework does not provide specific propositions or methods for creating a revenue model, nor does it cover the elements listed in the revenue and pricing literature.

3.2.3 Kobayakawa and Kandpal (2014b): Trade-Off Between Financial Viability and Affordability

Kobayakawa and Kandpal (2014b) states that although off-grid rural electrification by use of renewable energy is considered as one of the most economically feasible options, there are difficult decisions to make about the trade-off between affordability and financial viability. This decision is made through the tariff setting, and the electricity tariff setting is closely connected to covering the costs of operation and maintenance of the systems required.

In the tariff-setting framework by Kobayakawa and Kandpal (2014b), willingness to pay in the potential customer base is used as the starting point. The rationale is that a change in the tariff will induce a significant change in electricity demand based on customers' willingness to pay. The revenue is then a product of tariff and demand, and the operation and maintenance costs are dependent of the size of the utility and thus the electricity demand. If the operational income is negative, its negative percentage will have to be covered by subsidies. The flow diagram of the method is presented in Figure 8.

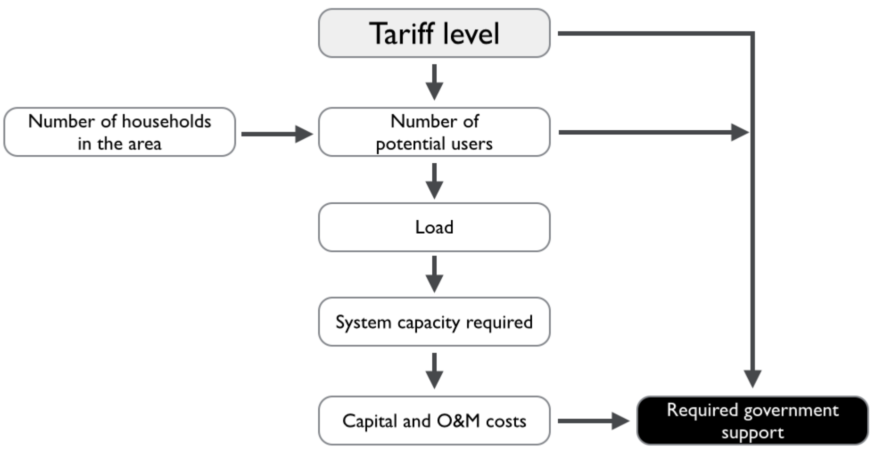

Figure 8: Flow diagram of design framework. *Source: Kobayakawa and Kandpal (2014b).*

By applying this method, one can for example optimize the tariff to balance:

- Positive operational income (local revenue)
- The highest number of potential customers → Highest positive impact

Kobayakawa and Kandpal (2014b) present an example of using the method for a mainly solar-based system. The results of using the tariff setting framework is presented in Figure 9 and Figure 10.

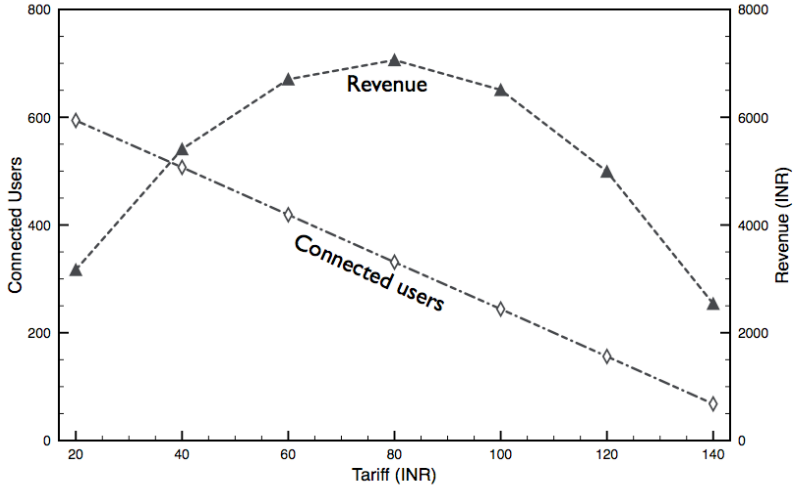

Figure 9: Example of relationship between tariff, number of connected users and total revenue from operation. *Data source: Kobayakawa and Kandpal (2014b)*.

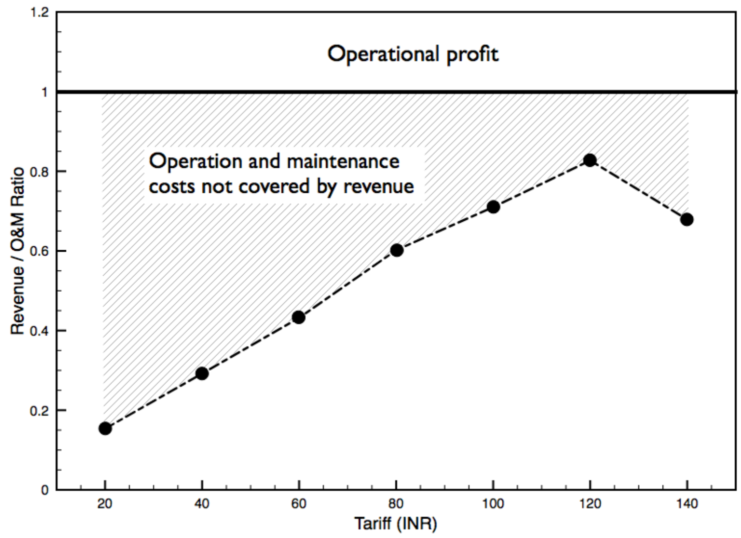

Figure 10: Changes in the ratio of revenue and operation and maintenance (O&M) costs as a function of tariff setting. The height of marked area indicates the percentage of costs that must be covered by other means. A solid line marks the lower threshold for profitability. *Data source: Kobayakawa and Kandpal (2014b).*

As indicated by Figure 9, the decision maker will have to deal with a trade-off between several measures for the success of the electrification project. One measure, such as connected user base, may be optimal at one tariff setting while another important measure, such as total revenue, may be optimal at another tariff setting. This is illustrated in Figure 9 and Figure 10.

The framework provides a tool to set the tariff to optimize operational profits, number of connections, and the trade-off between these depending on the objective of the business.

3.3 Case Studies: Revenue and Pricing Strategy Findings

In the two previous sections of this chapter, challenges and barriers relevant for micro-grid operators in the context were presented, followed by a set of existing frameworks that are developed to contribute solving these challenges and barriers. In this section, the authors will further increase the focus on the specific context of this thesis by presenting reviews of two case studies, listed in 11, with data from solar-based decentralized micro-grid rural electrification in India. In other words, they are focusing on the same context.

The results from the two case studies are put in the frames of the revenue model construct presented in the previous chapter. This is done to assess which findings from existing case studies that may affect the revenue model for micro-grid operators in India.

Author	Title
Loka et al. (2014)	A case study for micro-grid PV: Lessons learned from a rural electrification project in India.
Chakrabarti and Chakrabarti (2002)	Rural electrification programme with solar energy in remote region- A case study in an island.

Table 11: Specific case studies relevant to solar based renewable energy rural electrification micro-grid businesses. *Source: Authors.*

Revenue Sources

None of the case studies specifically suggested secondary revenue sources other than electricity sale.

Pricing Objective

Loka et al. (2014) presents Premier Solar's 13 kWh PV systems in 57 villages in Visakhapatnam District of the southern Andhra Pradesh, India. The project is 100 percent government funded, and it has a five-year scope, including operational maintenance, spare part supply, and collection of payments. Hence, the objective of the pricing is to pay back the initial costs within five years.

Pricing Strategy

Loka et al. (2014) states that Premier Solar's goal of a five-year payback focuses on cost. The yearly operational costs are calculated, and the total net present cost is calculated. This sets the foundation for a cost-based pricing approach.

Pricing Structure

The solar systems in Sagar Dweep Island in West Bengal, India, uses a price structure that is divided into three value proposition segments of fixed monthly prices (Chakrabarti & Chakrabarti, 2002). The prices do not depend on the amount of electricity consumed. Their pricing structure is presented in Table 12.

Value proposition	3 connection points	5 connections points	> 5 connection points. Commercial.
Price (Rs.)	70	120	> 120

Table 12: Sagar Dweep case pricing structure. *Data source: Chakrabarti and Chakrabarti (2002)*.

Pricing Level

In the Sagar Dweep case study, the price level of Rs.70 and Rs.120 is higher than the island's inhabitants previous energy costs of kerosene, which was Rs. 53 per month. However, the benefits and value propositions provided by the solar system increases the willingness to pay. Chakrabarti and Chakrabarti (2002) lists the benefits of establishing a new connection as lower costs compared to diesel generation, scarcity of kerosene, longer period of supply, and brighter light. Secondary benefits include longer periods for studying, housework, business, and the value of entertainment and physical comfort. Through a survey, about 46 percent of the households expressed that their willingness to pay is higher than what is presently charged for getting power.

However, willingness to pay can vary strongly from village to village, as can be seen in the survey results created by Millinger, Mårlind, & Ahlgren (2012), given in Table 13. The systems consist of small micro-grid of 3-4 kWp in Chhattisgarh. The micro-grids supply households and a handful of streetlights each.

Village	Size, households	WTP	Income	WTP as % of income
Sarsoha, Bilaspur	38	72	5000	1,4 %
Babutola, Bilaspur	70	192	3300	5,8 %
Manjuraha, Bilaspur	82	264	6000	4,4 %
Tiriya, Jagdalpur	88	84	10100	0,8 %
Nagalsar, Jagdalpur	64	48	4800	1 %
Kawapal, Jagdalpur	84	168	6600	2,5 %
Gudiya, Jagdalpur	84	192	12000	1,6 %

Table 13: Willingness to pay (WTP) related to household income. *Source: Millinger, Mårlind, & Ahlgren (2012).*

Value Creation & Communication

None of the case studies focused on value creation and communication, only value capture.

4. Development of a Conceptual Initial Construct

An initial revenue model construct will act as a starting point for the qualitative research of this study. This initial construct is developed based on the revenue model from section 2.5 and the contextual literature findings from challenges, frameworks and case studies in chapter 3. Development is done by categorization of contextual findings and identifying which components of the revenue model these categories are most relevant for. The findings in chapter 3 and the discussions in this chapter also points to propositions for ideas on how to develop a suitable revenue model in the context. Figure 11 recalls the theoretical portion of Figure 3, and illustrates the connections between chapter 2, 3 and 4 in this thesis.

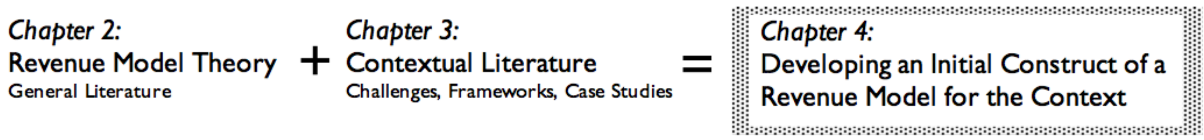

Figure 11: Findings from chapters 2 and 3 are combined in chapter 4. *Source: Authors*.

First, in section 4.1, the revenue model challenges and possible solutions in the context are discussed. Second, in section 4.2, the authors discuss how the existing frameworks and case studies presented in chapter 3 can be used to contribute to the development of a conceptual initial construct. In the end of this chapter, the results from the discussions are synthesized into a context-specific initial construct for a revenue model.

4.1 Discussion: Revenue Model Challenges in the Context

The presentation in Table 9 in section 3.1 shows a list of challenges that are found in the four articles by Urmee et al. (2009), Luthra et al. (2015), Gradle and Knobloch (2011) and Ilskog (2008). These are connected to the revenue model construct from section 2.5, and grouped into five categories by the authors:

Investments – challenges related to the capital need for establishing an electricity service in the village.

Customers' initial costs – challenges regarding connection costs for the customers.

Customers' running costs – challenges regarding the operational revenue paid by the customers, which often have low ability to pay. Includes payment collection issues.

Value and willingness to pay – about motivating the customers to be willing to spend a considerable amount of their income on the electricity service.

Income-generating activities – a focus that may both increase the customers' ability and willingness to pay

The challenges in these five categories will be discussed with respect to the revenue model in this section and summarized in sub-section 4.1.6 by connecting them to elements in the revenue model to form an initial contextualized construct of a revenue model.

4.1.1 Investments

Several challenges relate to initial financing, and the lack of such capital is an important barrier for electrification in the context. This is again partly because the lack of attractiveness to investors is a core challenge. Electrification projects often have more issues in covering the initial startup cost, compared to traditional solutions (Ahammed & Azeem, 2009). In many cases, the operators are not able to cover these costs, and since government institutions are not able or willing to provide the capital needed, private investors must be included to get the business started (Gradle & Knobloch, 2011). However, investors are expecting a considerable return on investment (ROI), a goal that is mostly incompatible with insufficient operational income (Urmee et al., 2009). Ahammed and Azeem (2009) have found that the payback period and benefit-cost ratios of many rural electrification projects are generally too low for commercial investors.

Thus in order to increase attractiveness for investors, it is important to be able to forecast, and later deliver, higher revenues to increase the expected return on investment. The same is the issue for being granted loans from for example microfinance institutions (Zerriffi, 2010). Based on these relationships, it may be argued that the challenge of securing the initial capital is closely linked to the revenue model of a renewable energy rural electrification business. It may further be proposed that this issue relates to the outcome of a successful revenue model: profit.

The challenge of investments is relevant to all parts of the revenue model, but in particular the selection of sustainable revenue sources and including an "investor's perspective" when creating the pricing mechanism. In other words, the revenue model should be made to meet the needs of the operator, but also with investors in mind.

4.1.2 Customers' Initial Costs

It is not only the micro-grid based electricity operators that are in need of initial capital. The access to credit for capital expenditures for rural electrification is a barrier both for households as end customers and entrepreneurs as potential service providers (Zerriffi, 2010). Although there exists banks and financial institutions that are able to grant loans, there are many issues such as many small loans and little credit history of clients. Such institutions expect increased security in future revenue to justify the investment.

In the revenue model, the price structure defines how the expenses for the customer is distributed in time, and it may be proposed that the initial cost often present in electrification agreements can be reduced by spreading them over time. Such a solution would have decreased the initial capital need of the customers, based on the expectation of higher repeated payments later. For the customer, this may be a viable option to remove or reduce an absolute barrier to electrification, the inability to purchase a solution due to high initial costs. On the other hand, it may impose an increased liquidity issue on the operator, which then may be in need for even higher initial investments. There might then be a trade-off situation for the operator to choose between number of potential customers and their own upfront capital needs.

The issues related to customers' initial costs are, as mentioned related to price structure in the revenue model. In addition, another option is to improve value creation by facilitating the income-generating activities of customers and to provide links to microfinance institutions. Such efforts by the micro-grid operator may increase the customers' ability to pay the cost of connecting to the micro-grid.

4.1.3 Customers' Running Costs

Although it is possible to take action to reduce the initial investment needs for the operator, it is the recurring revenue - the operational income, which must ultimately cover these costs later. In addition, the revenue should also produce a sufficiently high profit to provide both the operator and investors with the return required. However, in general, customers in low-income markets such as rural India have very limited funds and personal or household income. There may also be a trade-off situation setting the right price point such that a good balance of (1) revenue for the operator and (2) affordability for the customer, is reached.

First, the trade-off situation requires the operator to target cost covering on one hand, while also trying to maximize value capture on the other hand. Second, the operator may use this objective to develop a strategy and structure of the payments. For example, the payments may need to be distributed over a time period by adapting it to the local conditions and customers' ability to pay. As an example, it may be a problem for a farmer, who typically has seasonal income, to pay at a particular point in time, but the same farmer may have a considerably higher ability to pay after selling at the local market later in the year. Third, the price level will need to be set to meet the objectives of the pricing strategy.

In addition, it may also be important to assess the available transaction possibilities in the local area, as stated by van der Vleuten, Stam, and van der Plas (2013). Javadi et al. (2013), also points to transactional costs and practical issues as some of the central barriers to rural electrification. Transaction costs are also mentioned as one of the challenges summarized in Table 9.

The method of payment collection is related to price structure in the revenue model initial construct, and the costs connected to it may be an influencing factor. Regarding cash payment collection, it may be feasible to employ locals to collect the revenue to cope with collection issues described by Gradle and Knobloch (2011). By being able to collect a higher percentage of the payments, the revenue is assumed to increase. However, there are costs related to employment, and these costs will have to be covered by revenue. It is therefore a trade-off situation regarding price structure.

Even though electronic and automatic payments systems are matured in developed countries, the lack of structured payment systems is a bottleneck for the generation of stable operational income in this context (Urmee et al., 2009). It may be possible to leverage cellular phone technologies and create a payment structure that is mobile-based, which may be a more viable solution than employing locals. Bhattacharyya (2006) mentions poor tariff collection methods that cause poor operational income as one of the financial barriers to rural electrification. Ahlborg and Hammar (2014) emphasizes that a considerable amount of the cash flow issues may be solved by suitable payment systems.

The issues of operational income from customers with low ability pay relate to the complete pricing mechanism in the revenue model; pricing objective, pricing strategy, price structure and price level. Establishing a pricing mechanism that captures the maximum value on a running basis is the focus to meet these challenges. It is also important that the revenue sources are adapted to local transaction possibilities available to customers.

4.1.4 Value and Willingness to Pay

Even with suitable structures and price levels developed, it is still important that the potential customer base is willing and able to pay for electricity. The difference between willingness to pay and ability to pay should be noted. There may be considerable differences in what potential customers are willing to pay and what they are able to pay (Zerriffi, 2010). In customer surveys, it should be taken into account that the willingness to pay may be higher than the actual ability, and thus the economic market base is lower than expected. However, as the ability to pay is increased through local economic growth, the willingness to pay may follow (Zerriffi, 2010). If there were willingness and ability to pay, there is still need for the transaction infrastructure to receive money or values from the customer.

There are several factors influencing willingness to pay for electricity, such as income level, price of substitute fuels, the level of electrification and the real or perceived availability of alternatives to electricity (Zerriffi, 2010). The perceived quality of eventual existing electricity supply is also relevant. The discussion of customers' perception of electricity services points back to the need for local presence (Gradle & Knobloch, 2011).

Customers are often used to current solutions such as kerosene, diesel and biomass-based fuels like firewood, and there must be a good enough reason to change for customers (Zerriffi, 2010). Bhattacharyya (2006) includes the competition from traditional energy sources as one of the significant barriers to electricity demand and willingness to pay. Even though many micro-grid operators start with just a basic lighting-only service, it may be developed to more usages along the way (Palit, 2013). The useful value of electricity should be communicated to the potential customer (Gradle & Knobloch, 2011). Examples of such value are, among others, the increased stability and new usages, for example income-generating activities.

To recall, one way of increasing revenue collection rates may be to employ locals and the fact that such an employment comes at a cost. However, the wages these persons receive will contribute to increase the economic strength both for the employees themselves and in the community as a whole. It may result in an increased ability to pay and also the willingness to pay because the employees may act as representatives spreading awareness and information about the positive effects of electrification in the community, mentioned by Luthra et al. (2015). Furthermore, this may have implication on all parts of the revenue model. Local employees may also contribute to increase the competence in the community. This may be both market knowledge, easing the lack of market information to operators designing strategies, and technical knowledge. Increased technical knowledge and competence in the community may meet the challenges of skepticism to new technologies and those locals may act as pilot customers for electricity services. Technical staff may leverage from the fact that micro-grid solutions frees the customer from the technical risks of e.g. solar home systems (Palit, 2013).

The issues discussed here is clearly relevant to value communication and creation. Even though a suitable pricing mechanism is developed for the revenue sources, the value of the service must be sufficient for the customers in order to get them to connect. The value of the service must also be properly communicated. One way of communication this value is by making the price level attractive, and therefore price level in the revenue model is also especially relevant.

4.1.5 Income-Generating Activities

By providing tools to local entrepreneurs to build a sustainable business from renewable energy rural electrification, there may be a growth in locally-present independent entrepreneurs that can develop systems that is not restricted by the capacity of government-based organizations (Gradle & Knobloch, 2011). This added value must be able to overcome the higher initial investment from customers needed in many cases electrification (Bhattacharyya, 2006).

If a micro-grid operator would include the facilitation of customers' income-generating activities, it may provide additional revenue sources as well as increased costs. One example may be that the operator is selling productive tools such as pumps or mills to local customers (Palit, 2013). The customer may want to adopt electricity supply as a result of purchasing such tools. Regarding this new revenue source, the operator may apply e.g. a pricing objective to get costs covered plus an additional profit margin, and apply either a leasing or lending model with monthly payments as a pricing structure. The price level may be targeted low to give the customer financial room to purchase electricity. In such a case, it may be the long-term revenue from electricity the operator is focusing on. The offering of e.g. electric water pumps may be used as a catalyzer to initialize the electricity service agreement.

Another effect of income generating activities is increased possibilities for microcredit support. Microcredit is a viable option for investments that provides income within a shorter timeframe, both for customers and local entrepreneurs (Zerriffi, 2010). However, household electrification is not necessarily regarded income generating, and thus underpins the importance of local businesses as customers in rural electrification. By providing e.g. farmers with tools or in any other way facilitating their income generation, they may be eligible for microcredit and thus increase their ability to pay for electricity.

The authors have collected the challenges in the literature together with the implications, suggested propositions, and which revenue and pricing strategy component they can refer to in accordance with the revenue and pricing theory. The result is shown in Table 13, and will act as a prototype for the initial construct.

Relating to the revenue model construct, facilitation of income-generating activities is connected to all factors, but as an additional revenue source in particular. It is expected that the willingness to pay and ability to pay will increase as an effect of such an effort, leading back to the purely electricity sale revenue source trade-off situations described above. The market demand and operational costs are expected to be altered if the operator extends the business scope to providing tools.

4.1.6 Summarizing the Contextual Challenges of the Revenue Model

In this sub-section the authors bring their theoretical understanding of revenue model elements, together with findings from the context-specific literature in order to develop an initial construct of an appropriate tool for revenue model design in the solar-based rural micro-grid electrification sector in India. In Table 14, the challenges identified in sector specific literature and the implications for the micro-grid operators, along with proposed solutions to overcome these challenges. The right column links the challenges, implications and propositions to the elements of the revenue model construct presented in section 2.5. This is done to prepare for developing the findings into an initial construct of a revenue model.

Challenge	Implication for the operator	Proposition for addressing the challenge	Revenue model component
High initial capital cost for micro-grid operators. Liquidity issues.	Higher barriers to enter the market.	Increase the attractiveness to investors by increasing return on investment through improved revenue models. (Ahammed & Azeem, 2009) (Ahlborg & Hammar, 2014)	*All.*
		Present better revenue forecasts by applying improved revenue models and through facilitating customers' income generating activities to be eligible for microfinance. (Ahlborg & Hammar, 2014) (Zerriffi, 2010)	*All.*
High initial capital cost for customers.	Fewer customers.	Offer flexible payment schedules. (Gradle & Knobloch, 2011)	*Pricing structure.* *Time and size of payment.*
		Provide links to microfinance institutions through facilitating the customers' income generating activities. (Gradle & Knobloch, 2011) (Zerriffi, 2010)	*Value creation.*
		Apply the fee-for-service model (Palit, 2013), (Bhattacharyya, 2013)	Pricing structure.
Affordability / Ability to pay	Fewer customers. Low revenue from each customer.	Provide productive tools alongside electricity. (Gradle & Knobloch, 2011)	*Value creation.* *Additional revenue source.*
		Create economic opportunities through establishing activities such as food processing or sewing. (Gradle & Knobloch, 2011)	*Value creation.* *Additional revenue source.*
		Provide suitable payment systems. (Ahlborg & Hammar, 2014)	*Pricing structure.* *Time and size of payment.*
		Understand the local conditions to create an optimal payment structure.	Pricing structure. Time and size of payment.

Willingness to pay	Fewer customers. Lower price levels. Less revenue.	Local employees may act as representatives spreading awareness and information about the positive effects of electrification in the community. (Luthra et al., 2015)	*Price level.* *Value communication.*
		Facilitate customers' income generating activities. (Zerriffi, 2010) (Palit, 2013).	*Value creation.* *Value communication.*
Insufficient links to income generating activities in businesses / households.	Affect the perceived value of electricity.	Provide productive tools alongside electricity. (Gradle & Knobloch, 2011)	*Value creation.* *Additional revenue source.*
		Create economic opportunities through establishing activities such as food processing or sewing. (Gradle & Knobloch, 2011)	*Value creation.* *Additional revenue source.*
Difficulties in payment collection. Transactional costs.	Affect total revenue.	Employ local representatives for payment collection. (Gradle & Knobloch, 2011)	*Pricing structure.*
		Build on existing social structures such as cooperatives and groups. (Gradle & Knobloch, 2011)	*Pricing structure.*
		Partner with microfinance institutions for financial control. (Gradle & Knobloch, 2011)	*Pricing structure.*
		Assess the available local transaction possibilities. (van der Vleuten et al., 2013).	*Pricing structure.*
		Provide suitable payment systems. (Ahlborg & Hammar, 2014)	*Pricing structure.*

Table 14: Initial conceptual model. *Source: Authors.*

4.2 Discussion: What can be Learned From Frameworks and Case Studies?

In this discussion, the frameworks and case studies presented in sections 3.2 and 3.3 will first be briefly recalled. In general, the frameworks do not supply a complete method to design a revenue model and pricing strategy, but focuses on certain aspects of its subcomponents. The review of frameworks and case studies has identified a new set of challenges, and methods of how to address these challenges.

The revenue model construct presented in section 2.5 is applied to the frameworks and the case studies, and the discussion elaborates how the frameworks and case studies address the components of the revenue model. First, the authors identify the key concerns common to all these studies, which are found to be related to the issues of value capture. To recall chapter 2, value capture is the traditional focus of revenue models, while value creation is introduced by the value-based approach in Nagle et al. (2010). Further, the recommendations of these studies within value capture and value creation are discussed. In addition to propositions for a contextual revenue model, the authors also assess what is not included in the frameworks and case studies. Following that, the authors discuss the absence of value creation in frameworks and case studies.

This section is used as input for developing the initial construct for a revenue model, in addition to the results from section 4.1.

Before the discussions, a summary of the frameworks and the case studies are presented in Tables 15 and 16, respectively.

Summary of frameworks

Author	**Revenue sources**	**Pricing objective**	**Pricing strategy**	**Pricing structure**	**Pricing level determinants**
(Kumar et al., 2009)	Electricity sale. Recurring.	Not mentioned.	Cost-based approach.	Fee for service or fee per unit. Monthly payments.	Costs and production capacity. Find cost elements.
(Schillebeeckx et al., 2012)	Electricity sale. Recurring.	Two approaches: Pro-poor or pro-business.	Cost-based. Amount of subsidy vs customer revenue. Understand the user's needs.	Fixed or (partially) variable periodic payments. Adapt to local conditions for optimal performance. Ensure local embeddedness.	Set according to costs and the revenue boundary of the community. No higher than what they already pay for energy.
(Kobayakawa & Kandpal, 2014b)	Electricity sale. Recurring.	Optimize tariff to balance positive operational income, or the highest number of potential customers.	Marked based approach. Set tariff according to market demand.	Fee for service. Monthly payments.	Calculated from the willingness to pay. Choose the price level that best meets the best total combination of users and profit.

Table 15: Frameworks summary. *Source: Authors.*

Summary of case studies

Company/ case	Revenue sources	Pricing objective	Pricing strategy	Pricing structure	Pricing level determinants
Premier solar	Electricity sale	5 year project payback	Cost-based	Fixed monthly	Costs.
Sagar Dweep island	Electricity sale	Unknown.	Cost- and market based.	Fixed, value proposition segmented	Costs. WTP

Table 16: Case studies summary. *Source: Authors.*

4.2.1 Capturing Value

Most of the discussions around revenue models and pricing strategy are concerned with how to capture as much of the value as possible. There are many aspects to this, which may significantly influence the operational profitability of a company.

Price Level

Determining the price level is divided between three main fields of interest; *costs*, *affordability*, and *willingness to pay*.

Kumar et al. (2009) and Schillebeeckx et al. (2012) discuss cost elements as the fixed and variable costs. Fixed costs include installation costs, while variable costs are mainly operational and maintenance costs. Costs are major issues regarding the operational profitability, and are considered one of the main challenges. Schillebeeckx et al. (2012) also includes the willingness to pay of the locals into the equation. The pricing theory of price level sets two boundaries: 1) the price floor and 2) the price ceiling. The price floor is enough to cover the costs, while the price ceiling is the target customers' maximum willingness to pay for a value. The approach of Kumar et al. (2009) is identified as the cost-based approach as described in the pricing literature. This is enough to cover costs, but do not give optimal returns. Schillebeeckx et al. (2012) on the other hand includes the price ceiling in their calculations as the maximum willingness to pay of the customers, which they claims is no higher than what they already pay for energy today, approximately 25 percent of their total income. However, this is a limiting assumption, as can be seen by the case of Sagar Dweep island, where the customers are willing to pay far more than their previous kerosene costs, due to the added value propositions of the solar based micro-grid. Therefore, it can be argued that the cost-based approach to pricing is non-optimal.

Analysis of willingness to pay is used to establish the optimal price level through some trade-offs, which reflects a market-based approach of customer driven pricing. However, using the initial willingness to pay alone may not be enough. A problem is that a simple survey of what customers are willing to pay will not reveal the entire truth. As customers, demands may develop and change, influencing the willingness to pay. It can be suggested that the pricing mechanism should capture the full willingness to pay. A segmented value proposition structure assists in capturing this value. The survey results of Millinger et al. (2012) indicate large variations in both price level, and the willingness to pay to income ratio. Such variations may prove challenging when trying to find the correct pricing level. It may also be the actual case that it is not possible to identify a viable and profitable price level. A solution may then be to do more segmenting or to assess possibilities for further revenue sources.

In the case of Sagar Dweep Island, the willingness to pay increased with time after the introduction of solar micro-grids, as the customers could experience the benefits and value of improved electrification first hand. This may be an indicator for the identified need to better communicate the value propositions to the target community, in addition to performing an initial village analysis about willingness to pay. However, it may prove difficult to forecast the future willingness to pay in a satisfactory way, and that experience-based data gives the best approximation. In any case, it may be fruitful to build strategies as a starting point and adapt along the way.

The willingness to pay is further used in the calculations by Kobayakawa and Kandpal (2014b) who mentions that the willingness to pay determines the demand after the tariff is set. The work is basically a supply/demand analysis taking operational costs into account. Such an analysis may be useful to plan the size of the grid and its techno-economic optimization, but may alone not be enough to ensure optimal profits.

Price Objective

The cost-based approach seen by many rural electrification projects can be a result of the nature of the projects. They are often heavily subsidized by the government, and have arrangements for payback over a certain period; five years in the case of Premier Solar. The objective is therefore to price to cover the costs. It is earlier mentioned that the incorrect assumption that locals are not able or willing to pay create an unviable subsidy dependence. If the price can be set higher than to just cover the costs, subsidies could be reduced, and more income could be generated. This is a second argument for not following the cost-based approach to pricing. However, it was not clear in these studies if the cost-based approach followed in these projects is insisted on by the institution that provides the subsidy, in which case, their interest might be maximum social benefit over profitability. Private entrepreneurs who are interested in profits may choose a pro-business directed objective. The companies rarely define their pricing objective specifically.

Pricing Structure

The time and size of payment is mentioned by Schillebeeckx et al. (2012) to affect the affordability of the customers. In rural areas, cash flows vary from village to village due to industrial or seasonal variations. Schillebeeckx et al. (2012) therefore points out the importance of adapting the method and time of payments to the local conditions, for the highest value capture. However, the literature shows that monthly payments are the most common, and that the price metric is usually price per consumed unit or a fixed monthly price with no consumption variable. The important elements in theory presented by Nagle et al. (2010) are the time of payment, method of payment, price segments, and the value-based approach elements of price metrics and price fences. It is interesting that price segmentation is applied in the case of Sagar Dweep island (Chakrabarti & Chakrabarti, 2002), as this will according to theory capture more value.

Initial customer expenditure is dependent on the company's internal structure. In the fee-for-service model the mother company runs most of the operations and owns the equipment, limiting initial expenditure to connection costs, which makes it possible for more customers to connect. The other option is that the community buys the installation or parts of it. The large initial costs are barriers for many customers, even though it increases the local embeddedness, sense of ownership, and accountability. The fee-for-service model is successfully being applied by many new commercial rural electrification startups in India, such as Mera Gao Power, Naturetech Infra, Husk Power Systems and Minda Nextgen Technologies (Palit, 2013). There are many alternative business models affecting the revenue model that can be applied, including co-operatives, fee-for-service, community-managed initiatives, franchisees and private sectors models. However, there is no "best solution", and the decision has to be made depending on availability of resources, load profile, consumer's willingness to pay, financial viability of the project and local institutions (Bhattacharyya, 2013).

Securing that value is actually captured, educating and employing locals provide cost benefits and addresses the challenge in payment collection. Considerable issues regarding time and monetary costs in educating locals and the eventual monitoring costs required, may however arise. It may be assumed that this evaluation must be done for each case by the micro-grid operator.

4.2.2 Creating Value – Unexploited Possibilities?

The value-based approach introduces the focus of a revenue model to not only capture as much value as possible, but also to actively create and communicate value to increase the total value. In the frameworks and case studies presented here, a focus on creating value is found to be lacking. The authors therefore suggest how a value-creation focus could improve a revenue model for the context.

There are several important aspects that might be considered when designing a revenue model, and many of them include the mechanical aspects mentioned above, such as time of payment, method of collection, optimizing the price to demand/supply ratio, and using tactics to capture the most out of the value provided. However, an important finding throughout this work is that many companies follow the cost-based approach. What limits do this fact put on their business? They are likely to receive less income and have increased subsidy dependence, but most of all risk lacking the strategic ability to deliver more value to locals other than pure electricity. When the locals have reached their maximum ceiling of what they are willing to pay, it is often limited by their view of the value that the electricity provides them at the moment. Therefore, it seems logical that the perceived value needs to be increased. The rationale is to deliver more value, and get more value in return. An illustration on this is that the business should not only focus on capturing as much "of the pie" as possible, but also increase the "size of the pie". The micro-grid operator can for example sell or provide a local business with power tools, which increase the efficiency and income of the customer's business. With more income in the business, the customer may have an increased perception of the value of electricity and may now be willing to pay more. Also, the power tool will lead to higher electricity consumptions for the benefit of the utility. A similar result may be achieved by employing the locals for the solar system installation and operational work, giving them money to later be spent on electrical products and electricity. These locals may also work as unofficial representatives communicating the benefits of electricity access to others in the community. Focusing on value, as a development factor is the core of the value-based pricing approach - the objective is value creation.

Increasing the "size of the pie" requires an understanding of what is valuable to the locals. Such values will vary from village to village, and require a thorough analysis to be understood, and local embeddedness to be accepted. The analysis should include efficiency-increasing electrical products in the major industries in rural India, such as agriculture, cooking, metal and woodwork, entertainment (e.g. radio, TV), etc. Examples of value adding tools are cookstoves, power-tools, food processing machinery, water pumps, and more. The value adding is not limited to products, but should also include services, or any other value that might be beneficial to the local community, businesses, and individuals. Examples of such services is charging of already existing battery-based lamps used at local markets and charging of the strongly increasing population of cellular phones, presented in Figure 12.

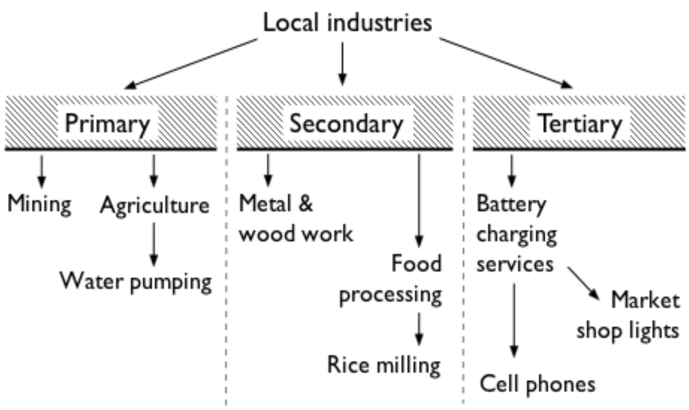

Figure 12: Example of local income generating activities adding new value propositions for a decentralized electricity service. *Source: Authors.*

Recalling the introduction of the value-based approach in section 2.4.5, business model literature focus on value creation as a core element for success. Due to the interconnectedness between the business model and the revenue model of a company, and taking the context-related findings into account, the authors propose that value creation should be a built-in component in developing a context-specific revenue model.

4.2.3 Challenges from Frameworks and Case Studies

Through the review of frameworks and case studies, the authors found additional challenges and propositions for the revenue model initial construct. These are presented in Table 17 following the same format as in Table 14 in section 4.1.

Challenge	Implication for the operator	Proposition for addressing the challenge	Revenue model component
Difficulties in payment collection. Transactional costs.	Affect total revenue.	Employ locals. Ensure local embeddedness. (Schillebeeckx et al., 2012)	*Pricing structure.*
Customers unable to pay at certain times.	Less revenue	Understand the local conditions (Schillebeeckx et al., 2012)	*Pricing structure.* Time and size of payment.
Size of plant, number of customers, and profitability	Affects profitability and plant planning.	Perform supply/demand analysis.(Kobayakawa & Kandpal, 2014a)	*Price level.* Cost analysis.
High project costs	Profitability	Identify fixed and variable costs. Reduce costs. (Kumar et al., 2009)	*Price level.* Cost analysis.

Table 17: Challenges and propositions from frameworks and case studies.

4.3 Synthesizing the Components into an Initial Construct

Through the review of literature, it is apparent that some of the challenges and propositions from sections 4.1 and 4.2 target more than one revenue component, and vice versa. The authors therefore summarize the contextual revenue model components into three categories, which are based on the elements of the revenue model construct from section 2.5 that they affect. These three categories are

- Value creation and communication
- Revenue and pricing structures
- Price level determination

These three form the basis of the initial construct of the revenue model tool, which consists of two parts arranged along these three categories. The two parts are related to assessing key dimensions of the revenue model elements and suggested actions to be taken based on those assessments. These relate directly to the challenges identified in context-specific literature in chapters 3 and 4. The result of the initial construct development is presented in Figure 13 on the next page.

In summary, the review of literature identified:

- Theory on revenue and pricing strategies.
- Challenges in solar-based decentralized micro-grid rural electrification.
- Procedures and actions to address these challenges.
- Existing frameworks describing revenue models and pricing strategies in the context.
- Case study articles of realized projects and their revenue models.

Based on these findings, the authors concluded that there is a need for value-adding activities in rural electrification, which support the use of the value-based approach to strategic pricing found in theoretical literature. The authors therefore applied the value-centric elements in the strategic pricing pyramid of Nagle et al. (2010) and added it to the pricing mechanism presented by Morris & Calantone (1990) to build the revenue model construct in 2.5, which is applied to the context of solar-based decentralized micro-grid rural electrification in India. This is done using the contextual challenges and recommendations described in the literature in order to develop an initial construct for developing a revenue model in this sector.

Based on this initial construct the authors conduct a qualitative empirical study with case companies in India in order to better understand revenue models currently in use, the logic behind them, and to develop a final tool for revenue model development for use in the context.

4.3.1 Initial Construct of the Revenue Model

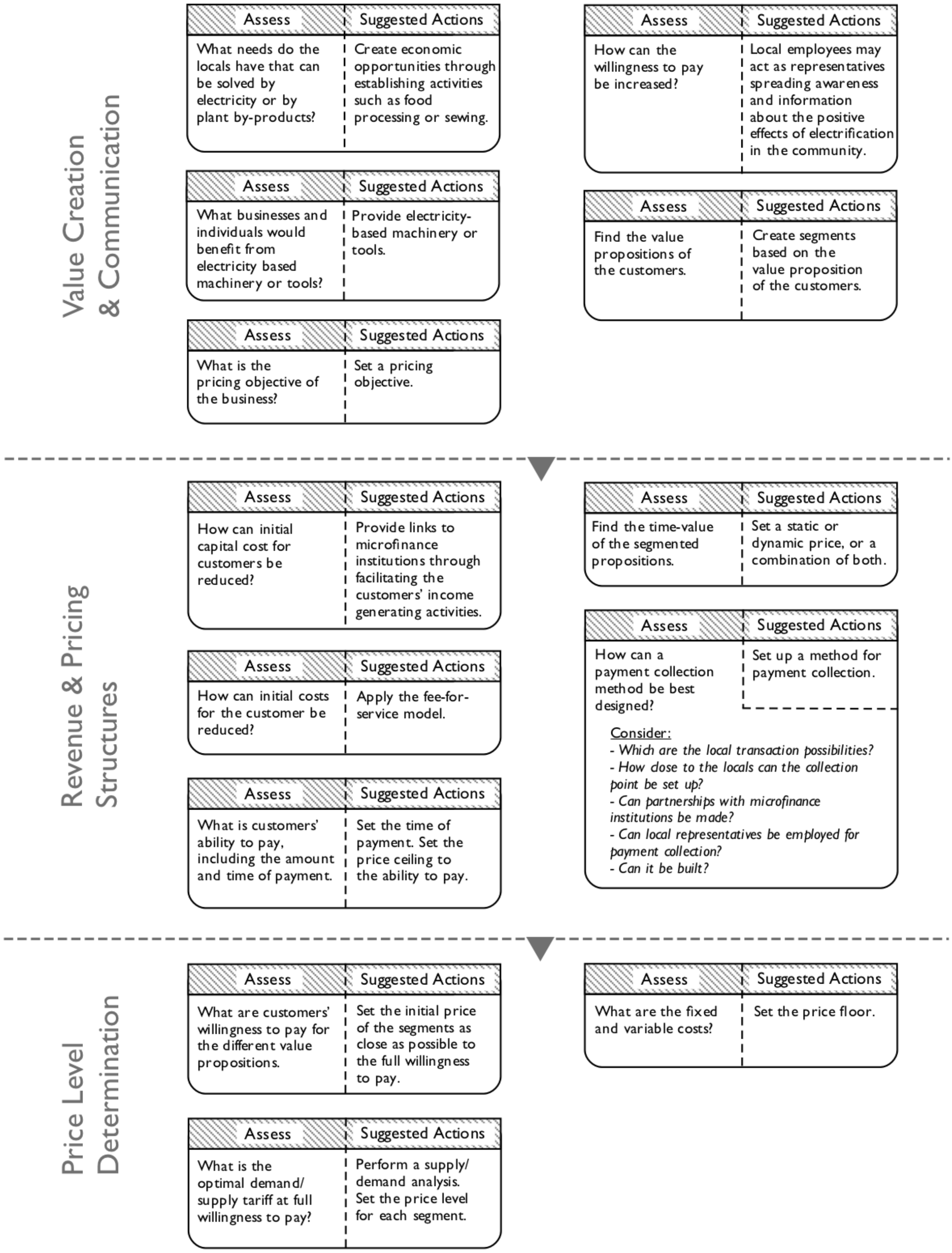

Figure 13: Initial construct of a revenue model for solar-based decentralized renewable energy rural electrification micro-grid operators in India. *Source: Authors.*

5. Method - Qualitative Case Study

This chapter presents the research methodology used in this study. The method is a qualitative case study following abductive reasoning. This chapter will go through the method used, starting from the search for existing literature to the development for the revenue model development tool, and justify the choice of method for this purpose.

5.1 Theoretical Base

In this research, the principles for literature search and review, as well as scientific method guidelines, are based on Adams (2007) and Fink (2013). To get a better understanding of the topic, it is necessary to divide the task into several fields of interest, such as *decentralized electrification* and *revenue models,* which are synthesized to build a comprehensive understanding of relevant topics. First, a general search is done to gain a general understanding of the rural electrification topic, key challenges and factors. The search is more specifically limited to the fields of business and revenue models. To investigate which revenue models and practices that are utilized by companies, a review of rural electrification case studies is performed. The authors conduct a literature search by using keywords relevant to the above topics in the online database Scopus. As some of the terms, such as "revenue model", are not consistently termed throughout all of the literature, a systematic approach is required. The revenue component is identified by reviewing business model literature, and is in this thesis defined to consist of two subcomponents, revenue sources and pricing mechanisms. Pricing mechanisms, however, is a wide field of research within several contexts and industries. To find general and relevant pricing literature it was necessary to limit the search. The selection might have excluded relevant articles. Therefore, snowballing and recommendations from scientists in this field of research is helpful in capturing the relevant parts of this literature. The literature is cross-checked through discussion before final selection. A summary of the search queries and their results are presented in Appendix D.

5.2 Qualitative Case Study

5.2.1 Justification of Method

Based on the suggestions by Yin (2009), the choice of research method type is a case-study research. This is based on the fact that the research question requests information about topics, which is not previously described in sufficient detail. This study is also about the choices micro-grid operators do and have done, and the reasons why they do and did so, respectively. The study is focusing on current or very recent choices, and the events studies are then considered to be contemporary and not historical, as such. Questions are then of the "How" and "Why" types and are about contemporary business events, for which a qualitative case study method is appropriate (Yin, 2009). In addition to build theory where no theory exists, case studies are also highly applicable to build on existing theory (Gibbert, 2010). Starting with theory and contributing back to theory is a goal of this research.

As the authors contribute to theory starting from existing literature and taking the leap through a qualitative case study, the method of systematic combining, as described by Dubois and Gadde (2002), is suitable and selected. The systematic combining method follows what is called an abductive approach where the research starts with literature and continuously develops constructs and frameworks through data collection, analysis and discussion, bringing in additional theory where needed. This abductive approach is appropriate for theoretical contribution while still not restricting the empirical part to existing literature (Dubois & Gadde, 2002). The process is also illustrated in Figure 15 later in this chapter.

Due to the restrictions of resources and time in this research, the iterative combination of empirical data and theory is done in the data analysis and discussion parts, as described by Dubois and Gadde (2002). The data collection is based on a thoroughly developed initial construct from which a semi-structured interview process and analysis scheme are developed. However, the initial construct is a tight framework to emphasize focus in the research as suggested by Dubois and Gadde (2002). In the rest of this chapter, a stepwise and more detailed description of the applied method is presented.

5.2.2 Supply-Side and Demand-Side

The focus in this study is the micro-grid operators, which is the supplier of electricity. To add strength to the study, the authors also find it of interest to study the customers of micro-grid electricity, the demand side. This is done to see if the customers' perception of the revenue model related settings applied by the operators match with the operator's expectations. Again, the focus is on the operators, the supply side, but information gathered from the demand side is used to triangulate to increase the accuracy of this study, as suggested by Yin (2009). To further describe the case study steps, the procedure may be divided into the following points.

1. Use the initial construct based on the literature review as a starting point.
2. Identify and pre-check relevant micro-grid operators and initiate contact.
3. Interview micro-grid operators with focus on overall strategy and strategic development relevant to revenue models.
4. Interview demand-side actors:
    a. Local businesses performing income-generating activities based on electricity from the micro-grid.
    b. Private households that are micro-grid customers.
5. Utilize information to develop the revenue model development tool through data analysis and discussions. Including additional literature.

5.2.3 Level and Unit of Analysis

Because the authors are studying both supply and demand sides, the level and unit of analysis are different between the two.

Supply-Side

Willingness and ability to pay, and therefore design criteria for local revenue streams, can vary strongly with income and location (Schmidt et al., 2013). Some micro-grid companies design and implement systems in many different villages across a large geographical area in India. There may also be different local businesses and value propositions for the different geographical areas. It is therefore of interest to study the revenue models at the firm level and also at the plant/system level where appropriate. This is to understand the locally adapted revenue models. In this study, the following analyses' are done:

- Within-case at the firm level
- Cross-case at the firm level
- Within-case and cross-plant (when appropriate)

Demand-Side

The customer of micro-grid electricity may be a household, a local business or any other entity in the rural village. The variation in customer profile is expected to be diverse comparing different supply companies and different villages. The level of analysis is at the customer/individual level for households and at the firm level for local businesses. It is however expected that in many cases, the local business consists of only one person - an individual enterprise. The unit of analysis is the one person that made the decision to subscribe to electricity from the micro-grid operator. In households, this is expected to be the family head - in the case of rural India: the father of the family. In local businesses, the unit of analysis is the owner or the manager.

Levels and units of analysis are summarized in Table 18.

	Level of analysis	**Unit of analysis**
Supply side	Firm level.	Executive-level employee directly working with strategies related to revenue models and pricing strategies.
Demand side	Individual level (households, single-person businesses). Firm level (local businesses).	Family head (households). Business owner or manager (local businesses).

Table 18: Levels and units of analysis in this study.

5.2.4 Case Selection

The case selection process was done in accordance with purposeful sampling techniques by Patton (1990). There were in general two opposing factors taken into account in the initial phase of case selection; 1) comparability of context and 2) variability of solutions and viewpoints within the case pool.

Supply-Side Cases

With a small population of relevant companies, selecting the companies with the largest number of operating decentralized systems will increase the sample size at system level. According to Miles and Huberman (1994), this will strengthen the precision, the validity, and the stability of the findings in a case study. The case firms had to be within the context of the thesis, as presented earlier in Figure 2, and meeting the following criteria.

- Operating in rural India, according to the definitions of the National Sample Survey Organization of India (Ravallion, 1996).
- Running more than one village grid.
- Supplying electricity to households, optionally in addition to supplying power to businesses.
- Powered by photovoltaic solar energy system(s).
- Operating pro-profit.

The search for relevant companies was done by online keyword searching, taking notes of companies mentioned in the literature, and by referrals in India. In total, four companies were selected to be interviewed:

- Mera Gao Power
- TARAurja
- Naturetech Infrastructure
- OMC Power

All of the selected companies were willing to contribute. In fact, the selection of four case companies represent the total possible case pool within the specified constraints of this study.

Demand-Side Cases

Demand-side cases were chosen for the customers of TARAurja in areas around Patna, Bihar, India and customers of Naturetech Infra around Lucknow, Uttar Pradesh, India. Only demand-side customers for two companies were chosen due to time restrictions and the case companies' ability to delegate resources to participate, which were the case with the sites of Mera Gao Power. The demand-side case villages followed these criteria:

- A village in rural India, according to the definitions of the National Sample Survey Organization of India (Ravallion, 1996).
- Commercial, non-governmental micro-grid electricity service present and in use.
- Operated by one of the supply-side companies interviewed.

Companies were contacted through the established academic contacts of NTNU through Development Alternatives in New Delhi, and through direct written communication with the micro-grid operators. Firms were informed about the purpose of the interview, and presented the initial theoretical framework.

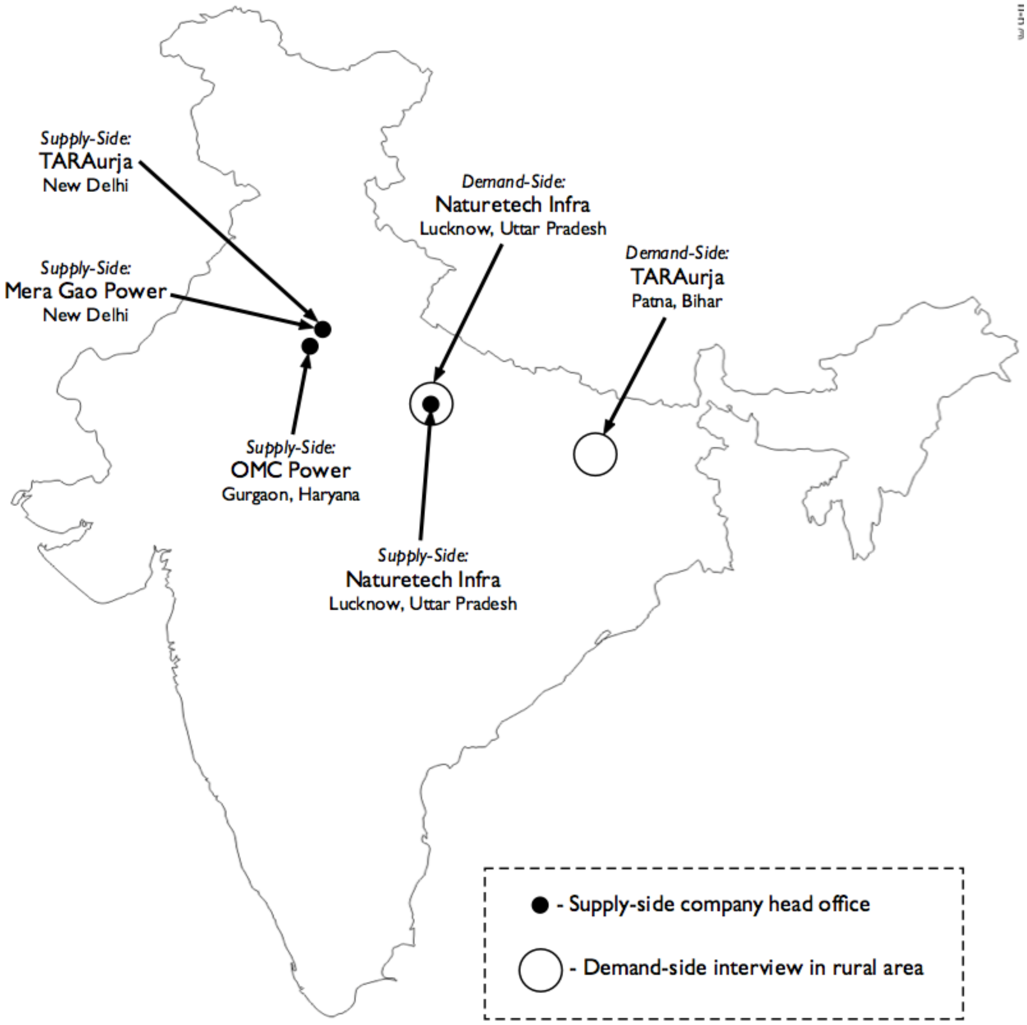

Figure 14: Geographical distribution of cases selected. Note that the map is for illustrative purposes only and does not reflect any opinions of the authors. *Source: Authors.*

5.2.5 Data Collection

The data was collected through interviews, based on the nature of the information being collected and guided by the six sources of data presented by Yin (2009). Documents were initially considered, however, financial and strategic documents are often classified, as they may contain competition sensitive information. The document data is therefore limited to what the companies are willing to provide and what can be found from public sources. There are gathered both current and retrospective data to strengthen the understanding of found relationships and increase trustworthiness of collected data (Graebner, Martin, & Roundry, 2012). Thus, interviews are used as source of the qualitative data. Interviews will provide data about the pricing strategy (apart from the pure numerical data) and about the sources of revenue. In addition, the interviews will cover the general strategies and tactics of the case companies, related to revenue models. Interviews will add nuances to the research and include the views of participants in revenue strategizing (Gibbert, 2010). Interviews will also further open the possibility for new and unexpected relevant information (Flyvbjerg, 2006).

Yin (2009) emphasizes the triangulation of information from different sources to reinforce the findings. Such triangulation will further reinforce the rigor of the research (Gibbert, 2010). In this research, data has also been collected from the demand-side - that is the micro-grid customers - for two of the case companies. The information from different sources of data is compared to see if the results are replicated or divergent. The authors have however focused on being open for rival explanations in the different sources of evidence. This in accordance with Yin (2009).

Interviews were about of one hour length for the four supply-side interviews and largely varying in length for the demand-side interviews, but in average about 15 minutes. Data from interviews was collected by the use of in-field notes and also recorded electronically by an audio recorder. The recordings were later transcribed in their entirety, and assembled for analysis.

5.2.6 The Interview Design Process

The purpose of the interviews is to uncover findings that are in sync with the initial constructs' challenges and actions, findings where there is either variability or similarities with the initial construct, and new and unexpected findings. Using the initial construct, the authors designed a semi-structured open-ended interview scheme for the case-study companies. The interviews were created by the following process:

1. Decompose the initial construct into its revenue model variables and elements.
2. Translate the variables and elements into questions.
3. Create open questions related to the basic revenue theory.
4. Combine the open and specific questions into the final interview.

Refer to Appendix A for the supply side interview guide. Since the number of demand-side interview subjects would be higher, and with a language-barrier in the villages, a simpler structured interview was created. The questions were reviewed and translated to Hindi by our supervisor. Also, refer to Appendix B for the final demand-side interview guide.

5.2.7 Interview Data Analysis

The transcribed interviews were analyzed by first coding the data based on thematic classes. The coding were developed based on the topics found in the initial construct, and the process of developing the coding library were done in accordance with Saldaña (2012). These classes are listed in Appendix C. The coded information were gathered into separate blocks and used to identify the three major types of findings:

- Findings that are in sync with the initial construct's challenges and actions.
- Findings where there is either variability or in accordance with the initial construct.
- New and unexpected findings.

The authors had post-interview discussions on the impressions from the interviews to cross-validate each others observations as suggested by (Gioia & Thomas., 1996). The findings were then analyzed both within-case and cross-case, as described by Miles and Huberman (1994).

5.2.8 Elaborating Theory Based on Findings

Findings that could not entirely be discussed using the theoretical concepts already presented are the basis for further literature research. This is done in accordance with practices described by Eisenhardt (1989). New theory is presented within its relevant discussions and the authors are developing new theoretical concepts based on this iterative cycle between case study findings and additional theoretical concepts. This is illustrated in Figure 15.

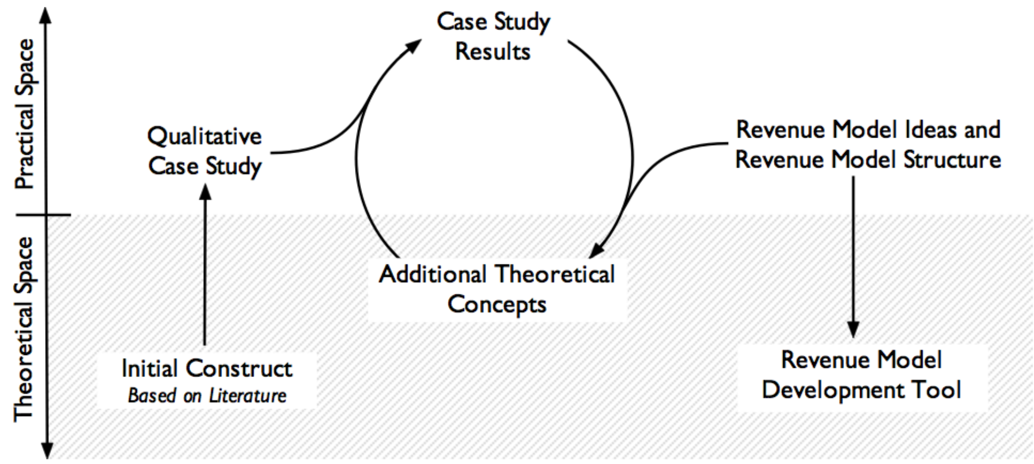

Figure 15: Illustration of method starting from the initial construct, going through an iterative process analyzing case study data, and then building a new revenue model development tool. Also refer to Figure 3 in the Introduction for its connection to the structure logic. *Source: Authors.*

6. Case Presentation and Analysis

This section presents the results from the within-case and cross-case analyses. The findings either confirm or elaborate the initial construct. Elaborative findings are highlighted, and discussed in the next chapter to identify the implications on the revenue model. First, the case companies are presented.

6.1 Case presentations

A presentation of the case companies and interview subjects are given in Tables 19 and 20, respectively.

	Mera Gao Power	**TARAurja**	**Naturetech Infrastructure Private Limited**	**OMC Power**
Founded in year	2010	In pre-foundation phase.	2010	2012
Company headquarter location	New Delhi, Delhi	New Delhi, Delhi	Lucknow, Uttar Pradesh	Gurgaon, Haryana
Grid type	240W, DC. 20-30 households.	30kW	1kW 220V AC. ~30 households.	10kW to 1MW mini-grids. >300 households.
Size of company in number of grids	~1200 grids	3-4 grids	5 grids	19 grids
Business model	Fee-for-service	Fee-for-service	Fee-for-service	Fee-for-service
Customers	Households and microenterprises.	Households and microenterprises.	Households and microenterprises.	Anchor loads (telecom towers. Excess electricity sold to households and microenterprises.
Products	7 hours evening electricity: 2 lights. Mobile charging.	6 hours evening electricity: Light and mobile charging. +Business packages.	Electricity.	Lighting. Business loads. LED lanterns.
Revenue sources	Subscription fee. Connection charge.	Subscription fee. Connection charge.	Usage fees. Connection charge.	Subscription fees. Connection charge.
Pricing	Fixed monthly price. Price varies by month.	Fixed package pricing.	Fixed prices of usage packages.	Fixed pricing or metered pricing, depending on segmenting.
Payment collection	Field staff. Postpaid weekly cash collection. Mobile reporting to central.	Field staff. Fixed price. Prepaid monthly cash collection. SMS reporting to central.	Field staff. Prepaid on-demand buying of recharge packages. Cash collection. SMS reporting to central.	Field staff. Prepaid monthly cash collection.
Distribution technology	Unmetered.	Unmetered. Remote control of on/off distribution lines.	Metered. Remote control of on/off distribution lines.	Metered and unmetered. Remote control of on/off distribution lines.

Short fact of company focus	Mera Gao Power (MGP) builds, owns, and operates micro-grids. The company is focusing on fast growth. They started in 2010. By the end of 2011 they had 20 customers in one village. Through expansion they grew to 130 villages with about 3000 customers by 2012, and 1000 villages with about 14000 customers by 2013. Taking a break in growth, they currently serve about 17 000 customers, and aim to grow to above 30000 customers and somewhere around 1500 - 1800 villages by the end of 2015.	TARAurja is in the very beginning of building micro-grids and has not yet formed an official spin-off company. TARAurja intends to do things differently than the current business models in the market. As the market is growing, they intend to build the distribution system only, including distribution lines and load controllers. They will then buy power in bulks from an Energy Service Company (ESCO), who will specialize in building the power-generation part of the system only. TARAurja will then sell the electricity to the customers.	According to the CEO, the company is solely an electricity provider, but however has quite a focus on socioeconomic improvement. The way the company distinguishes itself is through utilizing innovative solutions and technology, and they intend to find optimal solutions for scaling before starting growth.	The company has had a strategy of building mini-grids around telecom towers, using the towers as the main income source and use the surplus power to electrify households and businesses nearby. The company has a focus on finding strong partnerships, and are in the process of establishing a joint venture contract with Sun Edison, the largest renewable energy provider in the world. It involves the building of 5000 mini-grids of 50 kW each. OMC names their grids mini-grids to differentiate them from micro-grids, which are typically below 10kW capacity, and the grids reaches out 1.5 km to an average of 750 households.

Table 19: Presentation of case companies.

Interview subject	Relation to firm	Supply / demand side	Location and time	Company
Nikhil Jaisinghani	Co-founder and financials	Supply side.	Skype interview. *20.02.2015*	Mera Gao Power
Arjun Dhawan	Revenue system engineer	Supply side.	Corporate office. New Delhi. *02.03.2015*	TARAurja
5 commercial shops and 2 households	Customers.	Demand side.	Bheldi and Bansdih villages. North of Patna, Bihar. *08.03.2015*	TARAurja
Shyam Patra	Founder and CEO.	Supply side.	Kalyanpur and Raghunathpur villages, near Biswan, Uttar Pradesh. *10.03.2015*	Naturetech Infrastructure Private Limited
Households and shops.	Customers.	Demand side.	Kalyanpur and Raghunathpur villages, near Biswan, Uttar Pradesh. *10.03.2015*	Naturetech Infrastructure Private Limited
Sarraju Narasinga Rao	Chief Technology and Information Officer.	Supply side.	Corporate Office. Gurgaon, Haryana. *12.03.2015*	OMC Power

Table 20: Interview subjects in the case study.

6.2 Analysis Structure

The authors have categorized the results from the analysis into *findings* and *supplementary data:*

Findings represent the results of the analysis that has the greatest impact on the revenue model. **Findings are highlighted throughout the analysis.**

Supplementary data are the minor pieces of information in between the main topics, which supplement existing components of the initial construct. Although minor, they provide useful insights to the details of the contextual revenue model. These are mainly propositions and alternatives on how to solve known challenges. Supplementary data is described within the presentation of the findings, but is not highlighted. The data is listed sub-section 6.5.3.

The basis for the data collection is the initial construct. It is essential for the further development of the revenue model not to be limited by a strict rigid structure, as new structures could emerge from the case study analysis. Therefore, the data is analyzed by using the three main categories of the initial construct. Sub-categories are a result of findings from the within-case analysis, organized in topics by their relevance to revenue models and pricing, and by their relation to the initial construct components. The cross-case analysis compares similarities and differences within these topics, leading to a confirmation and/or elaboration:

- A *confirmation* supports a component from the initial construct.
- An *elaboration* introduces new information relevant for the revenue model.

Topics that did not fit under the three main categories of the initial construct are collected in a separate category at the end. Hence, the structure of the analysis is as follows:

1. **Findings that fit the categories of the initial construct**
    a. Value creation and communication
    b. Revenue and pricing structure
    c. Price level determination

2. **Findings that do not fit the categories of the initial construct**

The discussion and final revenue model development chapter combine all the categories into the final revenue model.

6.3 Findings that Fit the Categories of the Initial Construct

The findings that fit the existing main categories of the initial construct are presented in this section. These findings confirm components of the initial construct, and elaborate by introducing new topics for discussion in the chapter 7.

6.3.1 Value Creation and Communication

Segmenting Customers and Value Propositions

All of the case companies have assessed both value propositions and customer segments. Due to the nature of the company and their strategy, the applied segmentation varies, as illustrated in Table 21.

TARAurja	OMC Power	Mera Gao Power	Naturetech Infra.
A: Private households ***B1:*** Commercial Lighting needs ***B2:*** Commercial Productive needs	*A1:* *LED Lantern* ***A2:*** Mini-grid segment: Fixed price ***A3/B:*** Mini-grid segment: Metered *C:* *Top segment*	***A:*** Private households	***A:*** Private and commercial users.

Table 21: Customer segments of the four case companies. “A”-segments denote private household customers while “B”-segments denote commercial customers. Note that the two segments in italic are not micro-grid segments, as is the case with e.g. the “C” segment of OMC Power. Also note that OMC names their grids mini-grids to differentiate them from micro-grids, as presented in Table 19, but they are still within the definition of micro-grid used in this study.

Mera Gao Power delivers only two light bulbs and a mobile charging point per connection. Therefore, the possibilities of segmenting the customers are restricted.

Naturetech Infra. sells electricity directly, and is not concerned with what the electricity is used for. Commercial users will use more, and hence pay more. Private users will use less, and hence pay less.

TARAurja has performed the differentiation based on the ability and willingness to pay for the different customer segments, and the cost of delivering the desired services. They divide the needs of businesses into two main categories: light and productive uses. The value of light is longer operating hours for shop and production businesses, increasing sales and productivity. Productive uses include flourmills and other small-scale machinery. Commercial electricity empowers the businesses to make more money, making them entitled to pay a higher premium. For households, electricity is mainly needed for comfort, by increased study and cooking hours. Thus, TARAurja does not want to set the price level too high for this service.

OMC Power has a threefold pricing structure in which the segments are clearly distinguished. The lowest segment is the provision of lanterns, a battery-operated LED lamp with mobile charging output. Lanterns are priced to provide the customer with better quality light at the same price they would pay for kerosene fuel. The middle segment is mini-grid customers, which is divided in two based on the amount of electricity consumed and the nature of the customer. For residential or household lighting, the customers pay a fixed monthly fee. For commercial applications beyond simple lighting of shops and workshops, the electricity consumption is metered and billed based on the meter reading. The top segment consists of those who can afford their own solar home system or other solutions, not currently being a customer of OMC. This is illustrated in Figure 16.

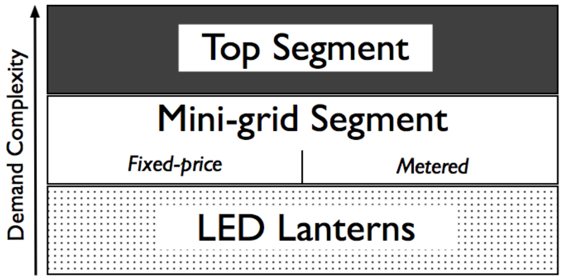

Figure 16: OMC Power customer segments. *Source: Authors.*

> ***Confirmation: Create value segments based on the understanding of customers and value propositions.***

Mera Gao Power has assessed adding more services that might be of value for the locals, but their search is limited to a simple revenue and cost issue. As each micro-grid only delivers a certain amount of kWh per day, MGP try to understand the willingness to pay for a service compared with the investment costs of increasing the kWh capacity of the micro-grid. The customers are for example willing to pay a fair amount for mobile charging, which requires a small amount of kWh, resulting in a very high price per kWh consumed. For services like refrigerators, however, the willingness to pay is not as high. The required kWh for refrigerators is substantial, giving a low price per kWh. This is what Jaisinghani call the "individual demand curve". MGP had to find the point where the individual demand and MGPs ability to supply met. This means that even though customers might want energy-intensive services, they are willing to pay significantly less for these services, making them financially unviable. MGP will therefore currently focus on light and mobile charging. The analysis method of MGP could be an elaborative proposition of evaluating the profitability and feasibility of value propositions.

> ***Elaboration: Discuss the implications of evaluating the WTP per cost of kWh for value propositions.***

Providing Electricity-Based Machinery or Tools

TARAurja intends to boost the socio-economic development by assisting commercial operators with tools and machinery. They plan to lease out equipment or sell the equipment at subsidized prices. TARAurja has a team of about six persons who are working on this issue alone.

Naturetech Infra. does not currently have any focus on promoting commercial use of the electricity service. Without any actions directed towards business customers, Patra still notice a clear increase in business activities in villages after electrification.

OMC Power also does not want to enter the business of actively starting initiatives for local businesses. However, OMC Power states that their existence in a village will make it possible for many microenterprises to exist, so they are contributing to local growth in that way. Focus is on making electricity available and affordable, also to customers, including microenterprises.

The choice of providing electricity-based tools is hence a decision that is up to each company. As some companies do pursue this tactic, the component is confirmed.

Confirmation: Assess whether to provide electricity-based machinery or tools.

Utilize Local NGOs to Increase Willingness to Pay

Luthra et al. (2015) suggested that "Local employees may act as representatives spreading awareness and information about the positive effects of electrification in the community". In a similar manner, TARAurja partners with local NGOs to communicate value and understand the local needs and conditions before building the grid. Partnering with an NGO has two levels. The first level is the initial contact, discussing the value propositions and local needs with the NGOs, meet potential customers, and communicating the benefits for the NGO. The second level is to go deeper and find out what the consumers are currently paying, what their pain-points are, which service of TARAurja can be set up in the village, and how much are the customers willing to pay for these services. TARAurja pays the NGO a management cost for helping them.

Since TARAurja wants to maintain an image for integrity, quality solutions, and devoted employees, they would rather back away from a business than getting it wrong. They are therefore extremely selective with which NGOs they wish to work with. Cooperating with honest NGOs that are well established and known in the village (existed for five to ten years) creates trust in the village, assists in maintaining a quality image for TARAurja, and increases the chances of attracting customers significantly.

Confirmation: Local employees or NGOs may act as representatives spreading awareness and information about the positive effects of electrification in the community

6.3.2 Revenue and Pricing Structure

Time Variation of Value Proposition

The customers of Naturetech Infra. stated that they would be willing to pay more at certain times during the year, for example during a local happening or festival. Also, TARAurja mentions that a household may want to for example host a bedding for ten days, and would like five extra bulbs and electricity for this period. TARAurja believes that such needs can be a good value proposition for the customers. To meet this demand, they aim to have a system that allows the customers to upgrade or downgrade their package from home in an easy manner.

Confirmation: Assess the time-value of value-propositions.

Customers' Ability to Pay

All of the case companies assess the customers' ability to pay to adjust time and size of payment accordingly.

Mera Gao Power found that their customers had a hard time to save 100 Rs for a monthly payment. The locals might have 50 Rs on them at all times, so MGP found that it was more likely that customers would carry at least 25 Rs in their pockets for a weekly payment. Therefore, a weekly payment model was applied.

For the locals in Naturetech Infra.'s villages, income from agricultural harvest is received two to three times per year. It was requested from a village that Naturetech Infra. adjusted their payment schedule accordingly. Therefore the company is trying to synchronize the payment schedule with the seasonal income.

Confirmation: Assess the customers' ability to pay, including the amount and time of payment.

Difficulties in Collecting Payments

One of the main challenges described in literature has been the difficulty of collecting revenue. The case companies had similar experiences, and applied their own solutions to cope with the problem.

MGP had a challenging year in 2014 in terms of revenue collection. Weather was impacting the performance of the solar-based grid, and MGP did not adjust price accordingly. The customers found this unfair and started to negotiate prices with the collectors in the field, which lead to the collectors agreeing to collect less than the full price. Also, the collectors were collecting different amounts from different customers, which in the end created a price race to the bottom. In 2015, MGP intends to avoid this problem by adjusting the price in accordance to the weather, or more precisely, to each month. They will set the tariff to 10 Rs a week in January, 15 Rs a week in February, increasing towards summer. Jaisinghani reports that they are doing a much better job collecting the tariff with this system. Everyone has the exact same tariff and the collectors are not permitted to negotiate below this price. He says there is still some work to be done, but that it is a vast improvement from 2014. According to Jaisinghani, successful collection is a matter of discipline, and to be fair to the customers. It is further essential to have routines to respond very systematically to customers who do not pay. Managers at all levels need to be fully aware and conscious of the process to ensure revenue collection, including management incentives. Therefore, MGP is strengthening the management to be focused on revenue and to be aware of their responsibilities. Mera Gao Power has very recently changed their structure to prepaid. However, since the customers of MGP pay the initial fee at installation (the pre-payment), the following payments appear to customers as postpaid.

Collection was also a problem initially for TARAurja. The management of TARAurja would have no idea of how much cash was collected. Their own employees were stealing money, claiming that customers had not paid, when they in fact had done their payments. To solve the issues, TARAurja came up with a system that transfers the risk of the collection to the collector. The collector now needs to invest in the customers' monthly payments, in the form of a deposit. If a village requires 5500 Rs of payments in total, the collector invests and pays TARAurja a 5000 Rs deposit. The risk and the responsibility for collecting the payments are now transferred to the collector. Once the collector has collected the entire amount of 5500 Rs and reported the payments by the SMS system, he can keep the extra amount of 500 Rs as his commission. Further, TARAurja believes that the prepaid model is the only way of governing the financial interests of the company. With a postpaid cycle, problems will arise with villagers saying they have no money, that they are poor, etc. It is therefore in the best interest of TARAurja to get the villagers used to paying for electricity upfront. TARAurja's decision to choose a prepaid model was done by looking at the experiences of other micro-grid companies who have operated for some years in India, like Husk Power Systems.

Naturetech Infra. emphasizes the need to have a system that allows full control when it comes to collecting the money. It is necessary to create a system that makes it possible so that there is no way but to pay. Naturetech Infra.'s solution to this is their prepaid system. In addition, Naturetech Infra. positions their electricity distribution branches at the top of tall poles, out of reach and in locked boxes. Together with electronic metering of the inputs and outputs of the box, they hope to control stealing and tampering of electricity.

OMC Power applies the prepaid model to residential customers. The customer will pay for electricity "credit" that is restricted in amount of power and amount of time. However, there are challenges communicating to the customer that their electricity amount or "credit" is running also when they are not consuming anything. To residential customers, OMC Power does not apply a metered prepaid model because of the technological concerns and administration costs involved. Payment collection for the four companies is summarized in Table 22.

	Mera Gao Power	**TARAurja**	**Naturetech Infra.**	**OMC Power**
Payment mode	Prepaid (was postpaid)	Prepaid	Prepaid	Prepaid
Collection discipline.	Fair dynamic pricing. Routines to respond to customers who do no pay. Management incentives.	Transfer risk of payment collection to the collector. Collector incentives.	-	OMC Power salespersons collect connection and monthly fees in the village.
Technology discipline	None.	Can turn off electricity if payment is not done.	Electricity is turned off when the unit package is consumed.	Can turn off electricity if the subscription is not renewed by payment.

Table 22: The findings elaborate propositions to the challenge of collecting payments.

The issues of postpaid and prepaid payment modes may introduce some interesting implications, which should be further discussed.

Elaboration: Discuss the implications on the revenue model of the postpaid and prepaid methods.

Elaboration: Discuss how the companies enforce revenue collection control.

Subscription Payments and On-Demand Usage Fee Payments

OMC Power, Mera Gao Power, and TARAurja applies the standard subscription model with monthly payments, either fixed prices for certain value propositions, or metered solutions. On the other hand, Naturetech Infra. sells electricity in unit-usage packages. A customer may for example buy 100 Rs worth of electricity. The recharge amount is loaded into the distribution box of the customer by SMS activation, and will deliver electricity until the amount is spent. It is then up to the customer to decide when to buy electricity again, and for which amount. This introduces the risk that the customers of Naturetech Infra. does not buy new packages at a frequency and level that is sustainable for the company. However, as previously mentioned, an on-demand system may respond better to increased demand. It is therefore of interest to investigate the tension between committed recurring payments, and on-demand payments. The recurring revenue models for the four companies is summarized in Table 23.

Mera Gao Power	TARAurja	Naturetech Infra.	OMC Power
Subscription fees	Subscription fees	Usage fees	Subscription fees
Monthly payments.	Monthly payments.	Pays for packages of units on demand.	*Option 1:* Fixed monthly payments. *Option 2:* Monthly payments of units consumed.
Dynamic price from month to month.	Static price.	Packages can be bought ranging from an estimated 1 day of use, to 6 months of use. Better value for money for larger packages of units.	Static price.
Not metered.	Not metered.	Metered.	Either fixed and metered, according to segmenting.

Table 23: Recurring revenue models of the four case companies.

Elaboration: Discuss the implications of committed recurring revenue and free demand-driven revenue.

A second finding is the choice between a metered and fixed solution. Each solution introduce certain benefits and drawbacks, and the companies may assess which option is the most suitable.

Elaboration: Discuss the implications of metered and fixed solutions.

A third finding is that Naturetech Infra. delivers more value for money with larger purchases, which is often called a "volume discount". In pricing theory, this is type of *price fence*. Price fences were not included in the initial construct due to the lack of evidence that it was being used in the context from the literature review.

Elaboration: Discuss the relevance of price fences.

Technology and market focus

Mera Gao Power's micro-grid is designed by simple technological principles. It cost 900 USD per grid, and consists of a solar panel, distribution lines, and 2 light bulbs and a mobile charger per connection. Their focus is to reach a large market by scaling the uncomplicated solution.

Naturetech. Infra. focuses on the technology and not the immediate scaling of their solution. By applying sound solutions, they believe they build the best foundation for growth and sustainable grids. The technology includes a metering system and a SMS system. The SMS system can monitor, report, and control consumption and the grid.

Hence, there is a difference in the focus on technology and the market reach focus.

Elaboration: Discuss the difference in technology focus and market reach focus.

6.3.3 Price Level Determination

Price Objective, Floor, Ceiling & Levels

TARAurja's first objective is to capture more customers, by pricing on par with the alternatives and their own costs. They do this by using cost as a price floor, and adding a markup of 10-15 percent. The price level is 120 Rs per month for private households, which TARAurja claims the customers will happily pay due to the value proposition that no one else is currently able to offer them. Even though the prices are higher for the inferior value propositions of alternatives, TARAurja still intend to price low at 120 Rs monthly to attract customers. However, the intention is to gradually increase the price in the future, to capture more value.

Naturetech has found that the monthly price ceiling of the customers are 300 Rs. Furthermore, the customers are spending in the range of 100-250 Rs per month in alternative energy sources such as kerosene and mobile charging shops. The state grid electricity supply costs are lower, but considered irrelevant because of the low stability of the service. Naturetech Infra. says that once the plant is built, there are very low operating costs. To cover the costs with a certain payback period, Naturetech Infra requires about 150 Rs per month. Based on this, Naturetech Infra has set a standard recharge amount of 150 Rs with the possibility of depositing multiples of this amount, for example 300 Rs. For customers with lower ability to pay, the company is experimenting with lower recharge rates. The customers currently pay 150 Rs monthly, which is half of the 300 Rs they used to pay for the existing solutions. The traditional solutions in the villages were kerosene lanterns and getting their mobile phone charged at different locations other than within the village, for example commercial charging shops. If the customers want to, they may recharge for a higher amount than 150 Rs, but they currently do not consume more than this value with lighting and mobile charging per month.

For the lanterns segment of OMC Power, the price level is determined by the market price for kerosene at an equal amount of time using a kerosene lamp. Currently, this price level is set to 150 Rs.

MGP also set the price to be competitive to kerosene prices. Subsidized kerosene is a challenge, as it gives an unfair advantage on price to the benefit kerosene. The price is further set according to the costs to have a payback period of about three years. This is to demonstrate short payback periods, which is attractive to investors.

Confirmation: Price objectives, floors, ceilings, and levels are actively used components by the case companies to set the final price level, confirming the revenue model components from the initial construct.

6.4 Findings that Do Not Fit the Categories of the Initial Construct

The findings that fall outside the existing main categories of the initial construct is presented. These findings are elaborated by introducing new topics for discussion in the next chapter.

The Process of Building a Revenue Model

TARAurja and Naturetech Infra. has a strong focus of learning and improving their model as much as possible before scaling.

TARAurja is using the time to quickly test out new concepts and methods, and experiment with their business and revenue models. Their intention is to optimize the models before scaling, as changing a system is much more expensive when there are many systems in operation.

Naturetech Infra. is also is this same mode, with only five operating plants. During the last years the revenue model and technology has been changed, as a response to the challenges that their first solutions presented.

Elaboration: Discuss how companies develop their revenue model through learning, and how a process of learning may be applied to a revenue model development tool.

Future Demand

It is a common expectation among the case companies that demand for electricity will grow, but there are differences in the levels of preparation.

Naturetech Infra. plans for the future by designing smart, and starting small. They initially install the smallest power plant of 1kW, with both a payment collection system and a technology designed for scaling. Naturetech Infra. experienced that through the customer's own experiences with electricity, they will quickly be able to see the benefits and increase their use of electricity-driven remedies. Then, with the following increase in demand, the power plant may easily be upgraded to higher capacity. The drawback of this method is that growth is slower in the first years of operation.

Mera Gao Power delivers a simple system, where the system itself is not able to scale with an increasing demand. The decision to apply the value propositions was based on their analysis of willingness to pay and costs per kWh for each proposition. A lighting point had a much higher WTP per cost than for example a refrigerator. However, Jaisinghani believes the next customer demands will be energy intensive, which they might not be able to follow up on with their current model.

"The next service our customers want is fans, but they are only willing to pay 20-30% more and yet we would have to invest 400% more in order to provide them with that service. Further, fans only have seasonal demand, further hindering the viability of the additional investment."

Nikhil Jaisinghani, Mera Gao Power

The demand-side interviews show that lighting and mobile charging are the main value propositions that the villagers want from electricity. However, there were additional services that the locals would like to have in the future, and were willing to pay more for:

- Being able to connect more devices like TVs, fans, refrigerators, water pumps, and tools. These include both leisure and productive uses.
- Additional light points.
- Additional mobile charging points.
- Daytime electricity, 24 hours of electricity service availability.

These needs require the possibility of connecting more devices. As TARAurja delivers a fixed set of light points, the customers cannot connect more devices or upgrade their subscription. The solution of Naturetech Infra. includes the possibility to connect more devices, and hence would satisfy a demand for new devices.

Elaboration: Discuss how micro-grid companies plan for future demand.

Implications of Value-Chain Positioning

In the future, TARAurja wish to create a business around the distribution side only, similar to the western model of operation. This in contrast to Mera Gao Power, OMC Power, and Naturetech Infra., who are responsible for both the generation and distribution of electricity in addition to local sales and customer support. Figure 17 and Table 24 illustrate this. TARAurja will therefore need to be experts in creating and communicating value to the local customers. Benefits include lower investment costs for TARAurja, as the distribution side of a micro-grid system cost about 20 percent of a full system.

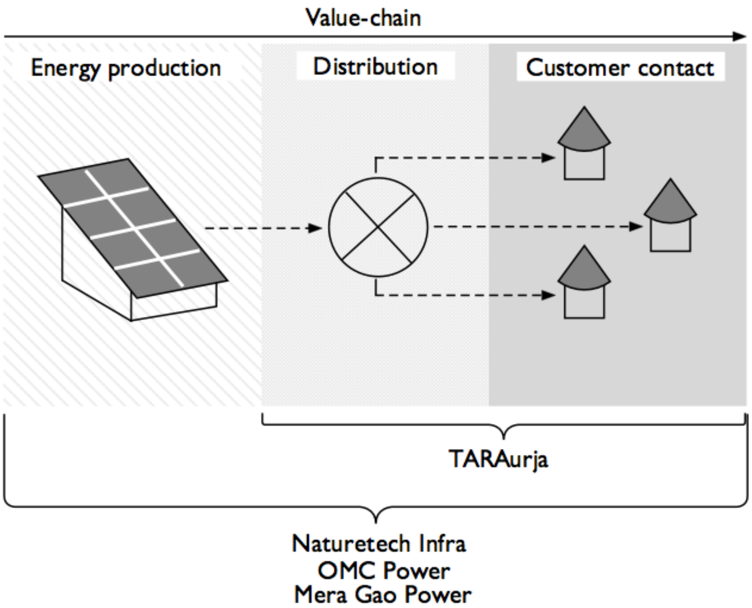

Figure 17: Value-chain placement of the four case companies. *Source: Authors.*

A challenge for TARAurja is that a solid agreement must be made between TARAurja and the *energy supply company* (ESCO). Major points include price of electricity, commitments to deliver the agreed amount of electricity, and how to solve issues if one of the parts are not able to hold their side of the agreement. In case of bad weather, the ESCO might for example want to install a backup DC generator to be able to provide the agreed amount of power. The details of an agreement would have to be figured out together with the ESCO, as both TARAurja and the ESCO aim to earn money. It is expected to be a tough balancing act between the two companies.

Mera Gao Power	TARAurja	Naturetech Infra.	OMC Power
ESCO + Distribution	Delivery only	ESCO + Distribution	ESCO + Distribution

Table 24: Value chain placement of the four case companies.

Elaboration: Discuss the revenue model implications of the position in the value chain.

6.5 Summary of Analysis

6.5.1 Summary of Findings

Findings confirm components of the initial construct, and elaborate by introducing new topics for discussion. This is summarized in Table 25.

Part 1: Findings that fit the categories of the initial construct	**Confirmation**	**Elaboration**
Value Creation and Communication		
Create segments based on the value propositions of the customers	x	x
Provide electricity-based machinery or tools.	x	
Utilize local NGOs to increase willingness to pay	x	
Revenue and Pricing Structure		
Time variation of value-proposition	x	
Customers' ability to pay	x	
Difficult to collect payments	x	x
Subscription and on-demand usage fee payments		x
Price Level Determination		
Price objective, price floors, price ceiling, price levels	x	
Part 2: Findings that do not fit the categories of the initial construct		
The process of creating a revenue model		x
Future demand		x
Implications of value-chain positioning		x

Table 25: Summary of findings from cross-case and within-case analysis.

6.5.2 Summary of Elaborations for Discussion

Elaborations within the categories of the initial construct

- Discuss the revenue model implications of evaluating the WTP per cost of kWh for value propositions.
- Discuss the implications of metered and fixed solutions.
- Discuss the implications on the revenue model of the postpaid and prepaid methods.
- Discuss how the companies enforce revenue collection control.
- Discuss the implications of committed recurring revenue and free demand-driven revenue.
- Discuss the relevance of price fences.
- Discuss the difference in technology and market reach focus.

Elaborations outside the categories of the initial construct

- Discuss how companies develop their revenue model through learning, and how a process of learning can be applied to a revenue model development tool.
- Discuss how micro-grid companies plan for future demand.
- Discuss the revenue model implications of the position in the value chain.

These topics will be the core focus of the next chapter, where the authors will discuss which *implications* these findings have for the revenue model of the operators.

6.5.3 Summary of Supplementary Data

As mentioned in section 6.2, supplementary data are collected to enhance the detail level of the revenue model. These include challenges and propositions, and supplement revenue model components. The summary is presented in Table 26.

Challenge	Implication	Proposition	Supplementary data to:
The customers negotiate prices with the collector.	Prices are lowered. Discipline is lowered. Leads to decreased profits.	Implement pre-paid systems. (Naturetech, TARAurja, OMC Power)	How can a payment method best be designed?
Pricing kWh-intensive services.	Services may not be included.	Do not include kWh-intensive services unless the WTP for the service is higher than the cost of kWh running them. Identify the individual demand curve. (Mera Gao Power)	Find the value propositions of the customers.
Poor collection control. Employees stealing money.	Unsatisfied customers. Less revenue.	Utilize technology for improved collection control. (Mera Gao Power, Naturetech)	How can a payment method best be designed?
		Transfer the risk of collection to the collector, by making the collector invest in the collection amount prior to the collection. (TARAurja)	How can a payment method best be designed?
Communicate the value of the grid and build local trust.	Attracts customers.	Partner with local NGOs. (TARAurja)	Value communication

Understand the local conditions in the process of finding customer value propositions and other factors.	Improved revenue model.	Partner with local NGOs. (TARAurja)	Find the value propositions for customers.
Increase the WTP of existing customers on metered system.	More payments from customers.	Allow flexible payment schedules with the possibility to pay for small amounts. (Naturetech Infra.)	How can a payment method best be designed?
Villagers are willing to pay more at certain times during the year, e.g. during happenings and festivals.	More revenue.	Allow flexible payment schedules with the possibility to pay for large amount of consumption.. (Naturetech Infra.)	How can a payment method best be designed?
Customers stealing electricity, and tampering with the metering.	Loss of control. Loss of revenue.	Make the distribution box inaccessible and fully automated. (Naturetech Infra.)	How can a payment method best be designed?

Table 26: Summary of supplementary data.

7. Discussions

In chapter 6, elaborative findings of the results were found. In this chapter, the implications of these findings in relation to the revenue model will be discussed. Together with the initial construct, the implications will form the main basis for developing the final revenue model.

The revenue model is subject to generalization. Hence, the generalization and contextualization of the revenue model is discussed at the end in this chapter.

7.1 Revenue Model Implications of the Elaborative Findings

In this section, the elaborations from the analysis are discussed. Each discussion leads to a revenue model implication that will be used to develop the revenue model development tool.

7.1.1 The Individual Demand Curve of WTP per kWh

The customers are willing to pay a certain amount for certain value propositions. The value propositions require a certain delivery of kWh. The micro-grid operator will have costs related to delivering each kWh, due to investment costs and operating costs. The grid will also have a maximum capacity of how many kWh that can be delivered. Therefore, it makes sense to assess the WTP per kWh, to find out which value propositions are actually profitable. MGP calls this the “individual demand curve”.

To recall, Mera Gao Power chose lighting and mobile charging as their services because of the high ratio between revenue and the required power in kWh. The amount MGP can charge for lighting is higher than the cost of service. For a fan, the cost of service is much higher, but the willingness to pay is not. Therefore, MGP does not provide this service. These relationships are illustrated in Figure 18.

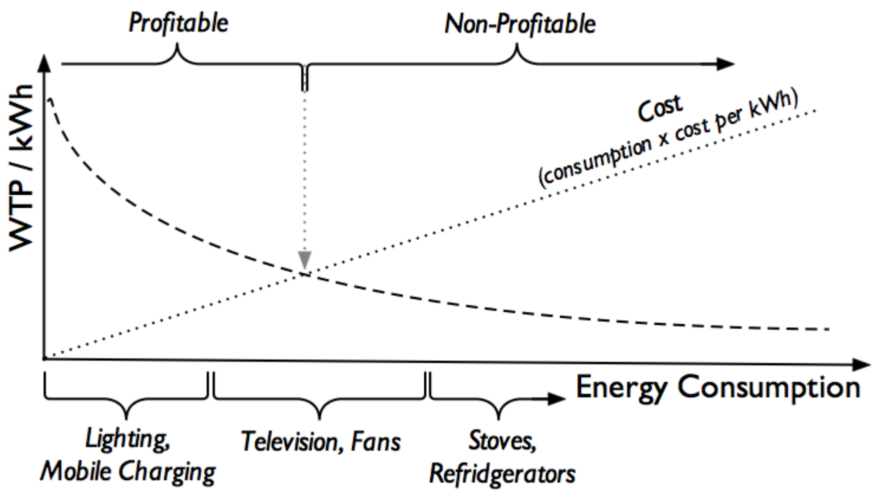

Figure 18: Illustration of decreasing WTP per required kWh for the use of different appliances on the micro-grid. Examples of appliances are indicated. It should be noted that this representation is not quantitative or comparable, but to give an idea of the characteristics of this relationships as considered by the authors. Note that the cost line represents the total costs of the operator company per kWh produced. *Source: Authors.*

It could be argued that the WTP might vary with time due to socio-economic development, meaning that the operators need to factor this into the equation when considering which services to build and not.

Also, it seems obvious that micro-grid companies should evaluate the value propositions of their customers in terms of WTP per cost of kWh. After evaluation, it is essential for the micro-grid operator to build only those services where the willingness to pay is higher than the cost of investment for the services.

Implication for revenue model: Assess which services should be offered and/or if there should be any usage restrictions from a value-cost perspective. Identify individual demand curve (WTP per kWh compared to cost per kWh).

When performing the above analysis, there are two main focuses that should be considered:

- The demand and WTP for services (lighting, mobile charging, etc..
- The demand and WTP for kWh consumption (consumption of electricity)

These are clearly correlated, however, the focus of assessment is dependent on the operator's choice of a metered or fixed solution. These solutions will be discussed next.

7.1.2 Metered and Fixed Pricing Structure

Fixed pricing means that the customer is paying a fixed amount of money for electricity service. The customer's usage might be limited per day, but the usage does not influence the monthly payment. A metered solution charges the customer per consumed amount of electricity within a certain timeframe.

Companies benefit from a model that generates the most income in the long run. Maximizing the revenue is a task of calculating income and costs. The main drivers are:

- In certain configurations, one solution might generate more revenue per cost of kWh for the value propositions, than the other.
- There are investment costs.
- There are operational costs: Maintenance costs, and costs related to revenue collection control.

A revenue model that contains a fixed pricing scheme is more likely to be found in companies where a known usage pattern is present. In the literature the discussions about fixed solutions have pointed out certain drawbacks. These include low incentive for customers to save power (Dossani & Ranganathan, 2004), and the temptation to consume more electricity than agreed (Ulsrud, Winther, Palit, Rohracher, & Sandgren, 2011). In the Indian case study of Ulsrud et al. (2011), the unmetered administration made it easy for customers to consume a little bit extra electricity, as well as stretching extra lines over to neighbors. Eventually, stealing became socially acceptable by the customers and silently acceptable by the operators, and the over-use was becoming high. Checking all customers for irregularities would be a difficult and time-consuming task. Hence, the unmetered and flat rate structure started to give challenges of overloading power plants, which also increased battery degradation – a maintenance issue.

A comparison can be done on how a fixed pricing scheme and a metered solution may evolve in a setting of increasing demand. One may assume that the cost of building and running a micro-grid has a linear relationship to the maximum power output of the plant. Initially, when the demand is low, a fixed pricing scheme may exploit the high willingness to pay for services that are cheap to supply, such as mobile charging and lighting. This can be seen in Figure 19, at the lowest amount of energy consumption. Once the demand increases the cost of serving the customer increases, but as mentioned, the willingness to pay does not necessarily follow in the same linear pattern, as indicated in Figure 18. A metered solution is easier to manage in terms of services. As long as the company is able to charge a price higher than the cost per kWh, the company is profitable.

In other words, the challenge for the micro-grid operator is that at a certain point of demand, one solution might be more profitable than the other.

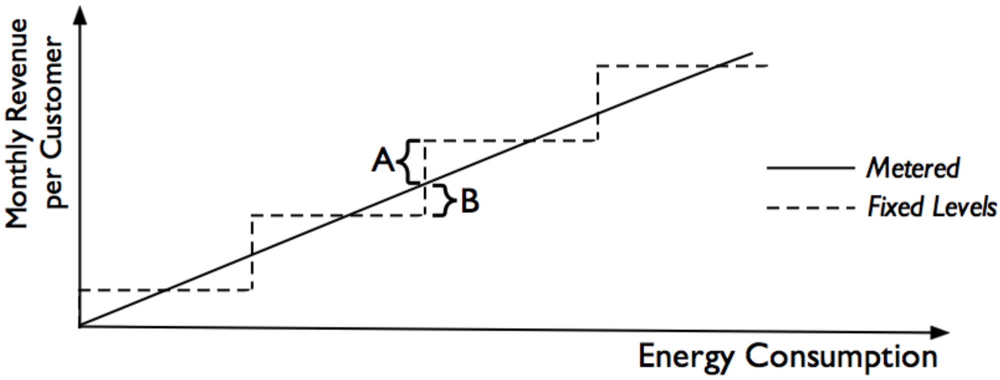

Figure 19: Illustration of the price level implications of levels of fixed (dotted line) and metered pricing (solid line). Notations 'A' and 'B' shows the price level difference between fixed and metered solutions that occur when the consumption reaches a certain threshold. *Source: Authors.*

In general, metered solutions are easier to manage in a setting of variable and increasing demand, avoiding over-consumption. However, they are more costly. Fixed schemes are cheaper, and might generate total higher revenue in settings of predictable and known usage patterns.

Implication for revenue model: Assess whether fixed or metered solutions are most beneficial based on the likely usage scenarios.

7.1.3 Committed Recurring Revenue and Demand-Driven Revenue

Committed recurring revenue is the situation where the customer pays every month, not dependent on the consumption. The payments might be either prepaid or postpaid, fixed or metered. This is the system of MGP, OMC Power, and TARAurja. Naturetech Infra. on the other hand, uses a system where the customer pays for whatever package that the customer wants and are able to pay for, on-demand.

An advantage with Naturetech Infra.'s system is that it responds very well to increased demand, and customers can decide to buy a package that is in line with their ability and willingness to pay. The pricing is perceived fair, as the customer only pays for what is consumed. However, a problem is that if the customer does not like certain aspects of the service the customer may not buy new packages, and can decide to minimize the use to what is only necessary to lower the total energy costs. The demand system is therefore only optimal if the demand is sufficiently high. As Naturetech Infra. experienced, customers decided not to pay for new packages since they experienced some instability issues and power-outages in their electricity supply. This, on the other hand, is the major benefit of the committed subscription. Customers will feel a commitment and duty to pay their bills, as their decision to connect have given them daily access to lighting and mobile charging, not dependent of how much they use it every day.

Seeing the benefits of both solutions, it might be that the companies should try to combine them. A subscription should be committed, with a minimum monthly payment including a maximum usage amount. If the usage surpasses the maximum amount, the customer pays for the extra units consumed. Such a structure would respond to increasing demand, and ensure safe and committed basic revenue. Such systems are already applied by telecom companies today, where customers pay a fixed amount subscription including a certain usage, and are charged for extra usage. The extra usage may be charged by choice up-front when all the units are consumed, or the customer may have agreed that extra usage is metered and paid by the end of the month.

Possible combination structures are presented in Tables 27 and 28 for illustrative purposes.

	Included amount	**Price**
Fixed monthly subscription	5 kWh	500 Rs
Extra units package 1	1 kWh	100 Rs
Extra units package 2	2 kWh	180 Rs
Extra units package 3	5 kWh	400 Rs

Table 27: Example of revenue structure with subscription and prepaid packages. Units from the packages that are not consumed by the end of the month can be transferred to the next month, or erased.

	Included amount	**Price**
Fixed monthly subscription	5 kWh	500 Rs
Metered	No limit	80 Rs/kWh

Table 28: Example of revenue structure with subscription and postpaid metering.

Implication for revenue model: Assess whether the company can apply a system of committed recurring revenue that responds well to increased demand.

7.1.4 Prepaid and Postpaid Methods

The main reason why OMC Power, Naturetech Infra. and TARAurja wants a prepaid model is to enhance the discipline and control of the revenue collection. The control is further enhanced with technology that allows turning off the electricity if the customers do not pay.

With a postpaid method one runs the risk that villagers are not willing or able to pay. They may complain about the service, lack of money, etc. The issue is how the operator claims money from customers in such a situation, which may be difficult to address. Mera Gao Power has been able to collect their revenues, but has faced several issues with the postpaid method. Unhappy customers negotiated prices with their collector, leading to a “price-race to the bottom”.

A possible advantage with a postpaid method is the increased likelihood that customers consume more electricity. It allows for less control of usage and costs, and may lead to customers spending more than planned. However, it requires that the customers are able and willing to pay and that the system is metered. Another advantage with postpaid methods is that it does not necessarily require technical solutions that can turn on/off the electricity, but it can be supplemented by such solutions to improve discipline.

The prepaid model on the other hand may allow better financial control for the customers, and improve their payment discipline. Together with the ability to turn on/off the electricity, the results from the case studies show that revenue collection success is increased.

Tewari and Shah (2003) describe the experiences from an on-demand prepaid electricity experiment applied in South Africa, summarized in Tables 29 and 30.

Benefits for the ESCO	**Drawbacks for the ESCO**
Improves customer service	Failure of prepaid meters increase maintenance costs
Upfront payment improves the cash flow of the business	
No meter readers required (employees)	
Easy to control fraud.	
Improves the revenue management,	

Table 29: Benefits and drawbacks of an on-demand prepaid system for the ESCO.

Benefits for the customer	**Drawback for the customer**
Consumer has better understanding of how much energy is being consumed.	Users might see it as a drawback to buy electricity frequently, which consumes their time and heighten their worries of not having electricity.

Table 30: Benefits and drawbacks of an on-demand prepaid system for the customer.

In Argentina, Casarín and Nicollier (2011) also found benefits and drawbacks in a similar system. Customers experienced better control of consumption, and more than 50 percent of the users were able to reduce their consumption. Also, customers liked the advantage of not having to make fixed monthly payments, and instead purchase electricity according to their access to money – their ability to pay. One of the main disadvantages was the possibility of disconnection, and the necessity of making frequent payments. This is also the experience of a case study from Botswana (Alam, 2012). However, the survey from Argentina points out that a high portion of prepaid meter users found no disadvantages in the system whatsoever.

The inconvenience of having to buy electricity frequently is linked to the ability to pay of the customer. However, those who are not able to pay every month, get the flexibility to pay when money is available. Considering this, a postpaid system will exclude the customers with lower ability to pay. It is worth considering that in the context of solar power in India, the supplier might not afford the risk of non-paying customers at the customer's convenience for an on-demand prepaid system. Therefore, the supplier should consider recurring revenue, such as a subscription fee in addition to the prepaid metering, as discussed above. In a rural village situation, it is obviously frustrating to run out of power without having the opportunity to buy new electricity. Measures should be applied to avoid customer dissatisfaction of disconnects and difficulty to buy new electricity, such as the SMS-notifications of Naturetech Infra. warning the customer that he is about to run out of electricity, giving him an opportunity to purchase more.

The micro-grid companies operate in rural areas where poverty exists and the ability to pay is low. Considering this, the advantages of a prepaid model outweighs the advantages of the postpaid model in this context, and so the prepaid model may be suggested as the preferred practice.

Implication for revenue model: Assess whether a prepaid or postpaid model is suitable.

Implication for revenue model: Assess the option of applying the prepaid model for increased revenue collection discipline and control.

Prepaid solutions using SMS refill and control should be of high technical quality. Failures after scaling the business might lead to high maintenance costs in the future. This concern can be generalized to any construct of technical finesse in the micro-grid system.

Implication for revenue model: Assess and test the quality of payment collection technology to avoid costly replacements in the future.

7.1.5 Price-Offer Configuration and Price Fences

In the theoretical background and initial construct chapter, the value proposition of Sagar Dweep case study is presented as in Table 31.

Value proposition	**3 connection points**	**5 connections points**	**> 5 connection points. Commercial.**
Price (Rs.)	70	120	> 120

Table 31: Sagar Dweep case pricing structure. *Source: Authors*.

Reviewing this in the light of the findings, the segments are somewhat unclear. The value proposition is not necessarily the number of light points, but lighting itself. Further, private and commercial customers are mixed. A more correct representation of the segmented structure could be the one presented in Table 32.

Customer segment	Private		Commercial.
Value proposition	Lighting		Lighting
Price-offer configuration	3 connection points: 70 Rs	5 connection points: 100 Rs	> 5 connection points: > 120 Rs

Table 32: Price-offer configuration for the Sagar Dweep case.

Price-offer configuration is a tactic to capture more value (Nagle et al., 2010), as some customers might be willing to pay more.

The same value may be captured by more accurate customer segmentation. However, finding the exact willingness to pay within a customer group might be difficult, and creating too many customer segments introduce unnecessary complexity. By applying price-offer configuration, the offer might be adjusted across the entire range of the assumed willingness to pay, and hence capturing more value by serving the customers more accurately. Therefore, one could argue that the price-offer configuration needs to be included in the final revenue model development tool. As presented in the revenue theory, price-offer configuration is part of the price structure.

Implication for revenue model: Assess the possibility of creating price-offer configurations to capture more value within a value-proposition segment.

Price fences were not included in the initial construct due to the lack of evidence in the contextual literature reviews. However, as Naturetech Infra. does apply price fences one could argue that it is relevant for the revenue model development tool. Nagle et al. (2010) defines price fences as fixed criteria that customers must meet to qualify at a lower price. Typical price fences are:

- Buyer identification fences.
- Purchase location fences
- Time of purchase fences
- Purchase quantity fences.
  - Volume discounts
  - Order discounts
  - Step discounts
  - Two-part prices

The question of which price fence is the most suitable option is dependent on context, technology, and the revenue.

Implication for revenue model: Assess whether price fence tactics are applicable to capture more value.

7.1.6 Revenue Collection Control

Regarding revenue collection, the authors find the most interesting part to be not the way it is collected - the collection methods, but the control methods possible in the operator's revenue collection configuration. The four different companies have utilized different kinds of technologies to manage their delivery of electricity and their collection of revenue, and it is the product of delivery and collection configurations that is regarded as the control configuration.

The authors define the control points as the elements in the revenue model chain of actions that the operator has the possibility to alter or control. A higher number of control points may be connected to a higher degree of successful collection of revenue. The case of control points may be related to the discussion on technology focus, as many of the control points of the four case companies are technology based. The most prominent example is Naturetech Infra., where the SMS-controlled meters open up possibility of control in payment, and time and amount of energy used. This is illustrated in Figure 20.

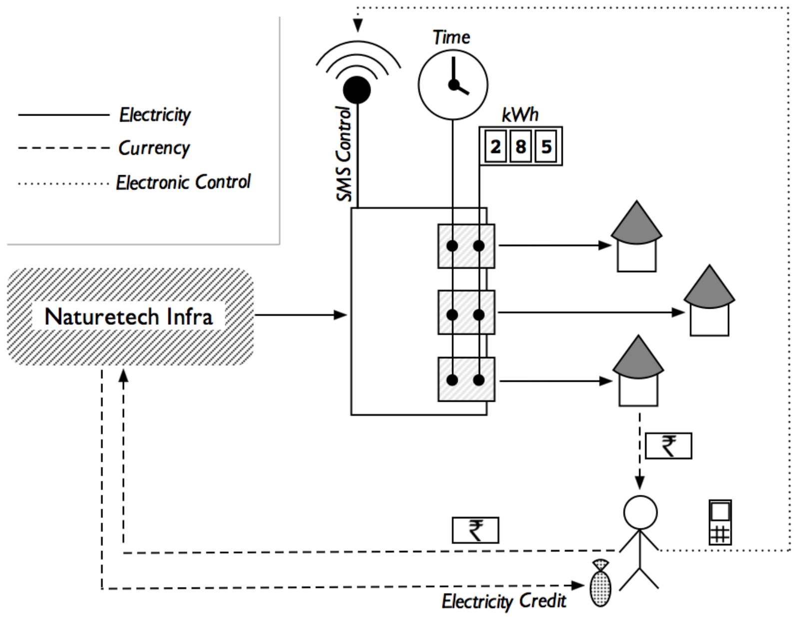

Figure 20: Delivery and control mechanisms of Naturetech Infra. *Source: Authors.*

With collection control and discipline being a problem in the context, the authors propose to include the assessment of collection control methods in the final development tool.

Implication for revenue model: Assess methods to enforce collection control.

7.1.7 Planning for Future Demand

As already mentioned, there is consensus between the case companies in that the demand for electricity will increase in the future. Some companies design their systems to respond to increasing demand, and others do not. For this discussion we discuss the case of increasing demand from an already installed micro-grid system.

Increasing demand from villagers will probably come from the desire for more devices, such as TV sets, fans, refrigerators and more. If customers follow the access-demand-loop as previously mentioned, total power demand increases. It would then seem natural that the micro-grid operators should allow for the customers to connect such additional devices easily. As of now, companies like MGP and TARAurja only allow non-metered fixed packages like the two light bulbs and a mobile charging point for MGP. This does not work well with increasing demand. However, the benefits of providing the most valuable value propositions to the villagers is that these companies can enjoy higher operational profits initially, as the willingness to pay is high for low kWh consumption devices. This operational profit might however be surpassed by companies like Naturetech Infra. as the demand increases, where the system can handle increased demand.

In the Sagar Dweep island case study, Ulsrud et al. (2011) found that there was a potential demand from villagers who did not manage to connect to the micro-grid in time before it was saturated with customers. The great interest from the community resulted in waiting lists for new connections, meaning that the demand outsized the capacity of the plants. As it was difficult to meet the demand with existing solutions, customers became highly motivated to connect to the national grid, which was projected to reach the island within some time (Ulsrud et al., 2011). This shows that the demand will much likely increase quickly once the villagers see the benefits, and not being able to meet the demand means losing the customers to competitors. It is therefore essential to introduce flexibility and scalability right in the planning phase, to meet the growing demand by increasing the modularity and flexibility of the design (Schmidt, Blum, & Sryantoro Wakeling, 2013).

To respond to increasing demand, the findings suggest that companies may do one of the following actions:

- Allow connection of any electrical device that the customer desire
- Allow increased consumption of electricity in each household
- Allow for increasing the capacity of the solar panels
- Allow for increasing the distribution network of the power plant
- Allow for cost-effective payment collection with an increasing amount of customers

Even though these issues might be solved by new technical solutions, the company must review their overall strategy to figure out what element serves their purpose. In any case, the issues should be carefully assessed before scaling the business.

Implication for revenue model: Assess methods to respond to increasing demand from customers and increased consumption.

7.1.9 Technology Focus and Market Reach Focus

There is a difference in the focus on technology as a means to improve or facilitate revenue generation. Among the four case companies, Mera Gao Power is at one extreme since there are no technical solutions involved with the revenue model, while Naturetech Infra. on the other hand is constantly focusing on developing innovative technologies to cope with some of their experienced challenges in the their previous revenue models as described in sub-section 7.1.6. In the case of Naturetech, the challenges of payment collection are met by introducing cellular communication technologies and including revenue model principles from prepaid mobile phone subscriptions. Based on the interviews, four components for technology adoption may be noted.

Familiarity

Many customers are already familiar with the prepaid mobile phone model. The model may then be easier to communicate and easier for the customers to accept the general terms.

Convenience

In the villages where Naturetech Infra is operating, most of the potential customers have access to a cellular phone. The operator may then leverage from the already established technology to improve the revenue model.

Control

The operator, in this case Naturetech Infra, can control the electricity service supply to a certain customer. In case the customer does not renew ("recharge") his account, the electricity supply will be disconnected.

Communication & Simplicity

The inclusion of information and communication technologies (ICT) may open up possibilities for improvements, such as customers being able to monitor their current recharge and their usage, the operator to gather information for future energy demand forecasts, and so on. Soto et al. (2012) points to the opportunity of using such data to seek an understanding of energy purchasing patterns. Such analysis may be used to apply price tactics to further increase the value capture, or to improve the operation of the system. For example, the price level may be set according to demand to provide incentives to use electricity at times when the load otherwise would be low. These variations in load may for example be on a daily or seasonal basis. The technology will then enable the operator to remotely set and control the plant, which includes the possibility of choosing different pricing for different villages. On the other hand, there is a risk of customer aggression if the difference in pricing is perceived unfair or discriminating.

Implication for revenue model: Assess whether the choice of technology is in line with the overall strategy of the company.

Implication for revenue model: Assess the possibility to collect and analyze information about consumption and buying patterns if such information exists. Utilize purchasing patterns to adjust the price structure to capture more value.

7.1.10 Position in the Value Chain

TARAurja wish to experiment by positioning themselves in the value-chain between the ESCO's and the customers. This introduces several challenges and implications, but what implications does it have on the revenue model?

The value chain may consist of:

- Energy Supply Company (ESCO)
- Energy Service Provider (ESP)
- End-user sales and customer support

The revenue model of the ESCO will be different than the revenue model of the ESP. The ESCO is only concerned with delivering an agreed amount of electricity to the distributor at some price. The ESP purchases electricity from the ESCO, and sells it to the proper consumer segments at a certain price. For a company controlling the entire value chain, the production of electricity translates to cost per kWh. By purchasing electricity from an ESCO, these costs can still be assessed as costs per kWh. Therefore, the revenue model is not particularly affected if a company decides to act as ESP only, instead of as ESCO + distributor. The potential market for such a solution exists. The state owned micro-grid operator WBREDA wish to solve the problem of irregular payments and over-consumption by involving a third party in the form of energy service providers (ESP). The responsibility of the ESP would be to buy electricity in bulk from the power plant, distribute to the consumers and collect revenue. This will create economic incentives for efficient collection, as well as controlling the overuse of electricity (Ulsrud et al., 2011).

One of the main challenges stated by the micro-grid companies in the case study is what they should do when state electricity reaches the village. State electricity can produce kWh at a lower cost than a small micro-grid, and the micro-grid risk being immediately forced out of the market. Bhattacharyya (2013) goes a far as stating that there will be nothing called off-grid in the future, except for physically inaccessible areas. A new role has to be found for the micro-grid operators when this happens. Micro-grids may enhance supply delivery, security, and sustainability, complementing the central grid supply. The current situation, the "pre-electrification" phase in the villages where micro-grids are built, increase the customers' surge for more electricity at a 24h availability of supply. The market is hence conditioned, which makes it economically reasonable to extend the national grid even to the remote areas (Ulsrud et al., 2011). It is therefore of interest to investigate how the revenue model and technical solutions need to prepare for coexistence with a central grid.

The authors therefore propose that a company who is currently running the entire value chain may have the following alternatives in this situation:

1. Continue to run the entire chain. Lower the price to the same as the state grid and continue to serve the existing customers. If the micro-grid investment has been paid back, the operational costs per kWh is the company's only concern for their current customers. Attracting new customers might be a problem, as the investment costs of new solar panels cannot compete with the price of state electricity.
2. Act as an ESP by buying electricity from the state grid and sell to customers using the existing distribution system, and ditch the micro-grid if it is too costly per kWh.

3. Continue operation of the micro-grid with existing customers. Expand as an ESP operator by expanding the distribution network and buying electricity from the state electricity.
4. The ESCO can connect the solar power plants to the state grid, and continue to act as a supplier. With time, new technologies will evolve and integration of independent local grids is possible to make the grid smarter (Ulsrud et al., 2011).

A company currently acting only as the ESP can easily replace its current ESCO when state electricity arrives. Therefore, the greatest risk is not in the distribution system, but in the energy supply system. However, ESCO's might have a period of solid profitability if the process of building state electricity is slow, or the state electricity fails to deliver on quality. Either way, a company controlling the entire value chain or only the distribution system faces the same possible future problems of state electricity reaching the village. Therefore, they should both prepare technology that is able to distribute electricity supplied by state electricity.

The decision to prepare distribution technology that can handle state electricity must be in line with the overall goals and strategy of the company. Some companies may for example aim to draw a quick profit from the current energy situation by applying simple and less costly systems. Companies with a longer time perspective may put more effort into preparations that consider the arrival of state electricity in the future.

Implication for revenue model: Assess the option of applying distribution technology that can integrate with future state grid electricity.

7.1.11 The Development Process of the Revenue Model

One of the most significant findings is that the case study companies go about developing their revenue model in different ways. The *development processes* are different. Starting with a theoretical idea based on knowledge and experience, the initial revenue model is implemented, tested and continuously developed. The end result varies between the firms due to a number of influencing factors like resources, strategy, technology, and context. Many factors could have an implication on the revenue model, and it is difficult to point out that one way of doing it is definitely better than another. However, some revenue models will undoubtedly perform better than others. It is the goal of every company to develop revenue models that capture as most of the value as possible, and it is therefore of interest to consider how the companies go about developing their revenue model.

The view of dynamic and complex systems is discussed by Moran (2001) in their description of small enterprises as complex adaptive systems, where complexity science is described as a systematic paradigm founded on observed similarities in the diverse dynamical systems, and that it attempts to find meaning from a dynamic perspective.

"The essence of dynamical systems is that they are open and dissipative, they do not follow the predictable entropic path of closed systems tending to chaos, rather they move in patterns at the edge of order and chaos."

Moran (2001)

As complexity science suggests, there will be no single optimal solution for a revenue model over time due to the complex and dynamic properties of the system. There are so many interconnected and constantly changing factors to consider, in a landscape of never-ending uncertainty and unpredictability. Managers can also be hindered by their own "bounded rationality", as they have formed the model on limited or imperfect cognitive representation (Sosna, Trevinyo-Rodríguez, & Velamuri, 2010).

However, a success factor may be the process the company follows in developing the revenue model. The discussion of Moran (2001) approaches a methodology in complex environments, by providing a frame of reference for a study of enterprise dynamics; *adaptation*, *evolution*, *fitness*, and *inter-dependence*. The concept of adaptation implies learning and change over time. The concept of evolution is relevant to alternatives, bifurcation (splitting the problem into several sub-problems), diversity and selectivity. Fitness is a concept of goals and relativism, and inter-dependency is a concept of relationships and co-evolution between agents in the system. With the collected data this paper may only handle the first two concepts in an ex post analysis: Adaptation and evolution. In a complex and dynamic system, it therefore makes sense that a development tool should introduce learning into its model, together with a set of contemporary alternatives.

The case study companies spend a different amount of time in the early learning process. Mera Gao Power started scaling after a very short time, and has managed to scale considerably. However, any learning that may have an implication on technical issues or other locked decisions will be costly to change because of the large scale. Naturetech Infra. has on the other hand operated on a small scale while going through the learning loop several times, taking notes on what works and what doesn't, and improving the system while it is still small. When they have learned, changed, and improved the system a number of times, scaling can start. Similarly, TARAurja points out that the period they are in is an extremely important time to spend experimenting with business and revenue models to see what works and what doesn't, and what is less-than-optimal. They are hence following the suggestion of Osterwalder and Pigneur (2010), who mentions that a critical success factor in the design process of a business model is to take the time to explore multiple business model ideas; a suggestion that is transferable to revenue models.

The method of testing the entire system in running operation at a small scale seem to follow the Lean Startup Approach of the build-measure-learn feedback loop (Ries, 2011). The build-measure-learn loop is illustrated in Figure 21. According to Ries (2011), the time consumed going through the loop should be minimized to improve quickly at low costs. For a micro-grid, this is only possible on a small scale.

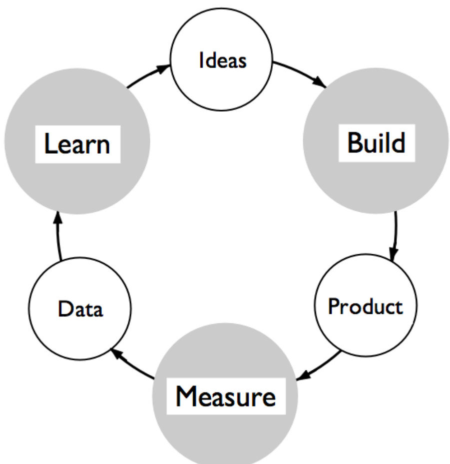

Figure 21: The Build-Measure-Learn loop. Linked to revenue models, the revenue model is the product, the data is feedback on performance, and ideas are new learning from the field or knowledge input. *Source: Ries (2011)*.

With the need for a continuous development process, the revenue model development tool should be designed to allow learning. How can learning be implemented into the development tool? One possible solution may be to separate the interchangeable or editable elements from the absolute elements. Such a separation may be between *inputs* and *outputs*. The output is the end product, the revenue model: The applied customer segments, the time of payment, the actual price, etc. The inputs are all the decision elements that the business evaluates, that eventually create the outputs. The inputs are the base of knowledge, ideas and methods that are worth assessing. Through learning, inputs are changed and elaborated. Using the new inputs the operator can build new outputs or alter the outputs in the revenue model.

Implication for revenue model: Separate the assessing elements in the initial construct from the output elements to allow changes through learning.

7.2 Contextualization and Generalization of the Revenue Model

The revenue model can be either *general* or *contextual*. To recall, the intention of this thesis is to assess how a revenue model applicable in the context of solar-based decentralized micro-grid rural electrification companies in India could be developed, which is a highly contextual focus. A contextual revenue model would therefore be satisfactory for this thesis. However, moving between the extremes of generalization and contextualization, there may be revenue models applicable for similar contexts. If so, this would add considerable value in regards of both the theoretical and practical contributions of this study.

Due to the characteristics of qualitative studies where the systems may be complex and characterized by feedback mechanisms, limits are set for the generalization possibilities. However, a moderatum generalization may be produced (Payne & Williams, 2005). According to Polit and Beck (2010) there are three main generalizations of interest: statistical, analytical, and transferability, where the latter are the most relevant for this study. In transferability, using the *proximal similarity model*, the researcher can envision other contexts that are more or less similar than the one in the study.

The task of generalizing the revenue model development tool is a considerable task requiring further research to identify which elements are similar across contexts. Mayring (2007) presents three general questions on generalization in qualitative oriented studies:

1. Is generalization of the study results important or necessary in research?
2. What is the aim of the generalization? To what statements to we want to generalize?
3. What are the possible procedures of generalization?

The authors provide initial answers to these questions in order to investigate the generalization opportunities of this study.

Importance of Generalization

Due to the limited amount of literature on general revenue modeling and pricing strategies, one could argue that there is a need to continue to develop the general models. In an ever more competitive world, revenue models will play an important role for businesses. Any business that could start developing their revenue model using a solid theoretical framework as a starting point could be able to reach their goals faster and increase their competitiveness. Therefore, generalized revenue models and context specific generalizations will be important in the practical world. For further research, any iteration that brings us closer to better and more correct theory and statements is important and necessary. Hence, an attempt to generalize the revenue model development tool to some degree is considered a task worth pursuing.

The Aim of Generalization

Mayring (2007) mentions two aims that are applicable to this study, using a moderate generalization approach.

1. Generalize at context-specific statements. This means to formulate rules or relationships that are valuable only under certain conditions, in similar situations, geography, technology, etc.
2. Generalize not in the end result, but in the procedure of reaching the results.

As discussed earlier, the revenue model between each firm is similar and different in some elements, and even in this very specific context the exact recommended action is not given. It is only possible to suggest certain options to be evaluated by the company, because of all the factors that influence the final revenue model. This is the reasoning behind splitting the development tool into inputs and outputs, where the outputs are similar for all the companies in the context. However, a procedure of developing a revenue model only would also not be enough for a satisfactory development tool, due to the large amount of necessary knowledge and challenges present in the context. Therefore, a generalization could follow both the first and second aim. The first aim is applicable to both the input and output part of the development tool. The second aim is applicable to the learning procedure of developing a revenue model.

Procedures of Generalization

According to Mayring (2007), there are several possible procedures to follow for generalization. Among many, these include working with bigger samples, looking at a phenomenon under different circumstances, and doing comparative literature studies. One could for example investigate literature on revenue models for a long range of other contexts. These are extensive tasks. Finding an adequate strategy for the available time is necessary. Depending on the chosen procedure, it is important to note the limitations to the generalizability.

For the purpose of a time-limited generalization, the ex post strategy of *argumentative generalization* is a more likely method. This includes discussing the qualities of the sample to consider the possibilities of generalization, and/or find out what aspects of the results are generalizable to what new situations. It may be important to consider that the experience and skills of the researcher will affect the quality of the generalization using this method.

The final revenue model development tool is first presented in its context to answer the research question. Thereafter, a limited generalization is done to find additional possible contributions to theory.

7.3 Discussion Summary

The discussions have led to a set of implications that will be used to develop the revenue model development tool. To summarize, the suggested revenue model implications are given in Table 33.

Implication for revenue model
Assess which services should be offered and/or if there should be any usage restrictions from a value-cost perspective. Identify individual demand curve (WTP per kWh compared to cost per kWh).
Assess whether fixed or metered solutions are most beneficial based on the likely usage scenarios.
Assess whether the company can apply a system of committed recurring revenue that responds well to increased demand.
Assess whether a prepaid or postpaid model is suitable.
Assess the option of applying the prepaid model for increased revenue collection discipline and control.
Assess and test the quality of payment collection technology to avoid costly replacements in the future.
Assess the possibility of creating price-offer configurations to capture more value within a value-proposition segment.
Assess whether price fence tactics are applicable to capture more value.
Assess methods to enforce collection control.
Assess methods to respond to increasing demand of customers and consumption.
Assess whether the choice of technology is in line with the overall strategy of the company.
Assess the possibility to collect and analyze information about consumption and buying patterns if such information exists. Utilize purchasing patterns to adjust the price structure to capture more value.
Assess the option of applying distribution technology that can integrate with future state grid electricity.
Separate the assessing elements in the initial construct from the output elements to allow changes through learning.

Table 33: New implications for revenue models.

8. Finalization of the Revenue Model Development Tool

In this chapter the initial construct and the implications derived from discussions will be used to develop a revenue model development tool for the micro-grid operators.

The authors have found strong evidence that there is an iterative development process in revenue model strategizing. Due to the added complexity of learning in revenue model development, the authors did not find it suitable to adapt the initial construct to fit the new findings. Hence, the initial construct structure serves only as an inspiration for the final development of the revenue model development tool. The main basis for the development are the findings from the literature review and the findings from the qualitative case study.

As the Revenue Model Development Tool will be used in practice, the authors defined certain criteria that it had to fulfill:

- The overall purpose of the tool is to aid the micro-grid operators in developing and/or improving their revenue model.
- The tool must be designed in such a way that it is practical to use:
    - Easy to understand
    - Easy to use

8.1 Splitting the Revenue Model Development Tool

The logic from the discussion of learning in the previous chapter suggests that:

> ***Separate the assessing elements in the initial construct from the output elements to allow changes through learning.***

As a result, the development tool will be split into **inputs** and **outputs**.

Deciding what elements should be included in the inputs and outputs, the build-measure-learn feedback loop of the Lean Startup Approach is applied as a construct for the learning process. The loop consists of two elements that seem clearly relevant: Ideas and Product. Ideas are elements that are assessed, to build the product. Transferred to a revenue model development tool, the ideas are the "inputs", and the product are the "outputs".

The final development tool should give an immediate impression of what the final revenue model components are, and how they relate to each other. This should not include any decision elements, but only those factors that explain *what* the revenue model looks like. Therefore, the outputs should be the revenue model structure, and inputs/ideas are the challenges and suggested propositions in the context.

In Figure 22, the relation of the inputs and outputs in the build-measure-learn loop is illustrated.

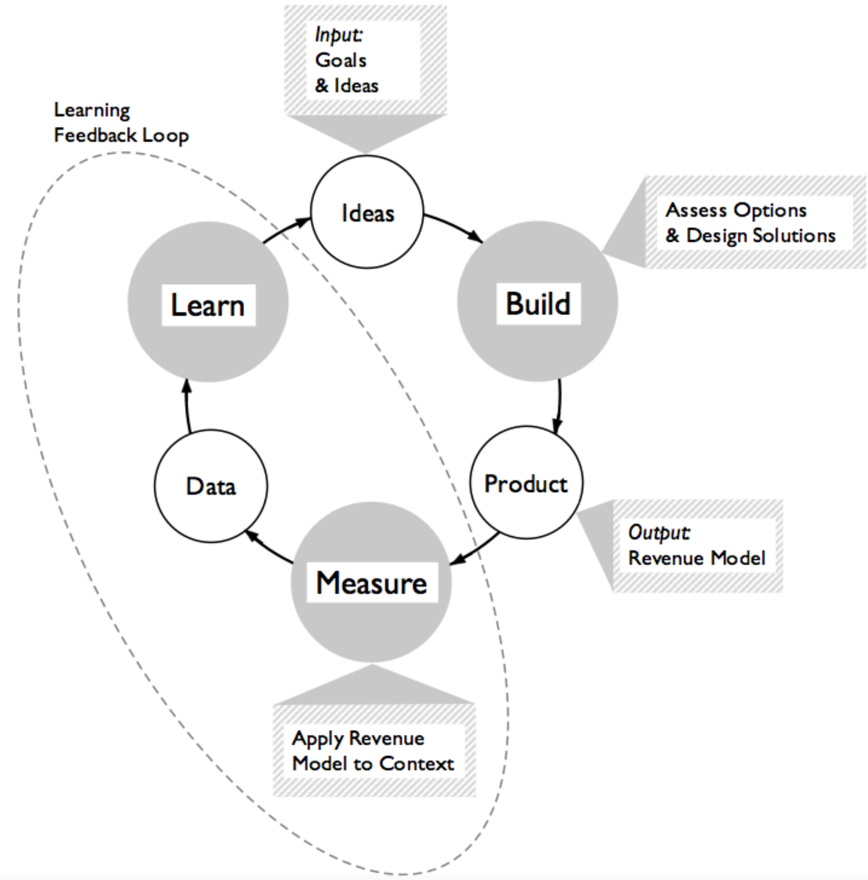

Figure 22: Relating revenue model development to the build-measure-learn loop. *Source: Authors.*

The authors use the above as a starting point for the learning process. However, other approaches to learning may be applied. By condensing the learning process of the build-measure-learn loop, a simplified learning loop is developed, as seen in Figure 23:

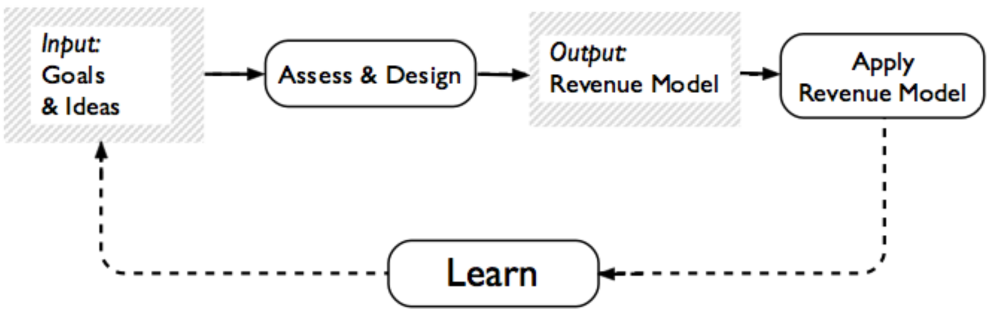

Figure 23: The revenue model adapted build-measure-learn loop. *Source: Authors.*

Hence, the revenue model development tool is split into two main parts which are incorporated in a development loop.

8.1.1 The Outputs

The outputs are the absolute elements of the revenue model: the revenue model structure. The structure consists of the basic revenue model elements, mostly derived from the general revenue model literature. Additional subcomponents are added as a result of the qualitative findings.

From the literature review and results one can see that certain elements are subcomponents of other elements, and that some decisions should be made before others. Many of these are obvious, while some are not. By discussion, the authors chose to apply a hierarchical design of subcomponents. Certain elements, like corporate strategies and choice of technology have been given their own category, as they are not directly part of the revenue model. However, the revenue model design depends directly on these elements, and they are therefore relevant.

8.1.2 The Inputs

The second part of the development tool is the ideas (challenges, propositions, options) of tasks and methods that can be applied to the revenue model structure. The ideas have been grouped into certain topics, and presented in an order that reflect their recommended consecutive execution. The topics and execution series have been decided through discussion.

The intention of the inputs is to decide upon the final elements of the revenue model structure. Therefore, the authors recommend the following layout:

> **Topic**. The topics relate to the revenue model structure. By following the topics from the top, one can assess each topic step by step, to decide upon the decision elements of the revenue model structure.
>
> **Goals**. These are derived from challenges, and reformulated into a goal that should be achieved to address challenges in the context.
>
> **Ideas**. These are ideas based on suggested propositions to solve the challenges, as a result of the literature review and qualitative case study.
>
> **Examples**. Ideas may have different options depending on the overall strategy of the company, and what is possible to do in practice. The intention is to provide the user of the revenue model development tool a set of possible choices to improve the assessment process.

Next, the results of the final revenue model output and input is presented in sections 8.2 and 8.3, respectively.

8.2 The Revenue Model Output

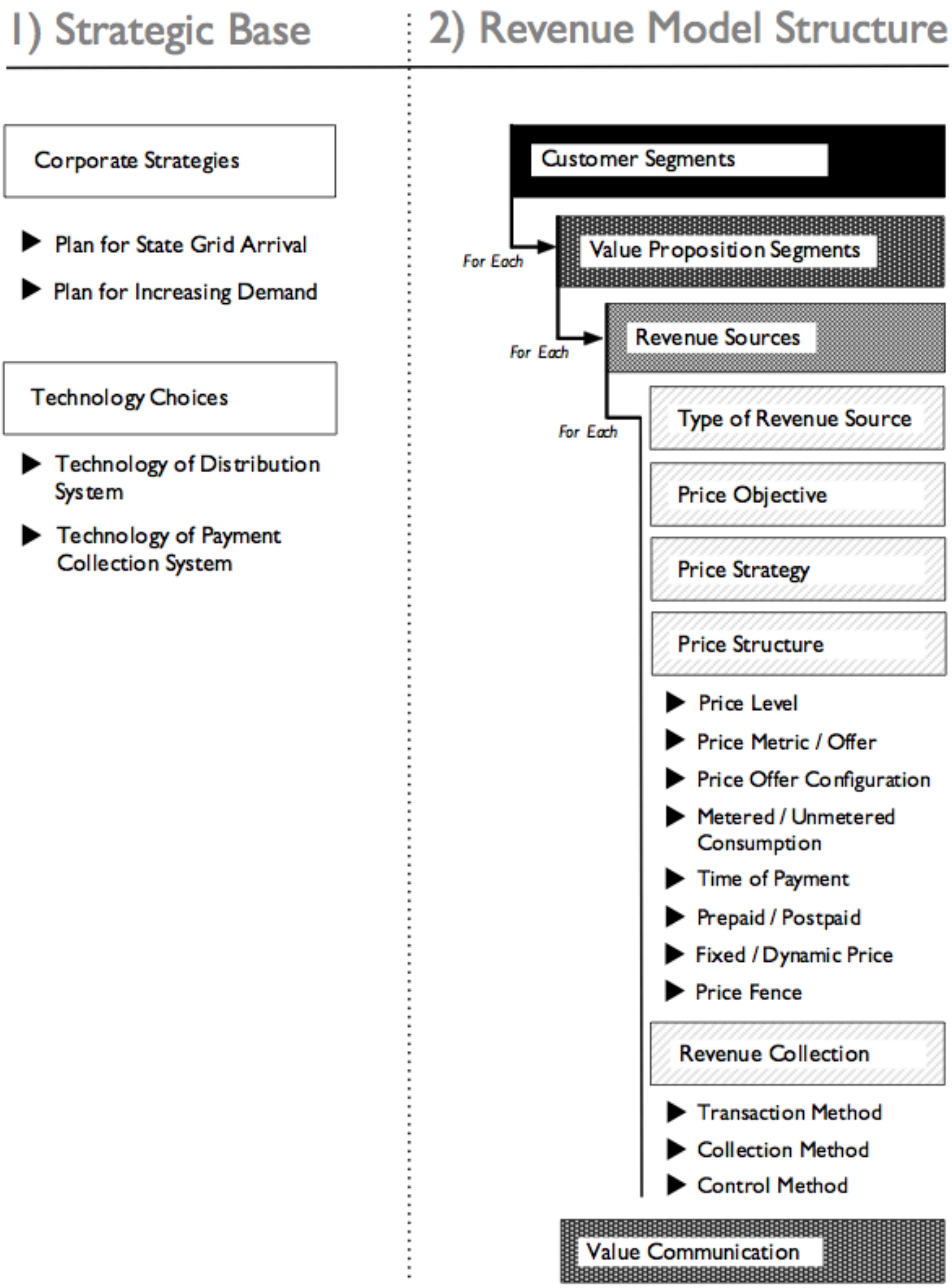

Figure 24: The revenue model development tool for revenue models in the context. Ideas for actions on the fields are presented next, in section 8.3. *Source: Authors.*

8.3 Revenue Model Input

In this section, the ideas for input into the revenue model development tool are presented. The ideas represent possible ways of solving challenges related to solar-based decentralized micro-grid rural electrifications in India. Each of the Figures 25 to 31 presents a main topic from the Revenue Model Development Tool.

Corporate Strategies

Topic	Goal	Idea	Examples
Plan for increasing demand	Create a plan for future demand.	Evaluate what methods can be applied to respond to increasing demand of customers and consumption.	
		Build a scalable grid and revenue model.	Allow connection of any electrical device.
			Allow for increasing the solar panel capacity.
			Allow for increasing the distribution network of the powerplant.
			Allow possibility for increased consumption by natural demand.
Plan for state grid arrival	Create a plan for state grid arrival.	Assess which action(s) to take if /when state grid electricity arrives to the village.	Apply distribution technology that can connect to future state electricity. This allows the opportunity to act as the distributor.

Figure 25: Revenue Model Development Tool ideas for corporate strategies. *Source: Authors.*

Technology

Topic	Goal	Idea	Examples
Customer segments and value propositions	Choose technology.	The choice of technology focus should be in line with the overall strategy of the company.	
		Choose distribution and payment technology that aids relevant revenue model components.	
	Avoid costs of technology failure.	Assess and test the quality of payment collection technology to avoid costly replacements in the future.	
	Avoid stealing or tampering.	Make the distribution box inaccessible and fully automated.	

Figure 26: Revenue Model Development Tool ideas for technology choices. *Source: Authors.*

Customer Segments and Value Propositions

Topic	Goal	Idea	Examples
Customer segments and value propositions	Find the value propositions of different customers.	Capture all customers by accurate segmentation and targeted value proposition delivery to these segments.	Assess the local needs.
			Partner with local NGOs to understand local conditions.
	Find the value propositions of business customers.	Facilitate customers' income generating activities.	
	Assess the profitability of the value propositions.	Identify individual demand curve (WTP per kWh compared to cost per kWh). Assess which services should be offered and if there should be any usage restrictions from a value-cost perspective.	
	Find the time-value of the value propositions.	Identify if villagers might be willing to pay more at certain times, e.g. during happenings and festivals.	
		Apply suitable technology and price structure to capture time-value.	Allow flexible payment schedules with the possibility to pay for large amounts of consumption.
			Apply dynamic pricing to better fit the seasonal changes in WTP.
	Boost electricity consumption to facilitate demand-WTP feedback loop.	Create economic opportunities through establishing activities such as food processing or sewing.	

Figure 27: Revenue Model Development Tool ideas for customer segments and value propositions. *Source: Authors.*

Revenue Sources

Topic	Goal	Idea	Examples
Type of revenue source	Find transactional revenue sources.	Set a connection charge.	
		Sell products, such as light bulbs, tools, etc.	
	Find recurring revenue sources.	Lease out equipment, such as productive tools.	
		Set up a subscription type revenue source.	
		Set up a usage-fee type revenue source.	
	Assure recurring revenue to avoid loss of income.	Create a system of committed recurring revenue which responds well to increased demand.	Mix subscription and usage fees.
Price objective	Set a price objective.	Set a plan for the current and future price objective.	Refer to Table 4 for price objectives.
Price strategy	Set a price strategy.	Create a price strategy that is in line with the price objective.	Refer to Table 5 for price strategies.
		Increase the willingness to connect.	Use a penetration pricing strategy.
Price structure	Capture maximum value from your customers	Understand the local conditions. Provide suitable and flexible payment systems.	
		Collect and analyze information about consumption and buying patterns if such information exists. Utilize purchasing patterns to adjust the price structure to capture more value.	
Price-offer configuration	Capture maximum value from your customers.	Apply price-offer configurations to capture more value within a value proposition segment.	
	Increase WTP of exisiting customers on metered systems.	Allow flexible payment schedules with the possibility to pay for smaller amounts of electricity.	

Figure 28: Revenue Model Development Tool ideas for revenue sources. This topic is continued on the next page, in Figure 29. *Source: Authors.*

Revenue Sources (Continued)

Topic	Goal	Idea	Examples
Price level	Find the correct price level.	1. Find the price floor.	What are the fixed and variable costs?
		2. Find the price ceiling.	What is the current customers' maximum ability to pay?
		3. Find the price levels in the market.	What is the price of substitutes?
			Perform supply/ demand WTP analysis.
		4. Set the price according to price objective, while taking price floor, ceiling and other price points into account.	
Metered / Unmetered	Choose a metered or unmetered solution.	Assess whether fixed or metered solutions are most beneficial based on the likely usage scenarios.	
Time of payment	Find the optimal time and size of payments for the customers.	Understand the local conditions. What is the customers' ability to pay, including the amount and time of payment? Consider local factors such as seasonal income.	Yearly, monthly, weekly, daily or other interval.
			On-demand: Customer pays when able to pay.
Prepaid / postpaid	Set a prepaid or postpaid method.	Assess whether a prepaid or postpaid method is suitable.	
Fixed / dynamic price	Set a fixed or dynamic price.	Assess whether a fixed or dynamic price is suitable.	Apply fair dynamic pricing, varying the price every month to match the price with the quality of solar generation.
Price fence	Capture maximum value from your customers.	Apply price fence tactics.	Provide volume discounts.

Figure 29: Revenue Model Development Tool ideas for revenue sources. This topic is continued from the previous page, in Figure 28. *Source: Authors.*

Revenue Collection

Topic	Goal	Idea	Examples
Transaction medium	Find a suitable transaction medium.	Assess the available local transaction possibilities.	Cash. Mobile phone payments.
Collection method	Find a suitable collection method.	Assess suitable collection methods.	
Control method	Ensure discipline and control in revenue collection.	Apply the prepaid model for increased revenue collection discipline and control.	Create practices or systems to avoid pitfalls of customers frequently loosing power and avoid customer inconvenience in paying for or upgrading subscription.
		Utilize technology for improved revenue collection control.	On/off distribution systems. SMS control of distribution system. SMS reporting of customer usage. SMS/Mobile payment reporting system.
		Create routines to respond to customers who do not pay.	
		Set up an employee and management incentive system.	
		Transfer the risk of collection to the collector, e.g. by making the collector invest in the collection amount prior to collection.	
		Employ local representatives for payment collection.	
		Ensure local embeddedness.	
		Partner with microfinance institutions for financial control.	

Figure 30: Revenue Model Development Tool ideas for collection. *Source: Authors.*

Value Communication

Topic	Goal	Idea	Examples
Value communication	Increase the willingness to pay.	Local employees or local NGOs may act as repesentatives speading awareness and information about the positive effects of electrification in the community.	

Figure 31: Revenue Model Development Tool ideas for value communication. *Source: Authors.*

9. Generalization

In this chapter, the revenue model development tool is generalized by using the argumentative generalization approach introduced in section 7.2.

9.1 Generalizing the Revenue Model Structure

To recall, the revenue model structure (hierarchy) is developed both through the contextual findings and the general theory. Some sub-components are elaborative of components higher in the hierarchy and at the same time contextual. The latter kind of components does not significantly weaken the revenue model structure by removal, other than losing its precision in the current or similar contexts. By removing contextual elements in the revenue model structure, it is moving towards generalization. Further, components may be generalized to fit similar contexts or situations, in addition to broadening of the context of this study. An overview of which components that are derived from a contextual literature and findings and which are from and general literature is presented in Table 34.

Revenue model structure component	General/ contextual
Customer Segments	*General*
Value Proposition Segments	*General*
Revenue Sources	*General*
Type of Revenue Source	*General*
Price Objective	*General*
Price Strategy	*General*
Price Structure	*General*
Price Offer Configuration	*General*
Price Metric / Offer	*General*
Price Level	*General*

Revenue model structure component	General/ contextual
Metered/Unmetered consumption	*Contextual*
Time of payment	*General*
Prepaid/postpaid	*Contextual*
Fixed / Dynamic price	*General*
Price fence	*General*
Revenue collection	*Contextual*
Transaction method	*Contextual*
Collection Method	*Contextual*
Control method	*Contextual*

Table 34: General and contextual revenue model structure components.

The contextual components are discussed to assess how they eventually are suitable for a broader definition of the context, and if so, which parameters that defines the relevance of these components – which is in the direction of generalization. It is worth noting that in this study, the generally derived components are confirmed by the contextual study.

Metered/Unmetered Consumption

Metered/unmetered consumption is related to contexts where the customers consume a unit in some amount, especially where each consumed unit incur expenses for the supply-company. The consumed amount may be measured or not. Similar context may be utilities such as electricity supply, water supply, and similar.

Prepaid/Postpaid

Paying before or after consuming a product or service is something that could be applied to a long range of businesses. It is about collecting revenue before or after delivering a product or service. A related situation could be to collect revenue before incurring expenses, which may or may not be the same as collecting revenue before or after delivering a product or service. The prepaid/postpaid component assumes discrete transactions, and it could be argued that the existence of continuous transactions would be extremely rare.

The definition as included in the revenue model structure presented in this thesis is to collect payment before or after the delivery of product or service, often as a means to increase the customer control and discipline. By staying to this definition, the prepaid/postpaid component is generalizable to all business that involves payments. Clarification can be added by renaming the component to "Prepaid/Postpaid: Collect revenue before or after delivery of product/service".

Revenue Collection

The greatest challenge found in the context is difficulties in payments, and these matters are concerned with the transactional medium (cash, mobile, etc.), the collection method (hired collector, SMS-payment, etc.), and the control method (prepaid, turning off electricity, etc.).

Any type of revenue collection must decide which type of transactional medium they want to collect through, and how to do it. Further, using a system to ensure customer discipline and control is essential for many contexts. Using a prepaid system is a form of control. Stopping the delivery of service upon default payments is another. One could argue that it is in the interest of all companies to ensure that their customers pay for the delivery of a product/service. The level of control required to pursue this is up to each company to decide.

Following the arguments above, the component of "Revenue collection", including its three subcomponents, is hence deemed generalizable to all contexts.

Must-Decide and Choose-to-Apply Components

Some elements like "price fences" and "control method" are not a choice that must be made. It is something the company can choose to apply, in the attempt to capture more value. The authors suggest that even though some components might be left out by choice, this does not restrict the generalizability of the component, as long as the conception that components are possible to leave out is given.

9.1.2 Summary of Revenue Model Structure Generalization

The authors have argued that the components of prepaid/postpaid and control method could be generalized to all contexts. The metered/unmetered component is generalizable to at least the context of utilities. Therefore, the final revenue model structure could be generalized to the context of utilities.

Contribution to Revenue Model Theory

Does the revenue model structure contribute to revenue model theory? The revenue model structure is developed through the general and contextual literature reviews, as well as by the qualitative case study.

The authors find that the revenue model development tool that is created by applying the theoretical concepts into the context affirms the recent trend in literature for a more value-based conceptualization of the revenue model. Furthermore, the authors find resonance with Amit and Zott (2012) about the importance of the close and dynamic links between the business model and the revenue model. For example, the revenue model structure developed in this study closely parallels Teece's (2010) conceptualization for the business model, which is illustrated in Figure 32. The authors therefore support a more value-based approach to revenue models, and that current conceptions of the revenue model, while providing a good overall structure, may benefit from some elaboration on certain elements.

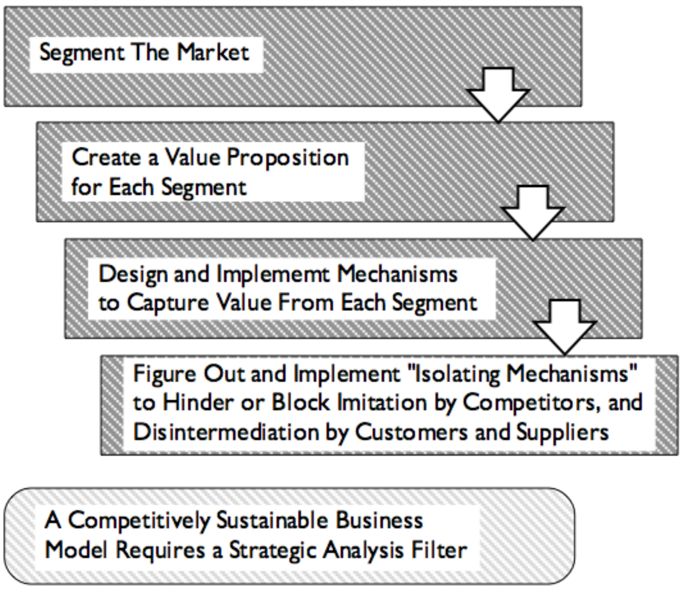

Figure 32: Steps to achieve a sustainable business model (Teece, 2010).

The literature on revenue models and pricing pay little attention to *how* revenue is collected. However, no income is generated without collecting revenue, which proves its importance in a revenue model. In the context of rural India, revenue collection has been a particularly challenging task. Through the contextual literature review and qualitative case study the authors have identified revenue collection to consist of (1) transaction methods, (2) collection methods, and (3) control methods, which are components within the context of utilities, as argued above.

Hence, the authors contribute to the revenue model theory in the context of utilities, in two ways:

1. A detailed revenue model structure is proposed.
2. Revenue collection is proposed as a component of the revenue model, consisting of:
    a. Transaction methods (cash, credit card, bank-wire, ...)
    b. Collection methods (Hired collector, SMS-payment …)
    c. Control methods (Prepaid, stop of service delivery, …)

9.2 Generalizing the Revenue Model Ideas

The revenue model structure is concerned with how the revenue model items are structured. Another important part of a revenue model is how to decide what the items in the structure should be set to, for example deciding the actual price level. The authors have created the Revenue Model Ideas to aid this process in the context of solar-based decentralized micro-grid operators in rural India. Although it is not possible to generalize it to the same level as the revenue model structure, some of these contextual elements might be transferable to similar contexts. The task of generalization can however be substantial. Due to limited available time, constraints on the generalization are set. The following constraints apply:

- Minimum alterations to the existing components.
- The company in question will have to be a provider of electricity.
- The company in question must operate in a decentralized, and rural location.

Further, the generalization in this section will focus on the following topics:

1. Geography. Are the ideas limited to India only?
2. Technology
    a. Are the ideas limited to solar only?
    b. Are the ideas limited to micro-grids only?

Geography

The fact that the micro-grid operators of this study are present in India introduces contextual elements that are cultural, behavioral, political, governmental, and economical. However, these elements might be sufficiently similar to other parts of the world. One of the important factors is the Electricity Act of 2003 (Govt. of India, 2003), which provides a high degree of freedom to private operators in the rural electrification market. One of the factors worth considering is the location of other micro-grid cases mentioned in the literature on rural micro-grid development. These are countries such as Africa, Indonesia, Malaysia, South-Asia, and South-America. The authors identify some similar factors:

- *Developing countries*.
- People lack access to electricity, or have access to a very poor service – *Energy poverty.*
- People have a low or limited ability to pay – *Low income markets.*

There may however be differences, for example in policies. It is beyond the scope of this study to identify for example if private sector players in other countries than India are allowed to generate and distribute electricity and set price levels independent of political interference. A geographical generalization can therefore not be suggested without further analysis of other relevant geographical and political contexts.

Solar Technology

Some of the components are specifically dependent on solar technology, for example the suggestion to adjust the price to the quality of solar generation (due to natural seasonal variations in solar radiation). The suggestion may however be similar to energy sources that vary naturally with time, which is the case with most renewable energy sources, like wind and hydropower. Also, biomass plants may have varying prices of the biomass they burn, resulting in a varying price of the supply electricity.

The context-specific components in the revenue model ideas are:

- *Build a scalable grid and revenue model → Allow for increasing the solar panel capacity.*
- *Assess whether a fixed or dynamic price is suitable → Apply fair dynamic pricing, varying the price every month to match price with quality of solar generation*.

Even though the components mention “solar”, the suggested idea is not dependent on being solar-based to address the challenge. Any “capacity” and any “generation” would suffice. Therefore, it could be argued that replacing “solar panel” with “renewable energy source” in the first component, and “ solar generation” with “renewable energy source power generation”, the revenue model ideas are generalized from solar to renewable energy sources without loss of precision.

Micro-Grid Technology

The revenue model ideas are strongly linked to micro-grid technology. However, the findings show that terminologies are mixed. The mixed terminologies are concerned with the size of the micro-grid, operating with other terms such as “mini-grid” and “village-grid”. Also, the definitions of these terms are not absolute, as companies operate with slightly different definitions. However, the similarity is that they are local grids using distributed generation. Due to the strong tie to micro-grids, the revenue model ideas is not generalizable beyond this, but it is applicable to the similar terms of “mini-grid” and “village-grid”.

Contribution to Revenue Model Theory

Following the argumentative generalization approach, the revenue model ideas have been broadened to the following.

Solar → Renewable energy sources
Micro-grid → Micro / mini / village-grid

The final context for the revenue model development tool is hence applicable for companies operating:

- Renewable energy micro / mini / village-grids
- Decentralized
- Rural areas
- Within India

The revenue model structure is generalized to the context of utilities in the previous chapter. However, the total generalization of the Revenue Model Development Tool is limited to the least generalized part. Therefore, the authors contribute to the discussion on revenue models of companies operating renewable energy decentralized micro/mini/village-grids in rural areas of India. The authors do this by proposing a Revenue Model Development Loop, consisting of a revenue model structure and revenue model ideas.

9.3 Replacing Contexts: The Revenue Model Development Loop

By separating the revenue model structure and revenue model ideas, the authors have in practice separated the primarily general and the primarily contextual elements of the Revenue Model Development Tool. Looking at the mechanism connecting them, illustrated in Figure 33 - the Revenue Model Development Loop is defined. The "Input" (revenue model ideas) may be altered or even replaced with another context. In this way, the Revenue Model Development Tool can be argued to be applicable to any context, simply by developing an "Input" for the context of interest.

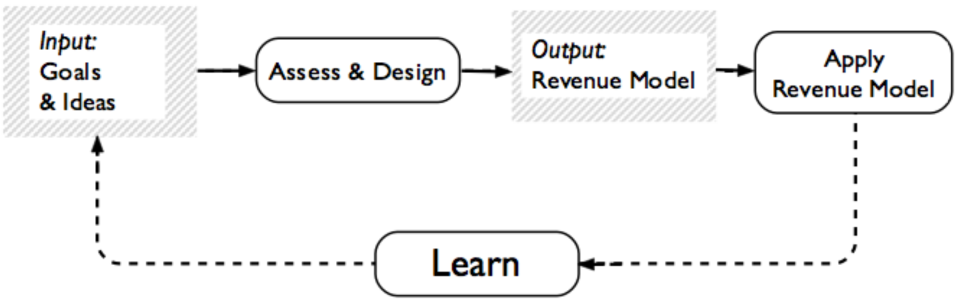

Figure 33: The revenue model development loop. *Source: Authors.*

By developing a database of contexts, a new company might start off by applying the context that is most similar to its own. From that point on, learning will change the company's Inputs to fit the context exactly, developing a new entry for the database. Thus, the Revenue Model Development Loop may be divided into a general part and a contextual component that is inserted into it to form a Revenue Model Development Tool for a specific and free-to-choose context. This is illustrated in Figure 34.

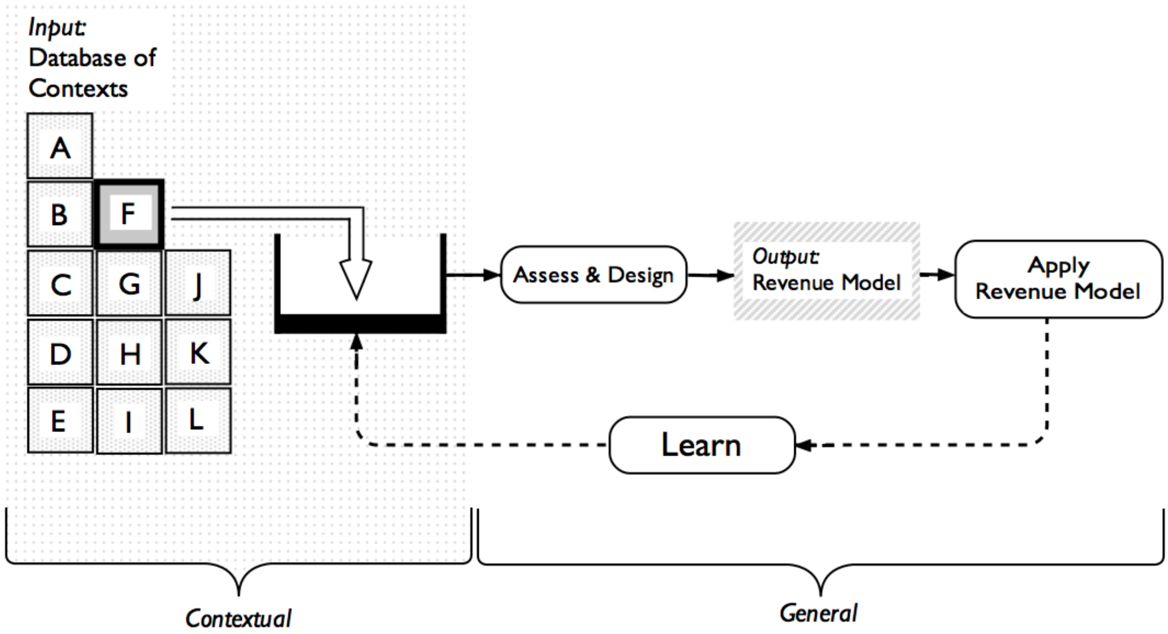

Figure 34: Revenue model development loop with interchangeable contexts from a "database" of information. *Source: Authors.*

Hence, the Revenue Model Development Loop is an important part of the Revenue Model Development Tool, and the loop is generalizable to the entire context of utilities, as discussed in this chapter.

In other words, the Revenue Model Development Loop is the mechanism of using the Revenue Model Development Tool. Furthermore, the Revenue Model Development Tool consists of a primarily general and a primarily contextual part. The general part is the Revenue Model Structure and the contextual part is the Revenue Model Ideas. Relationships between the elements are illustrated in Figure 35.

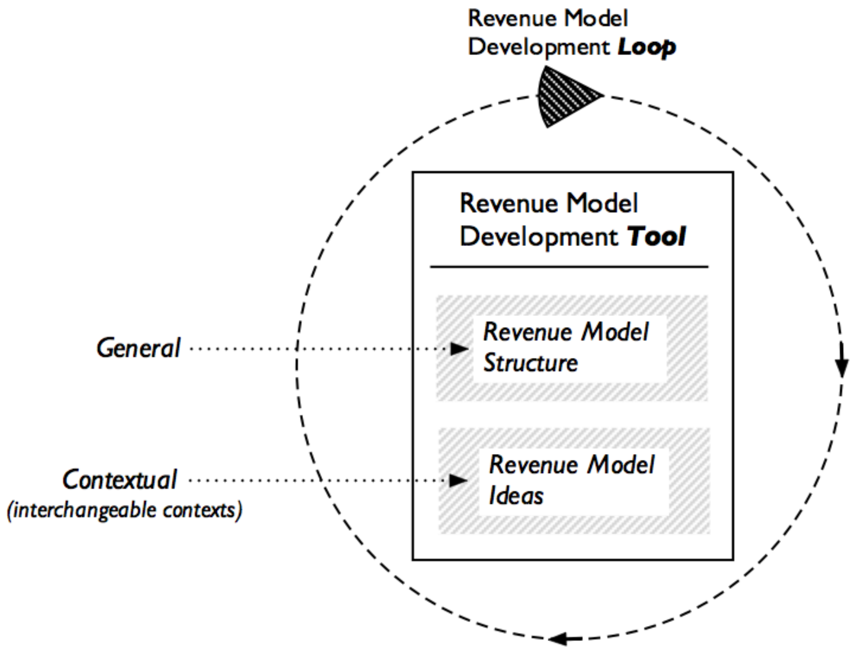

Figure 35: Illustration of relationship between the results of this thesis. *Source: Authors.*

10. Conclusion

To address the research questions, the authors first reviewed general theory on revenue models and pricing strategy, in addition to literature on challenges and frameworks in the context. This led to the development of an initial construct of a revenue model for the context. This initial construct was further used as a basis for a qualitative study.

Through analysis and discussion of the case study findings, the authors found it appropriate to develop a Revenue Model Development Tool. The tool includes the Revenue Model Structure and contextual ideas that attach to the structure – Revenue Model Ideas.

The authors further identified that the process of revenue model development is of significant interest. By applying learning mechanisms to address the development process, the Revenue Model Development Tool, which includes the Revenue Model Structure and Ideas, was further developed to include the Revenue Model Development Loop. The revenue model Loop, Structure, and Ideas, are the components of the Revenue Model Development Tool.

Table 35 summarizes how the authors address the research question including its sub-questions. The authors also performed a generalization exercise on the Revenue Model Development Tool. The Revenue Model Structure was generalized to be applicable to the context of utilities, and the Revenue Model Ideas were generalized to the context of renewable energy decentralized micro/mini/village-grids in India.

The authors have developed a tool that micro-grid operators running solar-based decentralized micro-grids for rural electrification in India can use to develop their revenue model in practice. Also, the authors contribute to theory by providing an iterative method for revenue model development that can also be applied to other contexts. This adaptability is a built-in feature of the tool. Also, the authors contribute by suggesting that revenue collection, including transaction, collection and control methods, should be included as parts of a revenue model.

Research Question	Addressed by…
How can a revenue model be developed for solar-based decentralized micro-grid rural electrification companies in India?	The Revenue Model Development Tool
a. What are the components and structure of a revenue model?	The Revenue Model Structure
b. What are the revenue model challenges in the context and how can the challenges be addressed?	The Revenue Model Ideas
c. How do companies within this context go about developing their revenue model?	The Revenue Model Loop

Table 35: Recalling the research question and stating how the authors have addressed them.

11. Suggestions for Further Work

In this chapter, the authors briefly introduce some suggestions for further work following this study. The topics presented are chosen because they are likely to add significant value to the research in this field.

More on Learning in the Process of Developing Revenue Models in the Context

By developing and presenting the Revenue Model Development Loop as a part of the Revenue Model Development Tool, the authors show that learning is an important aspect of revenue model development and suggests how it may be applied in the tool. The process of learning in revenue model development is insufficiently addressed by current literature. Therefore, to improve on the findings in this thesis, further research on the process of developing a revenue model is required, where this is the central focus of the work.

Further Generalization of the Revenue Model Development Tool

In chapter 9, the authors discuss the generalizability of the Revenue Model Development Tool, and suggest which parts are more generally applicable and which parts that are constrained to specific contexts. The Revenue Model Development Tool would be more valuable if it was applicable to more contexts. The further generalization of the tool is therefore a subject for further research. Substantial work will be required to achieve a high level of generalizability.

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Appendix A: Supply-Side Interview Guide

General Background

- How many systems do you have in operation?
- What is your ***growth strategy***?
- What is the ***penetration rate*** in each village?
- Why are some customers left out and who are they?
- Why are some villages more adoptive? Is there any social pressure on pricing?
- Are all ***villages profitable***?
- Which ***factors contribute to profitability***?
- What are the main issues in the non-profitable villages?
- What are the operational revenue to operational cost factor?
- How do you calculate the estimated profitability in a potential village?
- Have any started projects been cancelled? Why?

Value Creation & Communication

- Do you analyze the ***customer needs***? How?
- Do you analyze if local businesses have problems that can be solved by electricity, or ***electric tools?***
- Have you considered providing local businesses with electric tools to improve their business, and make them reliant on your electricity? Why (not)?

- What is the ***pricing objective*** of the company? (Current and historically)
- How does this affect pricing decisions?

- Do you analyze the ***value propositions*** of your customers? How?
- Do you segment the value propositions? Why? How?
- What is your ***value segment structure***?

- Do you analyze the ***WTP (Willingness-to-pay)*** of the customers?
- What are the customers WTP for the different value propositions?
- Have you considered analyzing WTP to better price your electricity?
- Do you try to increase the WTP of the cusotmers? How?

Revenue Model & Pricing Strategies

- What is the ***current revenue model*** of the company?
- Why did you decide to use this revenue model?
- What are your ***price levels***?
- How are the price levels determined?
- Do you follow any ***strategy for the pricing***?
- Do you think it is possible to get more revenue from the customers? Why?
- Which challenges do you see in revenue models and pricing strategies?
- Is there anything your company can do to get more revenue from the customers? If you are not doing such activities, why not?

Revenue & Pricing Structures

- Do you attempt to reduce the ***initial capital cost*** for your customers? Why? How?

- Do you analyze the customers' ***ability to pay?*** How?
- How do you decide your payment structure? (Time of payment, etc.)

- Do you use a ***static or dynamic price***? Why?
- Have you analyzed if the customer value change with time? Why (not)? How?

- How are ***payments collected***? Why?
- Did you analyze the local transaction possibilities?
- Do you ***employ locals*** for the payment collection? Why (not)? How?
- Did you evaluate the physical position of the collection points?
- How many percent of you possible ***revenue is successfully collected***?
- How is the collection enforced?

Price Level Determination

- Do you analyze the ***fixed and variable costs?*** How?
- What is included in the variable costs?
- Do you set a minimum possible price for the pricing? (***Price floor***)
- How do you set the prices for the ***customer segments***?
- Do you perform a ***supply/demand analysis*** for price-setting? How?
- Do you perform any activities in price optimization? How?

Appendix B: Demand-Side Interview Guide

QUESTION 1:

When did you subscribe for electricity?
Aap ke paas kab se yeh bijli sewa hai?
Aap ke paas kis tareekh se yeh bijli sewa hai? (for a specific date)

(Lit.: Since when have you got this electricity service? Make sure they understand you are asking about the specific connection from the company, for they might have/had a connection from other sources or the grid from before)

QUESTION 2:

Why do you subscribe for electricity?
Aapne yehi (isi company ki) bijli sewa kyun li?

QUESTION 3:

What have you subscribed to?

Aap ne jo sewa li hai, woh kis prakar ki hai? Jaise, kitne bulb, mobile charging, pankha, TV vagaira. (Lit: that you have subscribed to, is of what kind? For e.g. how many bulbs, mobile charging, fans, TV etc.)

a. Which needs does electricity fulfill for you?
   Bijli se aap ki kaun kaun si zarooratein poori hoti hain?

b. How does electricity provide value to you?
   In main se, aapke liye sabse mahatvapoorn kya hai aur kyun?
   (Lit: Of these, what is the most important for you and why?

c. What is the most valuable thing about electricity for you?
   Bijli se aapke liye sabse fayedamand cheez kya hai?

QUESTION 4:

a. Do you also use electricity for income-generating activities? (at a household)
   Kya aap ye bijli sewa upyog main lakar kuch aamdani kamaane ka kaam bhi kartey hain?
   (Lit: do you use this electricity service to also do some income generating activities?)

b. If yes, then what is this activity?
   Is kaam ke baarey main kuch bataiye
   (Lit: Please tell us a little about this work)

c. How do you use the electricity in your income generating activity?
   (if answer at household is yes or if you are at a commercial/industrial user)
   Aapke kaam main bijli kis prakaar se upyog main/ istemaal aati hai?

QUESTION 5:

How much do you pay for electricity?
Ek mahine main, bijli pe kharcha kitna hota hai?
(Lit: How much is your expense on electricity every month?)

QUESTION 6:

When do you pay for electricity? Weekly, monthly, etc.
Bijli ke paise aap ko kab dene padtey hain – mahine main ek baar, har haftey?

QUESTION 7:

What do you think about that price?
Bijli ke daam ke barey main aapki kya raey hai?

QUESTION 8:

Why do you think people in your village do not subscribe for electricity?

- Availability to pay?
- Willingness to pay?
- Knowledge?

Aapke raey main, jin logon ne abhi bijli sewa nahin liya hai aapke gaon main, unhone kyun nahin liya hai?

(Lit: In your opinion, those who have not taken a connection in your village, why have they not done so?

- *Woh iska daam nahin de saktey?*
  (they cannot afford to pay for this?)
- *Woh aisi sewa ke liye paise dena nahin chahtey?*
  (they do not want to pay for such a service?)
- *Unko is sewa ke barey main pata nahin hai?*
  (they are not aware of this service?)

QUESTION 9:

Is there anything that [the micro-grid operator company] could do to gain more customers?
Aapke raey main aur grahakon ko aakarshit karne ke liye, bijli company wallon ko kya karna chahiye?
(Lit: according to you, to attract more customers, what should the electricity company do?

QUESTION 10:

What do you think in general about the service from [the micro-grid operator company]?
Is company ki bijli sewa ke barey main aapki kya raey hai?

(Lit: what is your opinion about this company's service?)

a. What is the best thing about your electricity subscription?
   Bijli sewa ke baarey main sabse acchi baat kya hai?

b. What is the worst thing about your electricity subscription?
   Bijli sewa ke baarey main sabse buri baat kya hai? Kya kami hai?

QUESTION 11:

Is there anything that would make electricity more valuable to you?
Kya kuch aisa hai, jo karney se aapke liye is bijli sewa ka mahatva ya moolya badh sakta hai?

(Lit: is there anything, if done, will increase the importance or value of the electricity service for you?

QUESTION 12:

Is there anything that would make you pay more for electricity?
Kya kuch aisa hai, jo karney se, aap is bijli ke liye abhi se zayda daam dene ke liye taiyaar honge?

Appendix C: Case Study Data Code Base

The coding for the interviews has been developed in two stages. An initial set of codes were developed from the proposed development tool, and a final set of code was finished after the first iteration of data analysis.

Initial coding, translated from the initial construct:

A. VALUE CREATION & COMMUNICATION
  - A1: LOCAL NEEDS
  - A2: ELECTRIC TOOLS/MACHINERY
    - A2.1 PROVIDING TOOLS/MACHINERY
  - A3: PRICE OBJECTIVE
  - A4: INCREASING WTP
  - A5: VALUE PROPOSITIONS
    - A5.1: VALUE SEGMENTS
  - A6: MARKETING

B. REVENUE AND PRICING STRUCTURES
  - B1: INITIAL COST
  - B2: ABILITY TO PAY
  - B3: DYNAMIC PRICE
  - B4: STATIC PRICE
  - B5: PAYMENT COLLECTION
    - B5.1 TRANSACTION METHOD
    - B5.2 COLLECTION METHOD
    - B5.3 MFI PARTNERSHIPS
    - B5.4 LOCAL EMPLOYEES

C. PRICE LEVEL DETERMINATION
  - C1: WTP for VALUE PROPS
  - C2: DEMAND/SUPPLY TARIFF
  - C3: COSTS
    - C3.1 FIXED COSTS
    - C3.2 VARIABLE COSTS

Appendix D: Initial Literature Queries

Topic ***Database***	**Search query**	**Initial results**	**Articles read**	**Selected articles**	**Selected articles by snowballing**
Business models *Scopus*	TITLE(“business model*”) Subject Area:: business, and economics Exclude 2014,2013,2012 Limit to citations > 30 TITLE(“business model*”) Subject Area:: business, and economics Limit to 2014,2013,2012 Limit to citations > 3	62 44	11	5	
Pricing strategy *Scopus*	TITLE(pric*) AND TITLE-ABS-KEY(strateg* AND (compan* OR industr* or business* OR management)) Subject Area:: business, and economics Limit to citations > 30	98	15	4	1
Rural electrification *Scopus*	TITLE-ABS-KEY(rural electrification AND (decentrali?* OR off-grid OR micro-grid* OR village-grid* or mini-grid)) AND NOT TITLE(case study) Exclude 2014,2013,2012 Limit to citations > 10 TITLE-ABS-KEY(rural electrification AND (decentrali?* OR off-grid OR micro-grid* OR village-grid* or mini-grid) AND NOT TITLE(case study) Limit to 2014,2013,2012 Limit to citations > 0	60 37	38	16	9
Rural electrification and business/revenue models *Scopus*	TITLE-ABS-KEY(rural electrification AND (decentrali?* OR off-grid OR micro-grid* OR village-grid* or mini-grid) AND ((business model*) OR (revenue AND (structure* OR model*))))	18	9	4	1
Rural electrification case studies *Scopus*	TITLE-ABS-KEY(rural electrification) AND TITLE(case study)	68	15	5	1
Other				11	