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Adapting Organizational Models for Tanzania's Rural Communities

An exploration of meeting Tanzania's rural communities energy needs with community energy projects.

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Jesse Eckert, May 25th, 2010.

Abstract

There is a growing interest in the prospects of community energy projects to increase energy access for the world's poor. Yet it is not readily apparent how community energy projects can be organized to be successful in the long-term. By utilizing information from four case studies, this work creates a general framework for organizing community energy projects in developing countries. Using this framework, it then explores how community energy projects could be designed for Tanzania, a country that has been identified as potentially benefiting from a community energy approach to stimulate its low rural electrification rates. Results show that Tanzania could potentially benefit from supporting a broad scale community energy program given its current institutional framework, and communities could be the most appropriate body to manage the projects. However, results also show that there are a number of barriers facing the implementation of such a program. In order to overcome these challenges, this work argues that a network of actors, who can provide services to the communities, must be built up throughout the country.

Key words: rural communities, community energy projects, organizational models, Tanzania, rural electrification.

Executive Summary

There are approximately 2.8 billion people living in the world who have limited access to electricity and modern energy. A significant proportion of this group lives in Africa, and specifically East Africa. Although there have been efforts to increase electricity services to these people by trying to emulate the successes of America's rural electrification programs and through structural adjustments, the majority of rural people still remain without electricity in their homes. Tanzania, one of the countries that make up East Africa, has managed to electrify just two percent of rural people's homes. Because electricity access brings social, environmental, educational, health, and economic benefits to rural communities, there is a need to find alternative ways to increase rural electrification rates, because a centralized approach has not worked for the rural poor. A number of researchers have called for greater involvement by rural communities themselves, as a means to stimulate and improve rural electrification rates in developing countries, and in Tanzania specifically. However, to date, there is little information in the literature that shows how community energy projects can be organized.

Purpose

Driven by the following research problem - **there is a lack of effective and timely strategies to address low electrification rates in rural areas in Tanzania** - the aim of this thesis is to help improve rural electrification rates in rural Tanzania, and potentially other developing countries. The research objective of this thesis is to contribute to an increased knowledge on alternative organizational models for rural electrification.

Research Questions and Objectives

Two research questions have been posed in order to address the research problem.

Research question one

"How can organizational models, with strong links to communities, be designed to increase access to modern energy services?"

Research question two

"How could these models be adapted and implemented in Tanzania?

Methodology

The research was conducted between January and May 2010. The research problem sets the scope of the research, as it is focused on community electrification projects in rural areas in developing countries. The research has been undertaken using an interdisciplinary approach, utilizing a literature review and interviews with a variety of stakeholders in Tanzania. The research was undertaken to build a framework for organizing community energy projects, and develop models for Tanzania specifically.

Analysis

Two forms of analysis were applied during the different stages of the paper. The first analysis was undertaken with the four case studies from India, Nepal, Indonesia, and Bangladesh. By presenting the case studies' organizational models, that depict the actors and their respective tasks in a project cycle, the analysis identified similarities and differences between the case studies in order to outline a general framework for organizing community energy projects. This set the stage for the second analysis, which uses data collected from the interviews to identify challenges and opportunities for implementing community energy models in Tanzania on a large-scale.

Research Findings

Research question one

The findings for research question one, which asks how community energy projects can be organized, are summarized in the table below. As is shown in the table, communities are able to take responsibility for a number of key tasks, however, this depends on support from an outside organizations. It also appears that the coordination and involvement of many different actors, such as banks, rural energy service companies, non-governmental organizations, government departments, and international organizations, may be required to initiate and support a community energy project. It was also shown from the four case studies that governmental policy can be instrumental to the success of community energy projects. Examples of these policies include: decentralization of decision making for energy, setting targets for rural electrification, reducing administrative barriers, as well as offering subsidies for small scale projects.

These case studies are of interest to the author, and other people interested in community energy projects, because they can be learned from, and hopefully adapted and re-created elsewhere. Although the success of community energy projects has been demonstrated by the case studies, there were a number of bottlenecks that were identified from the research, which would limit the ability of the projects to be scaled up or replicated elsewhere. The bottlenecks identified by the study are as follows: funding, organizational capacity, availability of renewable energy service companies and non-governmental organizations, and technological and policy barriers.

General framework for organizing community energy projects.

Project Cycle	**Findings**
Project initiation	The communities should show interest in undertaking a community project, and then an external organization should help initiate the project process.
Capacity building	Is key to ensuring the community is capable of taking a large role in the rural energy project, however, it does not appear that communities are capable of undertaking this task themselves, therefore, an outside organization is needed. NGOs may be better suited to undertake this task as they may be familiar with the communities, but if they are not available a regional government body could take responsibility for capacity building.
Project planning	Communities should undertake project planning because their local input is important for the process in order to make it reflective of community needs,

	however, they must be supported by an outside organization to do this.
Construction	Community involvement in construction can help reduce project costs, and can undertake basic aspects of construction, such as preparing land, or digging trenches, but a RESCO or similar organization is needed for the complicated aspects of the installation of equipment.
Capital costs	Capital cost will most likely come from a mix of sources: governments, banks, communities, international organizations. Communities can usually contribute land, labor, and materials. The private sector was not present in any of the four cases.
Operation and maintenance costs	Although it can be difficult for the community to set tariff rates to cover operation and maintenance costs, as well as depreciation costs, communities must take full responsibility to cover these costs, unless an organization is willing to support the operation and maintenance costs in the long-term.
Continuing support and monitoring	Is key to build trust with the community and increase transparency, and this can be undertaken to some degree by the community themselves, but financial audits should be undertaken by an outside organization. Local governments may be in the best position to offer long-term support because they will maintain a presence in the area.
Management	It is evident that communities are capable of managing the project themselves, but capacity building is needed in order for this to occur. Managing the electricity projects can bring benefits, such as local jobs, a sense of local ownership, increased collection rates, and local input into decision making.
Legal ownership	Legal ownership does not necessarily have to reside with the community, but it could be appropriate in the case that the implementing body (government or international organization), does plan to maintain contact with the community in the long-term. This would place full responsibility on the community to ensure the continued operation of the plant.

Research question two

Based on interviews and background research, it appears that communities should be more involved in rural energy delivery because it does not appear that the private sector, nor the government in Tanzania, are going to ensure that they have access to modern energy. Findings reveal that there are opportunities for community energy projects to be undertaken in Tanzania. Some of the opportunities that were highlighted during the research include, a strong interest by communities, possible funding from Tanzania's Rural Energy Agency, skills and resources held by the government utility company, community based organizations, and non-governmental organizations. Two models are presented by the author that builds on these strengths. The first model is called the "Business as Usual" model and it shows how community energy projects could be organized in Tanzania under the current rural energy framework. However, in order to build a more effective community energy program, a second model is proposed, the "Building Energy Regions" model, and it takes a different approach from the previous model by including regional level governments as a major actor. However, based on discussions with the stakeholders, a number of barriers facing the implementation of community energy projects were identified which place limitations on the ability of the models to be implemented and scaled up. For the "Building Energy Regions" model specifically, a lack of regional government involvement and responsibility for rural energy delivery would be a major barrier. For both models, a lack of staff, funding, and responsibility at the Rural

Energy Agency would also be significant barriers. Also, because community energy projects are highly dependent on NGOs as well as Rural Energy Service Companies, their availability and interests is also shown to be a potential bottleneck for scaling-up the programs. Furthermore, the research has also supported previous findings, that there is lack of coordination between the actors involved in rural energy delivery, which would be debilitating for a large scale program. In order to implement the models, specifically the "Building Energy Regions" model, a number of recommendations are given to create a national network to support community energy projects.

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Abbreviations

ADBN: Agriculture Development Bank

GNESD: Global Network For Sustainable Development

CBO: Community Based Organization

CO: Community Organization

DDC: District Development Committee

DTI: U.K. Department of Trade and Industry

IPPs: Independent Power Producers

LMC: Local Management Committees

MHFG: Micro Hydro Functional Group

MNES: Ministry of Non-conventional Energy Sources

NRECA: National Rural Electric Cooperative Association

PBS: Palli Bidyut Samities

PLD: Village Based Electricity Management Units

REA: Rural Energy Agency

RESCO: Rural Energy Service Company

RESM: Rural Electricity Scheme Management

SNV: Dutch Development Organization

TATEDO: Traditional Energy Development and Environment Organization

TANESCO: Tanzania Electricity Supply Company

VDC: Village Development Committee

WBREDA: West Bengal Renewable Energy Development Agency

1 The opportunity for community energy in Africa

There are approximately 2.8 billion people living in the world who earn less than USD two dollars a day. This group is referred to as the worlds "poor" by international organizations such as UNDP, World Bank, UNEP, and the IEA. One of the key defining characteristics of the world's poor is their limited access to electricity and modern fuels. According to a Global Network for Sustainable Development (GNESD) study, this population faces three key energy challenges. Firstly, they are heavily dependent on traditional biofuels such as wood and charcoal that have negative implications to human health and the environment. Secondly, they have inadequate access to modern energy services, which can be used for productive purposes. Lastly, they have low incomes, and limited access to appropriate financing schemes, limiting their ability to purchase cleaner and sustainable energy services (Kareksezi, Kimani, Mutiga, & Amenya, 2004).

A large proportion of the world's poor live in Sub-Saharan Africa, approximately 547 million people, and a significant portion of these live in East Africa (Wamukonya, 2007). Energy use in East Africa has remained fairly static over the last century. Income levels have remained low, populations have continued to increase, and economies have continued to depend on primary products for export. Rural peoples in East Africa rely heavily on biomass to meet their energy needs, and electricity access is mainly experienced by high and middle income groups in urban areas, as well as commercial and industrial sectors (Murphy, 2001). The poor, who are in the majority, live in rural areas and have limited access to electricity. This polarization between urban and rural areas is shown in Figure 1-1, where urban areas experience rates between 10 percent and 100 percent, while rural areas in East Africa have less than five percent access (Ilskog, 2008).

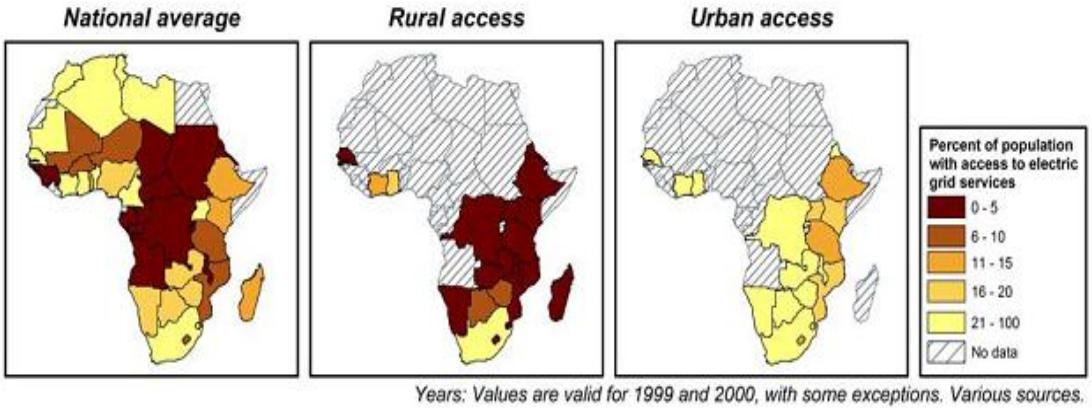

Figure 1-1: Access to Electric Grid Services in Africa (Ilskog, 2008)

East Africa's proportion of electricity supply compared to the whole African continent is almost insignificant. It contributes two percent of the total installed capacity, while North and

South Africa contribute 83 percent, and the rest contributes 15 percent (Karekezi, Kimani, Mutiga, & Susan, 2004). Subsequently, electricity consumption patterns per-capita in East Africa also appear to be comparatively low when compared to other low and middle income regions the world, as shown in Table 1-1.

Region	Annual Electricity Consumption per capita (kWh) – 2000
Latin America and the Caribbean	1,528
East Asia and the Pacific	760
South Asia	323
Sub-Saharan Africa[9]	432
Eastern Africa	60

Table 1-1: Electricity consumption per capita for developing regions of the world

Source: (Karekezi et al., 2004)

Up until recently, most of the electricity industry in East Africa has been run by state owned utilities. This "monopoly" has been accused of being a large contributor to the poor performance of the utilities in the past. They have been characterized as being unreliable, having low technical and managerial capacity, lacking accountability, having few incentives for workers to perform, and being corrupt (Karekezi et al., 2004; LOFTUS, 2009). They have also been unable to develop and expand the sector because of their inability to mobilize funds and collect revenues expediently from consumers (Karekezi et al., 2004).

Because of their poor performance, government utility companies in Africa have undergone structural reforms in order to improve operations and increase electricity production and access. Compared to other regions in the world, power sector reforms in Africa have been slow. They have mostly taken the form of introducing independent power producers into the energy market in the hopes that they will meet the shortfalls in electricity generation, however, the expected gains have not been achieved by many countries in the region (Wamukonya, 2003).

Tanzania is one of the East African countries that has been put under pressure by large organizations such as the World Bank to undertake power sector reforms because of the poor performance of the national utility company named TANESCO. Over the last two decades, electrification rates in the country have remained around 2 percent in rural areas where the majority of the population lives ("MEM," 2010). With the creation of the newly formed Rural Energy Agency, there is hope that rural peoples will benefit from an increase in personnel and funding to help meet their energy needs.

In a research project that is currently being undertaken by the GNESD, "participation of the poor in electrification initiatives" is one of the five key policy recommendations that the study presented in its initial research findings ("GNESD," 2010). There are a number of examples in developing countries where rural energy projects, that have incorporated a high level of community involvement, have overcome some of the major barriers facing rural energy delivery (Dauselt, 2001; Ilskog, 2008; Kirubi, Jacobson, Kammen, & Mills, 2009; G Walker, 2008; Gordon Walker, Patrick Devine-Wright, Hunter, High, & Evans, 2009). Furthermore, in regards to Tanzania specifically, two studies undertaken in rural areas have shown that community involvement in rural electrification initiatives has the potential to stimulate and improve electrification rates for rural communities in the country (Ilskog, Kjellström, Gullberg, Katyega, & Chambala, 2005; Kirubi et al., 2009).

1.1 Research problem and research questions

Although research studies have shown that community participation in rural energy projects can help increase electrification rates, there is limited information in the literature describing how rural energy projects can be organized to have a high level of community participation, and still be viable in the long-term (Ram M. Shrestha, Kumar, Martin, & Srinivasan, 2006)

Driven by the following research problem**- there is a lack of effective and timely strategies to address low electrification rates in rural areas in Tanzania –** the aim of this thesis is to help improve rural electrification rates in rural Tanzania, and potentially other developing countries. This cannot be achieved by this thesis alone, but will require the contribution of many other works. The research objective of this thesis is to contribute to an increased knowledge on alternative organizational models for rural electrification.

The scope of the research is focused on identifying operational models for community involvement in Tanzania specifically. From the research objectives and scope, the following research question and sub-questions are derived:

Research Question (RQ1)

"How can organizational models, with strong links to communities, be designed to increase access to modern energy services?"

Research Question (RQ2)

"How could these models be adapted and implemented in Tanzania?

Sub-Questions:

- How is a community, and community energy project defined?

- How can rural energy projects be financed?
- How have community energy projects been organized in developing countries in the past, and what commonalities do they share?
- What is the current regulatory and policy framework for rural energy in Tanzania?
- What components are currently in-place, and which are missing, in order to better support organizational models that emphasize community involvement in Tanzania?

In order to answer the two main research questions, three research objectives were set to guide the research process, and they are as follows:

1. Define key terms and build a basic background relating to community energy projects.
2. Identify case studies and organizational models for community energy projects and analyze for similarities to build a basic framework for designing community energy projects.
3. Present organizational models to stakeholders in Tanzania, and then create appropriate models based on responses and background research.

1.2 Research approach and methodology

In order to answer the research questions, research conducted for this thesis has been undertaken using an interdisciplinary approach. Data was collected from a variety of sources, using both qualitative and quantitative methodologies, because information on community energy projects, both outside and within Tanzania, is scattered among various literature sources, Internet sources, or not documented at all. For this reason, the study depends on interviews from a variety of stakeholders to obtain primary data about Tanzania. A variety of stakeholders was also sought in order to bring a more balanced perspective from government departments, NGOs, and community members living in rural areas. This also allowed for a triangulation of information, to cross check information that was obtained from the various sources.

Organizational models will be utilized throughout the paper in order to help present and compare community energy projects in order to help make suggestions for how Tanzania could organize its own community energy program. The organizational models present the key actors, and their respective duties during the project cycle of a rural energy program. Therefore, for this thesis, an organization model will be defined as "a description of the main actors and duties that are undertaken in order to implement a given project".

The literature review and field work was conducted between January and April, 2010. The research was broken down into different stages so that the research could be adaptive

throughout the process, as information gathered in the earlier stages would inform decisions taken in later stages. This was especially true for the field work, which had to retain a degree of flexibility, as new information and opportunities arose, guiding the research. The four step process is depicted below in Figure 1-2:

Stage 1: Literature Review

Methods applied	**Activities**
Literature review	Review literature that discusses the issues and key definitions in regards to community energy projects
	Identify organizational models of various community energy projects in developing countries. Identify models to present to stakeholders in Tanzania.

Stage 2: Stakeholder Identification and Research Support for Field Work

Methods applied	**Activities**
Literature review Internet research	Build local support for the research and identify appropriate stakeholders.
	Explore and identify appropriate communities to undertake research in.

Stage 3: Field Work in Tanzania

Methods applied	**Activities**
Interviews Workshops Informal discussions Field visits	Collect primary data from interviews, workshops, and informal discussions with various stakeholders from key organizations in Tanzania's energy sector, such as government departments, NGOs, religious organizations, the national utility company, communities, and the private sector. Collect Secondary data from various organizations when visiting as it is not often available in electronic form. Undertake field visits in Chole Village on Mafia Island, and Mavanga Community in the Iringa region.

Stage 4: Analysis and Recommendations

Methods applied	**Activities**

Comparative analysis of organizational models	Case studies' organizational models are presented and analyzed for similarities to build a general framework for designing community energy projects.
	Organizational models are presented to stakeholders and challenges and opportunities for model implementation are identified.
	Based on challenges and opportunities, scenarios are presented and recommendations are given to implement the models.
	Final recommendations are given for future research

Figure 1-2: Four step process for research methodology

1.3 Scope and limitations

The literature review is focused on rural areas in developing countries, however, in the theoretical background when reviewing definitions of "community" and "community energy", examples are also taken from developed countries due to the limited information available. Also, the case studies were taken from a variety of developing countries, because information on community energy projects in academic literature is rare, especially for East Africa and Tanzania. In terms of the technology discussed, there was no restrictions placed at the outset of the paper, however, much of the examples revolve around electrification, and the use of renewables.

The field work component took place solely in Tanzania. Because of time and budget restrictions, the field work was limited to two rural communities, and interviews were conducted with a small sample of stakeholders involved in rural energy delivery. Field work was focused on assessing the feasibility of implementing the organizational models in Tanzania, as well as learning from the experience of current community energy projects in the country. The study does not discuss in great detail the causes of poor electrification rates in Tanzania, nor does it address other solutions to increase electrification rates.

Finally, the limitations of the author should be mentioned. The author does not speak Swahili nor does the author come from a developing country. However, steps were taken to limit this bias, by depending on literature reviews and interviews to collect information

1.3.1 Literature review

The literature review was conducted between January and April, 2010. A variety of articles, websites, government publications, development reports, and unpublished studies were utilized. These documents are from both developed and developing countries. Most of the initial information was found by searching journals, using search words "community ownership", "community energy", "local energy", and "distributed energy", with different variations including the words "renewable", "Africa", "micro-grid", "developing" and "Tanzania".

Few academic documents were found specifically dealing with the topic of organizing community energy projects in developing countries, although a number of documents did discuss these issues as complimentary topics to their main research goals. Most relevant literature was found in development organizations reports, policy documents, academic articles, and government websites. The literature review was used to offer background information, clarify key terms and concepts, as well as gather information about the four case studies.

The case studies were chosen based on the following criteria: variation of organizational models, scale of the programs, and availability of information. Presenting a diversity of models is important because rural energy programs have to be adaptive to local conditions, so understanding how different models can be successful under varied circumstances is valuable to the research. In terms of size, small scale electrification programs may offer some useful information as pilot studies, but their applicability to broad scale programs is limited, so cases with large scale programs were preferred.

1.3.2 Stakeholder identification and research support

Stakeholders for this thesis are defined as a person or group who have a vested interest in a particular project, activity, or issue because they are involved in it or affected by it (Park, 2007). Relevant stakeholders for rural energy in Tanzania were identified using literature searches, as well as through discussions with stakeholders (snowballing), and other experienced researchers. Stakeholders identified include: governmental departments, utility companies, Community Based Organizations (CBOs), private companies or Independent Power Producers (IPPs), rural communities, and international organizations. Contacts were made within these groups in order to gain a variety of perspectives, on-the-ground support for the research, gain access to information and people, and organize meetings, that are key components of field work.

Aside from Chole Community, all of the organizations were chosen because they are directly involved in energy delivery in rural areas in Tanzania. The communities were chosen based on their suitability for the purpose of research, such as having no access to electricity, or having a community energy project in place. Also, practical considerations were taken into account, such as accessibility during the rainy season.

1.3.3 Qualitative interviews, workshops and document collection

Multiple interview styles were utilized during the field work in order to collect data. Stakeholders from Tanzania Electricity Supply Company (TANESCO), Tanzania Traditional Energy Development and Environment Organization (TATEDO), Rural Energy Agency (REA), Chole Community and Mavanga Electricity Committee, participated in standard open-ended interviews, meaning the interviews were structured by a set of well-defined questions that were typically asked in a specific order (Marshall & Rossman, 2006). In this case, the interviewees were presented with 2-3 organizational models, a community energy model, a

government energy model, and the third was a public private model that incorporates a new financing scheme called the "Renewable Premium Tariff", that will be discussed in more detail in chapter three. The communities were not presented with the government energy model because their role in the model was limited. The main goals of these interviews were to find out which organizational models for rural electrification programs are appropriate for the Tanzanian context, and to get respondents perspective on their potential role in the scenarios, and as well as the roles of other stakeholders. Also, the respondents were asked to make suggestions to improve the organizational models, and questions were asked to gage their organizations support of community participation in energy projects.

With support of the Community Development Office on Mafia Island and a UNDP volunteer, a workshop was organized with twenty community members in the village of Chole on the 31st of March, 2010. The meeting was organized because the community did not have electricity, and after my discussions with the local utility company, it was clear that there were no plans to extend the grid to the island community. The community was asked a number of questions to get background information about the communities, assess their interests in having electricity, and they were also presented with two organizational models for their feedback.

With the support of the Roman Catholic Diocese of Njombe, a workshop with eight members of the Community Electricity Management Committee in Mavanga was held on April 8th, 2010. Because the community has been managing a micro-hydro project for the last seven years, the workshop was organized in order learn from their experiences, and to also get their input about two organizational models that were presented to them.

A number of informal interviews also took place with various organizations such as the Roman Catholic Church of Njombe, The Dutch NGO SNV, as well as an IPP called Enviro-Care, and other staff members of TANESCO.

1.3.4 Analysis

Two forms of analysis were applied at the different stages of the paper, and depend heavily on the use of organizational models. The first analysis was undertaken using four case studies from India, Nepal, Indonesia, and Bangladesh. By presenting the case studies' organizational models, that depict the actors and their respective tasks in a project cycle, the analysis was able to identify similarities and differences between the case studies throughout their project cycles. With this information, a general framework on how to organize community energy projects with the various actors that are involved, was outlined.

This set the stage for the second analysis, where a sample of the organizational models were presented to various stakeholder in Tanzania. Based on data that was collected from interviews, aspects of the organizational models that were identified as "present", uncertain", or "missing" in Tanzania were shown. This helped to identify the challenges and opportunities for implementing the models in Tanzania, and later develop two organizational models that would better reflect the realities of Tanzania's rural energy sector

2 Literature Review: Community Energy - History and Theoretical Background

This purpose of this section is to present a brief historical context for community energy projects, and develop a common understanding of the key definitions and concepts relating to community energy that will be discussed throughout the paper. In order to achieve this, the first section presents a brief overview of the history of the cooperative approach to rural electrification in the United States, and how this experience did not translate well to the African context. Then, in order to define key terms, the next section discusses what has been written about communities, and community energy, in relation rural energy programs. Following this, a discussion of what has been written about the benefits of, and barriers to, community energy will be presented.

2.1 Understanding how the success of rural electrification in the U.S was not replicated in Africa

Community led energy projects are not a new phenomenon, and have a diverse history in both developed and developing countries. They are often initiated when the prospects of grid connection from government or private sector initiatives seem bleak, since the extension of conventional grid service is often beyond the financial capacity of governments (Kankam & Boon, 2009). One of the earliest and more influential examples of this occurring was in the United States. During the 1930's, nine out of ten rural towns in the country were without electrical services. The unavailability of electricity in rural areas meant that the main economies revolved around agriculture because it was difficult for factories and businesses to set up in rural areas because they did not have access to electricity, so they preferred to operate in urban areas. Power companies only expanded into rural areas where they were guaranteed profits from the beginning of operations (NRECA, 2010). American farmers lost patience, and were tired of waiting for electrical services that were enjoyed by the urban counterparts. They organized among themselves and built and managed their own distribution lines. Under this cooperative model the electricity was purchased in bulk by the federal power supply agencies or private power companies (Greacen, C, E. 2004). The cooperatives were supported by long-term low interest loans offered by the Rural Electrification Administration, and by 1953 more than 90 percent of U.S. farms had been electrified (NRECA, 2010).

Clearly the American experience was successful, and one could understand why some African governments have attempted similar electrification models in the hopes of developing as fast and as successfully as the U.S. These African countries were highly influenced by the centralized grid-based approach of the American model, and did not focus on the rural cooperative component. The belief that electrification would bring development was partially attributed to post-WWII development economics, which believed the availability of abundant and cheap electricity was a pre-condition for industrialization. It was thought that electricity would create its own demand, and subsequently industrialization would follow (Hirschman, 1970). However, according to Kirubi et al., (2009) major barriers that are due to the prevailing

characteristics of rural populations in African countries, were overlooked when trying to replicate the U.S. model. These defining characteristics include: limited financial resources to make investments, poor access to funds, remoteness and dispersed populations, low demand for electricity, cyclical incomes, and uncertainty over land rights issues. As a result of these demand side constraints, an increase in electricity demand did not follow after electrification. These factors, coupled with the fact that African utility companies often performed poorly, caused rural electrification projects to be plagued with prohibitive administration costs, power losses, and high operational costs (Karekezi et al., 2004). This has led rural electrification programs to be considered a low priority for utility companies, and the low earning potential has, for the most part, made rural energy projects uninteresting for private investors. Under this model, electrical access was mostly experienced by the wealthy, and it was not enough to spur rural development. Therefore, Kirubi et al. (2009) believes this "American style" path to rural development has not succeeded in Africa.

It is unclear if the cooperative approach, had it been given more emphasis by African Governments, would have worked, but it is clear that an alternative to centralized grid-based rural electrification is needed. As stated previously, a number of studies, as well rural energy programs currently in-place, have demonstrated the potential for communities to be involved in project planning, implementation, and management of rural energy programs, in order to stimulate rural electrification and increase the programs long-term sustainability (Syngellakis, Tayler, & Draeck, 2007).

2.2 Defining community

The term "community" will be used throughout this paper, and it is important to understand the different meanings it might have, because people have different interpretations of what it means (Walker & Devine-Wright, 2008). There are various definitions of a community, that cover the natural world, people, and even cyberspace. According to Websters Dictionary, the definition of community is as follows:

"The organization and system created by persons or groups of individuals or countries, variable in size and extent, that bring together common interests, values, or problems, outlooks and aspirations; examples: neighborhood **community**, religious **community**, rural **community**, and European **community**." (Websters, 2010).

From this definition a rural village could be considered a community, however, based on this definition, the people considered apart of this "community" could also be apart of other communities as well. This also means that people who do not live in the village could have "community" ties with people who live in the village, if they shared common interests or values with people from within the village. When considering energy projects, one could see how this definition could leave the definition of "community" to be fairly flexible, and the flexibility of this term is not without its problems. For example, in the U.K., the installation of wind turbines on 3 farmers' properties faced protests because the project was labeled a "community project". The protesters felt that no one other than the farmers benefited, and so

this label was misleading from their perspective (Walker & Devine-Wright, 2008). In a report produced for the U.K. Department of Trade and Industry (DTI) by the Center of Sustainable Energy, two further distinctions of the term "community" are made that can help clarify this issue. The terms "communities of locality" and "communities of interest" were created to distinguish between geographical and personal communities (DTI, 2006). Communities of locality are defined by a communities close proximity to each other, while the latter describes a group of people who have a common interest, such as a group of investors in a renewable energy project. This begs one to ask what can be considered a community energy project?

2.3 Defining community energy projects

When discussing the important characteristics of community energy projects, a study performed in the U.K. showed that there were two common dimensions held by activists, local residents, policy makers, project participants, and administrators. The two themes are a *process* dimension, that is concerned with who the project is run by, who is involved, and who has influence over the process. The other dimension is *outcome*, who benefits from the project, socially or economically (G. Walker & Devine-Wright, 2008). The two dimensions have been placed on a chart as shown in Figure 3-1. Furthermore, different interpretations of the term "community renewables" were derived from interviews with the various stakeholders, each having a different interpretation as to where a project should be positioned on the graph in order to be properly labeled a community project.

If a respondent fell within the viewpoint (A), they were more concerned with the process dimension, and believe that communities need to be heavily involved in a projects planning, construction, and even management. Also, some of these respondents showed a strong support for the principals of empowerment, participation, and capacity building. Respondents who fell under group (B), were less concerned with process but rather the outcome of a project. This meant that a local organization could be the instigator and project manager, as long as the project benefited the community. These benefits could come in the form of jobs, educational opportunities and so on. The last viewpoint group (C), covers a larger space of definition, and is open to various interpretations of what can be considered a community project. Respondents in this group were less concerned with the actual characteristics of a project, but were more concerned with the fact that a project would take place, and it would lead to something beneficial (Walker & Devine-Wright, 2008).

To demonstrate how the figure works, a utility wind farm has been placed on the lower left corner because it has little community benefits, and was developed by entities outside of the community of locality. In this example, the project process nor the outcome is locally focused. In the upper right corner, an "ideal" community project could be placed, one that is carried out by local people and benefits local people. An example could be a community heating project for a community hall, where the project coordination is done by a community committee, the installations are down by local trades people, and the heating benefits are enjoyed by all who come to the hall.

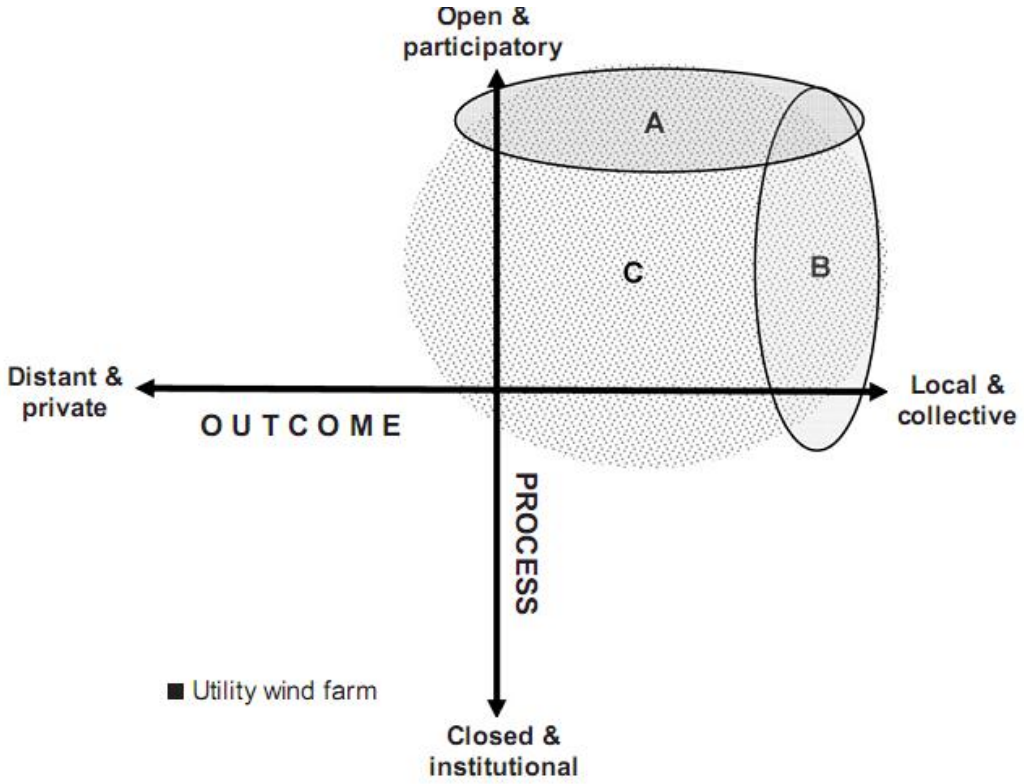

Figure 2-1: Understanding of community renewable energy projects in relation to process and outcome dimensions. Projects placed in the upper right corner have a high level of community participation and local benefit. Source: (Walker & Devine-Wright, 2008)

Understandably, there is certain amount of flexibility that is needed when attempting to define a community or a community energy project. This also means that the organizational form that these projects take on, are also diverse in character. Energy projects can be owned entirely by a community under a cooperative association, which are not-for-profit organizations that aim to serve its members. Co-op members vote for a board of directors, and the board makes the management decisions (Moner-Girona, 2009). Energy could also be produced and distributed by a Community Based Organization (CBO), such as a religious organization, and these organizations are usually composed of a steering committee or an executive committee, working under various by-laws that are set up by in collaboration with the government. Community Charities, usually take on the form of an association with charitable status, and they provide or run facilities for the local community (G Walker, 2008). For example, as in the case with Mawengi village, the Roman Catholic Diocese wanted to give control of their micro-hydro project to the village community, so they founded they facilitated the formation of the LUMAMA Electricity Association to manage the energy project (personal communication, 2010).

Because the focus of this paper is aimed at exploring how rural electrification rates can be improved by utilizing an approach with community involvement, when considering the parameters of process and outcome as shown in Figure 2-1, a project will be considered a community energy project when it falls within Group C. Therefore, it must both benefit the community of local, such as a village, and involve the users in the process. There will be no restrictions placed on how high or low a communities' involvement must be, as long as it at minimum has had some form of involvement in decision making. The key is that the community has a sense of involvement and ownership over the project, so the project must be planned and implemented in a way that this is achieved.

2.4 Identifying the benefits of community participation

As discussed, community participation in rural energy supply has the potential to increase rural electrification rates. However, it is not always clear how this should take place. It has been argued by Holland et al. (2001), that electrical supply systems should be owned by the people who have the highest stake in its success. For example, if the government had its administration offices in a large town or city, then they might be in the best position to run the electrical system. However, if this town was also connected to the grid, and energy could be sold to the grid, then it could also make sense for private companies to get involved. Private ownership might also be the most appropriate choice when industries that require large amounts of energy operate in town, such as steel mills, grain mills, and textiles factories, and access power can be sold to neighboring communities. Because it is difficult to attract private investment for small and isolated communities, in this case, community ownership or individual ownership could be the most appropriate option (Holland et al., 2001). It is important to mention that there are notable differences between developed and developing countries in regards to when and how community energy projects could be undertaken. It is apparent that community based models are less likely to take hold in developed countries because of the high rates of electricity access, which reduces the incentive to undertake a community project to meet a communities energy needs. However, the reasoning to undertake a project of this nature in a developed country could be for many reasons, such as strengthening community relationships, environmental concerns, or decreasing dependency on government or private services.

The benefits of community ownership can vary depending on the ownership model is adopted, and who's perspective is taken into account. For example, if a community is defined by locality as discussed by the DTI, then investments in shared ownership by people who live outside of a community would be seen as beneficial to the investors. However, the locals who could not afford to make investments would not benefit in this situation. On the other hand, if a Community Charity or Cooperative model was used, it is likely that most people in the community would benefit one way or another. As Walker (2008) writes, different community models can be either inclusive or exclusive, having differentiated benefits for the various stakeholders involved.

In a more general sense, according to Walker (2008), there are a number of benefits that can be accrued for the various stakeholders involved in community power generation. The benefits include generating local income from the selling of power, returns on investments, and the creation of employment. By involving the community and engaging them throughout the process, Walker goes on to say that there is the added benefit that a project may have local support, be responsive to community needs, and will experience less barriers when attempting to get the appropriate planning permission. For the benefit of the community, it means that they will also have more local control over the energy project, and decide where infrastructure will be located and its size (Dunning and Turner, 2005). Community involvement in distributed energy projects, when taking into the costs of grid extension, can also mean that energy can be produced and purchased at a cheaper rate if grants can be obtained for upfront costs, the owner can operate on a non-profit basis, and communities can donate land and/or labor (Snigdha Chakrabarti & Subhendu Chakrabarti, 2002). Initiating community projects can also cut down the long waiting times to receive electricity, especially in East Africa, that could be many years away.

There is also an educational benefits accrued when community energy projects are undertaken. Communities can be educated about environmental issues, specifically how their lifestyles connect with the creation of air pollution, and perhaps climate change. They can also learn how to operate and maintain equipment, and learn about participatory approaches to dealing with group issues and projects. When communities undertake projects together, social capital is developed, not only tying the communities together, but also building a sense of pride (Chaurey, Ranganathan, & Mohanty, 2004).

2.5 Barriers and success factors for establishing community projects.

Although the benefit of community involvement is apparent, these benefits are not easily achieved as a number of barriers make it difficult for communities, or other implementing organizations, to undertake these projects. Prior to installation and operation, a number of major details must be discussed within the community and agreed upon. This includes the ownership model, the legal conditions under which the entity will operate, and establishing sustainable programs, both financially and technically (G Walker, 2008). Throughout the process, it has been shown that it is important that communities have access to outside support, and highly trained staff, within a reasonable time frame. When supporting agencies or groups do not have strong incentives to support community power initiatives, than there will be large challenges facing communities, as many communities will not have the local capacity to implement, maintain, and support these ventures (Ilskog et al., 2005). In the case of co-operatives, it is important to have a managing committee that can oversee the day-to-day operations, and meet the formal requirements of cooperative ownership, such as holding regular meetings and creating annual reports, and making transparent decisions. Also, as hinted above, the success of community ownership will be highly dependent on receiving initial financial support for capital costs, and or initial problems with recovering operational costs (Ilskog et al., 2005). Furthermore, community initiatives are also susceptible to being

undermined by local politics, leading to decisions being made that have a biased towards personal motives or group motives that may not uphold the long-term interests of the users.

In order to compare local participation versus centralized approaches, and present further points that were not brought up in discussion, a summary of the pros and cons of centralized and decentralized ownership and management of rural power supply is presented in Table 2-1.

Table 2-1: Pros and cons of centralized and decentralized ownership and management of rural power supply.

Pros	*Cons*
Centralized Management of Grid	
Financial risk on utility Management capacity already exists Technical capacity already exists	No stake in power supply, so lack of interests to maintain Operation and Maintenance staff brought from outside the community Bureaucratic management Repairs take longer because they must be approved by central government Tariff collection is expensive No load management Disputes between utility and community possible.
Decentralized Management (community-owned stand-alone scheme)	
Interests in continual operation of scheme load management possible Flexible tariffs possible Repairs made quickley Less bereaucracy Local person employed as operator Local people provide labor, reducing initial capital required for scheme.	Financial risk placed on community. Technical training required Management training required Outside assistance required for major repairs (costly) Local disputes possible if management breaks down.

Source: (Anderson, 1999)

3 Financing Rural Energy Projects

Securing adequate financing is a major barrier to undertaking rural energy programs. With limited budgets, governments in developing countries are faced with the challenge of providing energy to dispersed populations with low energy requirements and purchasing power. In many cases, this results in conventional forms of energy delivery, such as grid extension, to be prohibitively expensive, leaving rural communities without the prospect of receiving access for many years in the future. Therefore, universal access to modern energy will never be achieved unless rural energy programs can secure financing and become economically sustainable in the long run. The following section will an overview of the challenges facing financing rural energy programs, and it will discuss some the optiosn to overcome these obstacles.

A focus will be given to renewables, because there is a growing interests in supporting renewable energy projects by international funding agencies and local governments because conventional energy projects are faced with increasing fuel prices, high operation and maintenance costs, as well as concerns over health and the environment (Moner-Girona, 2009). Even well funded utility companies, as discussed with a representative of TANESCO in Tanzania, are struggling to maintain their equipment and provide funding for their diesel powered micro-grids (personal communication, 2010). It appears that renewables will continue to gain a larger share of distributed rural energy projects, therefore, renewables will be a focus in the overview of financing for rural energy.

3.1 Challenges

There are a number of reasons why rural renewable energy projects specifically in Africa have had a hard time to attract significant investments. At a governmental level, there is a lack of policy and institutional support, as well as regulatory and operational uncertainties. Governments tend to focus on centralized energy projects using conventional energy, and have overlooked the potentials of RE and the energy needs of rural communities. Market related barriers are experienced due to a lack of market information and feasibility studies, resulting in an absence of project developers needed to implement projects. Technological and financial barriers are experience from the high initial capital costs needed compared to conventional energy projects, as well as the limited financing for RE research, development and manufacturing (Syngellakis et al., 2007)

When all of these barriers are factored into the equation, financing for these projects are usually considered high risk investments, and therefore have a poor reputation with the finance community. This has lead to higher requirements placed on investors and developers, further increasing the barriers. All of these barriers coupled with the large amounts of money needed to undertake project planning, purchase and install equipment, and train staff to operate and maintain equipment, has resulted in the realization of few rural renewable energy projects in East Africa (Syngellakis et al., 2007).

3.2 Risk assessment

In order to decide if a project can be financed, and to come up with the terms such as the financing amount, repayment terms, interest rate etc., a risk assessment must be undertaken by the financier. There are a number of risks categories that are explored, including: country risk, market risk, foreign exchange risk, project risk. Usually similar projects in the same region are looked at in order to come up with the risk level if there is not similar project then the risk level will be "uncertain". In this case, it is difficult to receive loans from commercial financiers without having a high interest rate or backing by an international organization to offer a guarantee for the loan (Syngellakis et al., 2007).

Before committing to finance a project, a number of aspects will be reviewed, including: the business plan, projected cash flows, reliability of the technology involved, creditworthiness of all parties involved, stability of the regulatory and policy environment, and other permits etc that are required to undertake the project.

Once the risks assessment has been made, a structure for risk sharing is agreed upon and the risks are priced and allocated among the major players. For example, governments in developing countries, often backed by international organizations, will have to take responsibility for risks that result from their own actions or lack of action, relating to policy or regulations etc. Risks that are outside of government control will have to be covered by insurance or other organizations.

If prospective financial organizations feel they will make a return on their investment, then they make a loan or invest in a project. The financial returns are accrued through either interest, that occurs in the case of loans, and dividends, when an equity investment is made. The higher the risks of the project, the higher the return must be in order to attract investors (Syngellakis et al., 2007).

3.3 Basic financing options

There are a number of forms of financing that were briefly discussed above. Debt financing requires that the lender take out a loan in order to offer financing for a project. In return they require a return on the amount loaned as well as the interests that they will be charge on this amount. This is a fairly common type of loan for development projects, because the interests made allows for the development funds to be replaced. For larger projects funders could include: international and national commercial banks, and multilateral development banks, and the International Finance Corporation, and these organizations could each take a part in financing a project in order to reduce their own risk. International organizations could offer "soft-loans", that have low interests rates and flexibility in the repayment time frames ("WB Treasury," 2010).

Equity investors provide capital for a project in return for a share in the projects earnings or the projects revenues, such as through shares, which can involve the right to join in on decision making processes in order to help secure the return on their investment. Because of

the higher risks associated with these types of investments, the expected return is fairly high, usually about two times that of debt financing. Possible funders for equity financing commonly include equity fund investors, venture capitalists, equipment suppliers, multilateral development banks, institutional banks and insurance companies, and individuals.

Grants are different from the other forms of financing in that they do not require repayment, but they may have specific terms of use, such as limitations on how the money can be spent and the time frame that it can be spent within. Often grants will be given by international organizations in order to promote environmental or development policies, and can be used to purchase equipment needed for a project. Funders will often be private organizations, however, grants can also come from development organizations such as the World Bank and the Global Environment Fund ("GEF," 2010).

Guarantees can also be offered by well funding organizations such as multilateral development banks and national development banks in order to offer security to investors and lenders who are financing in risky situations. For example the Multilateral Investment Guarantee Agency, will insure projects against losses that are related to political risks, such as breach of contract, expropriation, war and civil disturbance, makes lending more attractive to commercial lenders, while at the same time helps developing countries attract and retain investment ("MIGA," 2010).

3.4 Financing models

A majority of rural renewable energy financing programs are government-led. Governments can take on a number of different roles, and programs can involved a number of different market players, therefore, there are several government-led models that can be utilized to support rural electrification. This is shown in the case studies in section four, where central governments, state governments, and local governments, have provided funding and guidance for energy projects, covering: capital costs, training for both users and rural energy service companies (RESCOS), expanding productive uses of energy, operation and maintenance costs for a specified time period, etc. Although the programs had private sector involvement, they were highly dependent on government support in order to execute the programs.

Success stories for market-based models are hard to find, since the perceived risk of the projects as discussed previously is high. As such, there is a need to find ways to reduce the dependency on the government to support rural renewable energy projects, and find ways that they can become a part of conventional economic activity. There needs to be support for models that make electrification affordable and payment plans flexible enough to meet users economic situations. Since many rural inhabitants are low income earners, are not able to safe large amounts of capital, payments plans must be over long periods of time.

One way of facilitating a longer payback period is the consumer finance approach. This requires an initial down payment from the customer, and in successful programs this has been lower than 25-30 percent of the total cost. Then, periodic payments are made to cover the

capital costs and interest. In order for the dealer to reduce the price, a high volume of installations can be achieved, and this could be achieved through a village level electrification program. Keeping interests rates down is also an important goal, that can be attained if operating costs are reduced and affordable financing rates are secured, such as through micro-credit loans. User education and after-sale service is also important to ensure user satisfaction, which will also help to ensure loans will be paid back (Syngellakis et al., 2007).

In order for this model to function well, there are some key issues to consider:

- Creditworthiness of the customer
- Creditworthiness of the financial institution
- Quality of the system and warranties provided by the dealer
- Contractual arrangements between the dealer and the financial institution(s).

Similar to the consumer finance approach, a leasing option also allows for a long-term payback time. However, in contrast, under the leasing agreement, the lender retains ownership over the system. Ones the contract is finished, often the customer has the opportunity to purchase the system, and in the case with development organizations, the system may be gradually transferred to the user. Some of the advantages of this system, are the low transaction costs, long payback period, the ability to disconnect consumers who don't pay, and the ability of leasers to secure loans as compared to customers ("IFC," 2010).

A RESCO model has shown to have a lot of potential to offer large amounts of people access to electricity in rural areas. It is a fee for service approach that has been utilized in many countries. One well known example is the company Selco that operates in rural areas in India. Selco offers contracts with users to provide the installation, operation, maintenance, and repairs of the various systems they install. In order to make arrangements affordable, Selco helps secure loans for users by acting as an intermediary and guaranteeing the loans from banks and other financial institutions. Flexible payment schemes are arranged, that allow the consumers to make staggered payments over a longer period and pay low initial down payment, that can exclude many prospective clients ("SELCO," 2010).

The Feed-in Tariff (FiT), has been a market support mechanism that has been able to stimulate the deployment of renewable technologies in some parts of Europe, the Americas, Asia, and Africa (IEA, 2008). The Renewable Energy Premium Tariff (RPT) is a locally adapted variation of the FiT scheme, and it aims to promote the production of renewable energy via mini-grids in isolated areas in developing countries. In order to come up with the optimum price for the RPT, a quantitative economic analysis must be performed that considers payback time, Internal Rate of Return and Net Present Value, of the different mini-grid configurations. The configurations could include among others, a diesel generator system, a hybrid system, or purely photovoltaics. The analysis basically looks at capital costs, operation

and maintenance, and replacement costs over the different systems lifetime. By undertaking the analysis, a range of tariff values can be identified, that will make the project profitable or not for investors. For a profit approach, an 8-15 percent return was sought, while for a non-profit approach a six percent return was needed to cover interest rates (Moner-Girona, 2009). Because there has been interest shown by the government of Tanzania in exploring this option to support rural electrification, the RPT was discussed with some of the stakeholders in the field world (personal communication, 2010).

4 A Review of Community Electrification Projects

There is an interest by policy makers, communities, organizations, and other interested groups, to learn from the experiences of electrification initiatives that have included rural communities in energy planning, management, and ownership. However, there is very little information available in academic and other resources showing how these projects can be supported and organized to be successful in the long-term. Therefore, the objective of the following section is to show how rural community energy projects in four developing countries have been organized. Then, by presenting their organizational models in one common chart, commonalities between the case studies can be identified, and recommendations for designing and involving communities in energy projects can be made. The analysis is also used to help identify models to present to stakeholders in Tanzania, in order to get their input about the challenges and opportunities of implementing similar models.

4.1 Case study 1: Nepal - REDP

4.1.1 Country profile

Nepal is one of the poorest countries in the world and poverty in rural areas is greater then in urban areas (Giri et al., 2004). The average annual per capita income of Nepalese people is around USD 241. It is mostly a mountainous area and 85 percent of people live in rural areas (Neupane & B. Sharma, 2006). Energy consumption in the country is very low, the average per capita energy consumption is around 15 GJ per year, meaning there is a shortfall between what is required and what actual consumption is. Although the country has the technical potential to create 44,000 MW hydro electricity, only 600 MW has been harnessed so far. Most hyrdro projects have focused on building centralized large damns. Due to the remoteness of communities, and the topography of the landscape, it is expensive to extend the grid to reach rural areas, thus only five percent of rural communities have access to electricity from the grid, and 33 percent of the total populations has access to electricity (Giri et al., 2004). In order to meet their energy requirements, the population heavily depends on biomass, which accounts for approximately 86 percent of energy used (Neupane & Sharma, 2006)

4.1.2 Acts and policies related to energy access

The overarching policies that guide electricity generation, transmission and distribution, in Nepal is the Nepal Electricity Act of 1992, and the Electricity Regulation of 1993, that falls under the Government of Nepal (Ram M. Shrestha et al., 2006). However, much of the decision making power for rural electrification is given to more local governments, and the importance of community participation is recognized by Bylaw 2060, "Nepal Electricity Authority Community Electricity Distribution Bye Law" (Nepal Electricity Authority, 1992). Overall electrification targets of 55 percent have been set by the National Planning

Commission, for the years 2002-2007, no updated plan has been created yet at the time of this paper (National Planning Commission, 2003).

Policy specific to hydropower was further developed in the "Hydropower Development Policy of 2001". The policies outlined also show support for local participation in projects, since it is stated that a Rural Electrification Fund will be established to help mobilization communities, and benefits will be provided at the local level when hydropower projects are operated in communities. Furthermore, existing institutions will be re-structured to create a competitive environment to encourage the involvement of community and cooperative institutions (Ministry of Water Resources, 2001). In terms of supporting independent small-scale power producers, there are provisions to reduce costs and limit administration procedures for small producers. For example, no license is required to be obtained by a national or corporate body for projects under 1000 Kilowatts, grants are given to domestic private sectors who want to build hydropower centers below 100kW, and projects of the same size are given priority for loans and supporting facilities. Finally, for projects under 1 MW, the producer may determine the rate of electricity they sell (Giri et al., 2004; Ram M. Shrestha et al., 2006).

4.1.3 Rural Energy Development Program

The Rural Energy Development Program (REDP), was launched in 1996 by the Government of Nepal, with the assistance of UNDP. The objectives of the program are summarized as follows (Giri et al., 2004):

1. Institutional arrangements and development to promote rural energy development in its cross-sectoral dimensions, at the central and local levels

2. Environmental preservation through social mobilization and the promotion of alternative energy primarily in the form of micro-hydro

3. Promotion of local economies and livelihoods

4. Utilization and development of research and dissemination of technologies

5. Human resource development for the development as well as operation and maintenance (O&M) of rural energy systems.

In the beginning of the program, REDP initiated a pilot program in five districts, but by 2005, it had expanded to twenty-five districts. Overall, 135 micro-hydro systems have been supported, and this has supplied more than 100,000 people with electricity. The program has not limited itself to micro-hydro, but other technologies have also been supported, such as: biogas plants, solar PV home systems, and improved smokeless cooking stoves (Ram M. Shrestha et al., 2006).

4.1.4 Institutional framework

Nepal Electricity Authority (NEA)

Nepal Electricity Authority is the main player in the main authority in the power sector in Nepal and it was established in 1985. It is fully owned by the government and is responsible for rural electrification in the country.

Alternative Energy Promotion Center

In order to exploit the relatively untapped renewable energy technologies, the Government of Nepal created the Alternative Energy Promotion Center. The main reasons for the center's inception are to develop and implement policies to support communities to plan, implement and managed rural renewable energy projects ("AEPC," 2010).

Village Development Committees and District Development Committees

There has been a move away from centralized decision making to decentralization, to increase the ability of its diverse population to participate in their own governance, as well as to ameliorate services and reduce poverty. The main legal document that guides decentralization in the country is the Local Self-Governance Act of 1999. The local authority system is broken down into two levels. The most local governance is undertaken by the Village Development Committees (VDC) and Municipalities, and above them is the District Development Committees (DDC). DDC act as district government, and their primary role is to coordinate development initiatives in their entire district ("ADDCN," 2010). This includes managing the REDP program, under the Rural Energy Development Section. The Rural Energy Development Section, under the umbrella of the DDC, acts as a support on all matters relating to energy in the district, such as planning, implementation, linking and coordination, monitoring and evaluation ("REDP," 2010).

Support Organization

Support Organizations (SO), and their social mobilizers, are usually NGOs who are contracted to mobilize communities in their respective districts, where energy projects are to be implemented. Their activities are based on the six guiding principles of the "REDP Community Mobilization Process" and this is further explained later. As such, the SO does not make decisions, but rather acts as a facilitator, supporting community members to identify and plan energy projects in a participatory manner, and help create Community Organizations and appropriate Functional Groups (REDP, 2010).

Community Organizations and Micro Hydro Functional Groups

Community Organization (CO) is a group of people who live in close proximity together, share common interests, and are willing to work together for a common goal. Membership

must include at least on female and one male from each household who will benefit from the project. All decisions are made by consensus in weekly meetings. Functional Group (FG), is made up of a collaboration of COs in order to achieve a specific development activity. One FG would be responsible to management and maintain the Micro-hydro scheme, by making decisions about tariffs, employee management, operation and maintenance, and electricity distribution (Winrock International, 2005).

Private Sector Organization

Private sector organizations also play a role in community electrification projects. Private sector organizations provides both training for community members when needed, as well as technical services to fabricate, install, and repair energy equipment and appliances (REDP, 2010).

Agriculture Development Bank of Nepal

The Agricultural Development Bank of Nepal (ADBN), main objective is to provide credit for enhancing the production and productivity of the agricultural sector in the country. ADBN was established in 1968 and is an autonomous organization functioning under the supervision of the Ministry of Finance. One of the bank's mandates is to provide funding to support capital investments for the development of alternative energy sources in rural areas. As such, ADBN has been providing financial support to micro hydropower, biogas, and solar home system ("ADBN," 2010).

4.1.5 Village selection

In order for a village to undergo the selection process, the village must first express interest, then preliminary social, environmental, and technical assessments are undertaken. Approximately four villages are selected per year in each district by the DDC. The DDC bases their decision on the REDP feasibility studies, that include a Technical Report, Environment Assessment Report, and a Vulnerable Community Development Report. Lastly, a Technical Review Committee that is made up of members of the Nepalese government and donor agencies such as the UNDP and World Bank, must give the final approval to the selected sites. The Technical Review Committee is responsible for reviewing the assessments that were made, as well as deciding upon the subsidy amount to be given to the project (Shrestha et al., 2006) .

4.1.6 Community mobilization

The community mobilization process is based on six guiding principles, these principles are known as *Mul Manstras* and they are as follows: organizational development, skill

enhancement, capital formation, technology promotion, environmental management, and empowerment of vulnerable groups. Furthermore, there are four pillars that form the basis of community mobilization, that support the six basic principles listed above. These are: participation, transparency, consensus decisions, and inclusion.

The REDP community mobilization process requires the participation of 99 percent of the beneficiary households in the community. The primary beneficiaries are the rural communities, with special considerations to vulnerable communities such as women, Dalits (untouchables), and indigenous people. The community mobilization process encompasses, among others, institutional development at the grass-roots, savings and credit schemes, capacity building for the promotion of Renewable energy technologies, and social capital development. This is done in order to make the community people aware and capable to implement various activities related to organizational development, income generation, and natural resources management (Ram M. Shrestha et al., 2006)

The first stage is to introduce the VDC, the community and other leaders to the REDP program. This is done through small meetings, community meetings, and household visits by social mobilizers. During the community meetings, the COs are established, and their respective Chairperson and manager are appointed (Winrock International, 2005).

The second stage is the formation of the Micro Hydro Functional Group (MHFG). They are formed by a minimum of one male and one female CO. An executive committee is formed with representatives from each CO. The MHFG then hires three or more people to manage the Micro Hydro project, consisting of a manager, operator, and a chairperson. One of the key selection criteria for the employee selection, is they must make a commitment to stay in the community on a long-term because they are given both technical and management training. If they decide to leave the village, they must pay for training for their replacement.

In the third stage, the group is legally recognized. This takes place after the MHFG has been in operation for over six months. The community as well as representatives from the DDC and the VDC, decide one what legal form the MHFG will take. There are a number of options, such as becoming an NGO, Cottage Industry, Company, Multipurpose Cooperative, or a Micro Hydro Cooperative. The latter being the most popular choice.

The last stage aims to achieve long term sustainability for the micro hydro scheme, by gradually shifting responsibility to operate and maintain the micro hyrdo scheme onto the community. It usually takes the SO two years before it leaves the community, however the REDP still monitors and offers support to the community if needed (Winrock International, 2005)

4.1.7 Project implementation and maintenance

It is expected that every household, that is able to do so, should provide labor and local materials to the construction phase of the project. The amount of time that is spent by each house is decided at community meetings. Each household that is involved in the CO is electrified and community buildings such as schools and hospitals can also be electrified if it is decided. Once the MHFG has been elected and the project planning has been undertaken be the group with support from the SO, the construction begins.

Once the basic initial works have been done by the community, the installation of the turbine and generator is undertaken by a AEPC approved company. In order to increase the amount of trained technicians in the various Districts to services these micro-hydro projects, there has been an effort by REDP to support private Rural Energy Service Centers. For example, in 1997, the Pragati Bio-Gas Company started operations with 11 employees in the Tanahun district with a 18,500 USD soft loan from REDP. By September 2005, the company had grown to employ 265 people, and now works in 35 districts, on both REDP projects and other ventures dealing with various technologies (Shrestha et al., 2006).

When there are technical problems that can be easily fixed, such as cleaning equipment or replacing poles, this work is undertaken by the local technician and/or local community members. However, when there is larger technical breakdowns, the villagers must seek the service of the RESC such as the Pragati Bio-Gas Company discussed above. This service is paid for by electricity revenue, and when there is not enough funds, cash may have to be collected from the community (Ram M. Shrestha et al., 2006).

4.1.8 Funding

There are a number of funding sources for REDP projects, mainly from the REDP budget, the Alternative Energy Promotion Center, the Agricultural Development Bank, DDCs, VDCs, and the community. According to Shrestha's interview with a REDP manager, the average contribution of each stakeholder can be summarized on 5-1 It is important to note that this is an approximation, and Shrestha's field work has shown that these numbers can fluctuate.

Table 4-1: Contribution of the different stakeholders in a REDP project

Sources	Type	Share	Remarks
ADBN	Loan	20%	Medium term loan to be repaid in five years at the interest of 14.5%.
REDP	Grant	50%	As per Government subsidy rate[1]
DDC	Equity	5%	Minimum 5%
VDC	Equity	5%	Minimum 5%
Community People	Equity	20%	Labor, local materials and cash (if available)
Total		100%	

Source: (Shrestha et al., 2006)

As was mentioned previously, the Technical Review Committee must approved the subsidy rate to the community. Once this is done, the funds are channeled to the District Energy Fund and then to the Community Energy Fund of the appropriate MHFG. The funds from DDC and VDC are equity investments, and this means the DDCs and VDCs become shareholders in the projects and get a percentage of the benefits of the project.

The equity that is offered by the community can come in the form of either labor or cash. The type of equity that is given, depends on the circumstances of each community, so this is decided in mass community meetings. Once all the money has been raised, the community can make a contract with the Agricultural Development Bank for a loan, to pay the remaining sum. The loan money will be paid with the revenues from electricity generation (Shrestha et al., 2006)

4.1.9 Revenue from electricity generation

Electricity tariff rates are decided by consensus during mass meetings. To simplify operations, a flat rate can be paid based on the electrical devices in the homes. However, meters can be installed for businesses who want use high amounts of electricity, and there rate is decided by the MHFG. Since the tariff rate is decided by the community, there can also be varied rates

[1]

within the community for people who are in special circumstances, but again this has to be decided upon by the community at large.

The MH manager is responsible for collecting the revenue on a monthly basis. According to Shrestha (2006), collection rates vary between communities, where some have a 100 percent collection rate, while others have members who have not paid in many years. The revenue that is collected is deposited in the community energy fund, and the amount is used for meeting various expenses related to operation, repair and maintenance, debt service, dividend, community works, remuneration, and office administration. The MHFG members must undergo a "public auditing" that occurs every year to present and get approval of the transactions that have been made. Furthermore, the accounts undergo an audit by a registered external auditor as well (Shrestha et al., 2006).

4.2 Case Study 2: Indonesia - E7

4.2.1 Country background

Indonesia is an archipelago with over 17,000 islands, which 6,000 of them are inhabited. The population is at 212 million people, and 65 percent live in rural areas. 52 percent of the households are electrified; the main type of energy consumed is oil, followed by natural gas, coal, hydro power and geothermal, and biomass is used for cooking in rural areas (Giri et al., 2004).

4.2.2 Renewable Energy Supply Systems Project Background

The E7 group was formed in 1992, and it is made up of eight leading electricity companies from six countries; France, Italy, Canada, Japan, Germany, and United States. E7's mission is to play an active role in protecting the global environment and in promoting efficient generation and use of electricity with a focus on developing countries. For this reason the E7 implemented a joint project called 'Renewable Energy Supply Systems' in Indonesia.

The main objectives of the project were:

1. To supply a limited but reliable amount of electricity to households in remote areas of Indonesia.

2. Develop and introduce a new sustainable and decentralized management concept for rural electrification, and ensure project sustainability by utilizing bottom up planning and active user participation principles.

3. To obtain recognition as "Activities Implemented Jointly" under the United Nations Framework Convention on Climate Change project.

The project implemented three rural electrification programs, which consisted of solar homes, micro-hydro, and photovoltaic/wind hybrid system. At the completion of the project in the year 2000, more than 4,000 homes were provided with electricity (E7, 2001).

4.2.3 Institutional arrangements

The E7 is the project initiating body, supplying the capital funding and on-site support management. Their work focused on the development of bottom-up dissemination concepts that considered both technical and non-technical aspects. The E7 helped ensure the systems were constructed properly and then handed over to the Directorate General of Electricity and Energy, and then to the Village Based Electricity Management Units (PLD). In order to help coordinate the differences between the project partners, a local resident manager was appointed, and the manager helped facilitate the interaction between the E7 and other parties. According to the E7 final report, the following section outlines the institutional arrangements of the program (E7, 2001)

Indonesian Government

The project is recognized by the Indonesian Government within the framework of the UNFCCC as an Activity Implemented Jointly. Indonesian Government Institutions (GOI), limited their contribution to conceptual and design aspects, and the project itself was closely monitored by the GOI. The project was implemented under the umbrella of the Directorate General of Electricity and Energy, and according to the G7 participants, this offered the group more flexibility and independence.

Village based electricity management units

As a part of the bottom up approach of the program, it was expected that management of the electrification programs would be on the village level. The PLD are seen as project developers, helping customers realize their energy needs, providing and managing the electrical services, as well as undertaking the management of funds. The PLD technician candidates, along with the rest of the PLD staff, were elected by the villagers during the project mobilization phase.

Non Governmental Organizations

The project was cooperated with local NGOs since they had experience with the region undertaking community development work. The NGO's acted as the appropriate body that could translate the project objectives to the local communities. NGO field officers were place in the communities for up to two years, to organize user groups and to strengthen the PLD's

management organization. The NGO's were also responsible for documenting the results of the community discussions.

Local suppliers

Contracts were arranged between the PLD and the local suppliers, and they are to be renewed every six months. The aim was to make the relationship between the two parties mutually beneficial, by creating incentives on both sides to maintain long-term cooperation. The suppliers would benefit because they have an interests in securing new markets as in the case of PV, and also to increase their presence in the region. The PLD, could be sure that it had a competent partner that could support its technical requirements when local staff and resources would not suffice. It would also receive incentives when they promoted further sales of additional Solar Home Systems for the suppliers.

Indonesian National Utility

As discussed previously, the National Electricity Company (PLN) acted as a consultant for certain field activities and also offered support to projects after the construction was finished. In one of the MHP, the PLN purchased electricity from the project, since the E7 had fixed a MHP that had been formally run by the PLN, but had broken for decades and left unfixed. Although the group was fairly independent, they did seek support from the National Electricity Company as a consultant for certain field activities, and this proved to gain their long-term support after the project was constructed (E7, 2001).

4.2.4 Program management and decision making

In order to help facilitate the bottom up, inclusive approach, that had been stressed by the E7 group when initiating the project, three levels of management were defined and selected (E7, 2001):

- Program Management: which was the interaction between international/national and local levels of participation (Players)

- Rural Electrification Scheme Management (RESM), was the interaction between the players and the village/user level management Aactors),

- Asset Management (AM), the Interaction at the village level (actors only)(E7, 2001).

Program management

There is a diversity of E7 member companies, and this comes with different experiences, not only between the members but also the beneficiaries. In order to help manage the cross over, a local manager was hired that had lived in the area for many years, could speak Indonesian, and understood the local populations, and was also from Europe. He was responsible to manage the interaction between the E7 and other parties, liaise with the Indonesian Government, provide office management, support to the projects coordination and implementation, and monitor and support all the technical and non-technical activities.

The project leader was responsible for the overall implementation and management of the project. The program management emphasized the advantage of using locally available resources such as materials and expertise, as opposed to using externally provided resources. Therefore, external support was only obtained when it could not be attained locally (E7, 2001).

Rural Electrification Scheme Management

In order to ensure project sustainability, project activities were managed both by the players' decisions and local interests. Community Based Organizations and local actors were encouraged to be actively involved in the implementation, maintenance, management, and ownership of the various rural electrification projects. This local participation was achieved by supporting local NGOs, who placed field officers in each community for up to 2 years, in order to train and establish the electricity management units (E7, 2001).

Asset Fund Management at the village level

The project organizers did not believe that any non-technical decision should be made by higher level administrators, but rather the users themselves when their capacity allowed. This was achieved by utilizing focused group discussions, field interviews with participants, as well as field studies. This bottom up decision making approach was also utilized by the payment mechanisms that were put in place, as the users and the PLD were free to finalize their own payments plans. In order to help attain a sustainable and documented management of these funds, as well as the electricity facilities, the PLDs introduced fee and budget management, after sales service and reporting routines. In order to gain commitments from the users to maintain payments, signed contracts were collected from each user (E7, 2001).

Capacity building

In order to support the PLD and provide further training, mid-term capability analyses were conducted for each staff member by the supporting NGO and Program Management. These reviews provided input to the Program Managers, as to how to better support PLD staff and upgrade their management capabilities, as well as undertake institutional restructuring when

needed. A newsletter was also created and distributed by the supporting NGO so that PLD issues and new information could be communicated to the community at large (E7, 2001).

4.2.5 Project cycle

Site selection

For the Solar Home System project, the main selection criteria for the community was that it should not be expected to connect to the grid within 10 years, and that it have sufficient sunshine throughout the year. The villages were also ranked based on a comprehensive household income surveys that was conducted by the project office. It assessed the households' financial profile, and the institutional arrangements in the village to see how organized the village was. For the second project, the Hybrid System, the basic criteria that needed to be met was the availability of renewable energy resources, specifically wind and sun, and there should be no future plans to connect to the grid. The consumers also had to show the ability to pay for the electricity. Furthermore, the number of potential consumers as well as the size of the village had to match with the technical constraints of the system due to a modest budget. The third project, the MHP, had less requirements since the project aimed at refurbishing an already existing, but broken, Micro hydro plant (E7, 2001).

Mobilization

During the mobilization stage, there was an assessment made of the local human resources, as well as the users' profiles. The local people, and the NGOs (facilitators), were briefed about the projects objectives and expected results, including possible risks and benefits. Each household was offered a chance to participate, and no one was forced into joining the program. Local input was obtained through focus group discussions, where both men and women discussed project financing and interventions.

According to the projects final report, the communities had mixed reactions in the beginning, including feelings of suspicion mixed with interest. However, once the projects were starting to be built, and the PLD concept was promoted, gradually the communities gained trust, and the community began to familiarize themselves with their respective duties (E7, 2001).

Construction

In most of the E7 projects, alliances between the local people, the NGO's and contractors, which is not the normal protocol in Indonesia, took place in order to support the construction activities. This included clear technical specifications, extended guarantees, progress payments, tight repair/replacement procedures, and detailed commissioning procedures. For the construction itself, local people played a limited role, and it wasn't expected that the locals would contribute, however, it was found that communities did participate when the physical progress of the project could be seen (E7, 2001).

Operation and maintenance

The PLD is responsible for the O&M of the equipment in all three of the projects. For the Solar Home System project, the equipment underwent technical inspections every two months during the guarantee period. Additional inspections were held when reports of failures were provided by the PLD. The technical problems were all dealt with within a few days, as was stated in the contract. Following the guarantee period, an After Sales Service agreement was established between the PLD and local supplier, and this was to be renewed every six months.

For the HS projects, PLDs were given training to monitor the distribution network. Monitoring forms, that summarizes the systems performance, were filled out regularly and sent to the task leader.

For the MHP, during the guarantee period, technical issues were dealt with by the subcontractor. Minor problems, such as landslides and leaks, were dealt with by the PLD staff using local knowledge or training manuals (E7, 2001).

4.2.6 Finances

Since the project was implemented under the Activity Implemented Jointly pilot phase, one of the guidelines states that all capital costs must be provided by the investor. The E7 funds were granted to the Indonesian Government under a bilateral project agreement with the Directorate General of Electricity and Energy. One of the requirements of the project was that the beneficiaries had to be able to pay for the full operation and maintenance costs of the project, therefore, all funds that were collected from the users were meant for O&M. In order to help the communities gain income to pay for the electricity, income generating activities that focused on local agricultural potential were initiated by the E7 and local NGOs.

Focus group discussions were held to see the user's ability and willingness of the users to pay for electricity services. Financial sustainability analysis were also conducted in order to calculate the minimum tariffs needed to support O&M, and to determine financial management procedures that would be needed to maintain and operate the systems throughout their lifetime. Based on these analyses, recommendations were given to the PLDs, which took into account the local economic situation and project sustainability.

The three projects implemented slightly different payment schemes. The Solar Home System project charged consumers a down-payment, a fixed monthly fee, and an annual fee, and after 10 years the ownership was transferred from the PLD to the users. In the HS and MHP projects, a down-payment was required, as well as various monthly fees, and the ownership remained with the PLD.

In order to maintain transparency and good financial management, the NGO supported the PLD in generating quarterly reports to monitor the O&M accounts and other expenditures. If

there are inaccuracies, corrective measures could be proposed. In order to ensure security of the collected fees, they are placed in two different accounts, one for O&M and repairs, and another for salaries. Through these various financial measures, it was hoped that the projects could sustain themselves without external support well after the initial seed-funding (E7, 2001).

4.3 Case study 3: India - Sundarbans

4.3.1 Country background

India currently has a population of 1.2 billion people, and this is expected to rise. Approximately one third of the world's population without access to electricity resides in India. Although India has undergone decades of planned programs and energy policies in the Indian energy sector, electricity has reached around 40 percent of rural households (Shrank, 2008). Access to electricity and modern fuels is mainly limited to urban and semi-urban areas. Seventy percent of India's 1.2 billion people, lives in rural areas, and over ninety percent of rural households depend on traditional sources of energy such as fuel wood, agricultural residues, and animal dung to meet their cooking and heating requirements (Bhattacharyya & Srivastava, 2009).

4.3.2 Government acts and policies relating to energy access

To date, India's energy provisions have been dominated by two characteristics, strong public sector involvement and a high level of subsidies and cross-subsidies. Private entry into the energy sector was restricted to public entities. The need to extend electricity to rural areas was recognized fairly early by the government, and the rural electrification program focused on extending the grid and electrifying irrigation systems for agricultural. The program did not focus on households to be electrified but rather just the extending of the grid. This situation has resulted in a skewed picture of India's electrification rate, since 86 percent of villages have access to electricity, but as stated above, the actual number of households is much less (Bhattacharyya, 2006). In 2003, the Government of India's Tenth Five Year Plan and Electricity Act 2003, places obligations on the government to prepare a national rural electricity policy, and also develop a national policy on stand-alone systems for rural areas.

The National Electricity Policy (NEP) was notified in 2005 by the Central Government in accordance with the Electricity Act of 2003. Taking a new turn, it has made new provisions for local government institutions, user associations, cooperative societies, NGOs, and franchisees to manage rural distribution. Special attention has been given to the role of communities and it aims to make process more participatory. Access to electricity has been identified as a priority area, as it is one of the key drivers for rapid economic growth and poverty alleviation. Therefore, one of the key objectives is to achieve electrical access to all areas by 2010. It also highlights the need to give special attention to more disadvantaged

sections of society, as such, and a minimum lifeline consumption of one Kw per household a day has been set as a target for 2012 (Chaurey et al., 2004).

Two programs have been initiated in order to help achieve the rural electrification targets of the NEP. The Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) program of Rural Electricity Infrastructure and Household Electrification, is being implemented by the Rural Electrification Corporation, and the Remote Village Electrification (RVE) program is managed by the Ministry of Non-conventional Energy Sources (MNES). RGGVY is being launched to provide access to electricity to all rural households, bridge the urban-rural divide, and accelerate rural development. This is financed through a 90 percent grant towards capital costs of the projects by the Central Government, and households above the poverty line have to pay for their own connection charges. For households living below the poverty line, the program will received a 100 percent grant in order to connect the households to the grid at no charge ("RGGVY," 2010).

The RVE program compliments the RGGVY, and it focuses on establishing renewable energy sources of energy to meet the energy needs of villages and hamlets where grid extension is not foreseen in the future. MNES provides financial assistance for meeting up to 90 percent of the project costs, and for comprehensive maintenance for periods up to 10 years (Chaury et al., 2004).

4.3.3 Project background: Sundarbans

The Sundarbans region is characterized by a poor and dense population, where 85 percent of the people depend on agriculture as their income source. Geographically, the area is made up of many islands, and therefore, grid extension is not an option in many cases facing technical and financial barriers. In order to meet the areas energy needs, the West Bengal Renewable Energy Development Agency (WBREDA) has deployed a number of renewable energy technologies in the region such as: biomass gasifiers, solar power plants, solar home lighting systems, and a wind diesel hybrid system. In 1996, it set up its first SPV power plant in Sundarbans, and from then on it has set up a number of renewable mini-grids, serving 230,000, of the 4.1 million people living in the region. Although this has been a significant achievement, in the overall picture, this amounts to only 5.6 percent of the population. According to the WBREDA, it has plans to electrify the entire Sundarbans with non-conventional energy sources by 2012 ("WBREDA," 2010).

4.3.4 Institutional Framework

WBREDA

WBREDA was formed in 1993, and has a mandate to promote Renewable Energy technologies and create an environment conducive to their commercialization through innovative projects. It is the project coordinator and reviews and decides on applications from

different communities. It also plays the role of an Energy Service Company, and owns all of the assets associated with the power plants, and guarantees a reliable supply of electricity to the consumers ("WBREDA," 2010).

Local Management Committees

The Local Management Committees (LMC's) have been created put in place in order to make the projects have a high level of community involvement. LMC's collect revenue from the electricity sales, as well as acting as a liaison between the consumers and the WBREDA

Panchayat Levels of Government

The Panchayat Samiti, is responsible for overseeing development programs in its "block", and this consists of approximately 10-12 villages and their respective Gram Panchayat or village councils. It recommends electrification proposals on a priority basis to WBREDA. They often undertake the development works of the projects.

Ministry of Non-Conventional Energy Sources

Is a financial institution that has been established under the Ministry of Non-Conventional Energy Sources, to offer concessional financial support to the renewable energy sector, therefore offering low interest loans.

User Beneficiary Committees

The committees are made up of elected members of the local village council, consumers, and a representative of WBREDA. They give input into the day to day operations of the the cooperative association (when WBREDA is not managing the plant), and have a key role in the management of the power plant.

Renewable Energy Service Company

Is contracted by WBREDA to provide qualified and trained operators for the daily operation, and maintenance work. Usually a local contractor is hired to maintain the low tension lines, so that service can be quick and reliable, and it boosts local entrepreneurship.

4.3.5 Project Cycle

Project planning and implementation

As stated above, the village level governments initiate the proposals to be sent to the Panchayati Samiti governments, who then forward the proposals on to the WBREDA on a priority basis. WBREDA then decides upon the projects by shortlisting applications based on

the following criteria: number of willing consumers, location of the proposed site, and the optimum use of local renewable energy sources. The local Panchayat Samiti, a government body for many villages, usually undertakes the development works of the projects, and the local people provide labor for the construction of the plant and the site development (Chaury, Misra, Chawla, & Shukla, 2004).

Operations and management

In the beginning of the project, users take part in information sessions to familiarize consumer with renewable energy technology, in order to teach them how to use their technologies efficiently. This includes getting information concerning the hours of supply, as well as how to use the electronic load controller.

WBREDA gives technical assistance to the LMC to support O&M of the plant. After some time, in order to decrease the dependence of the villagers on WBREDA staff, local youth are trained for day-to-day maintenance of the plant. It is hoped that the information sessions as well as the training of the youth will lead to effective demands side management.

The management of the power plants can be done by a local cooperative or by the WBREDA with the support of a local NGO or a local government. In the case of Sagar Island, the biggest Island in the region, the Sagar Rural Energy Development Cooperative overseas all the renewable energy development on the Island. Its membership comprises important local officials. Each power plant on the Island has a beneficiary committee, made up of members of SREDCOP and other village leaders as well a consumer representatives. The beneficiary committee is responsible for consumer selection, setting and collecting tariffs and some minor aspects of maintenance. Local youth are hired and trained to deal with basic maintenance, and WBREDA deals with more complicated technical issues via an ESCO. The Sagar Rural Energy Development Cooperative, through the LMC, is also responsible for dealing with non-compliance in payments as well as illegal activity. At the Mritunjoynagar plants boasts that this local involvement has resulted in a 100 percent compliance with tariffs (Shrank, 2008).

4.3.6 Finances

Many of the projects undertaken by WBREDA were initiated before the RGGVY funds were available. As stated above WBREDA acts as an ESCO and owns the infrastructure and applies for loans from various sources. Capital costs for the generating unit are usually covered by money from the MNES, and money from the State and local area development funds, as well as soft loans from the IRED from the World Bank credit line, are used to cover the distribution network. The communities contribution comes in the form of land, and the initial connection charges and users fees are covered by the customers. Funds from the users are charged on the number of connections in the households rather then the amount of electricity consumed, and bulk customers are charged a fixed monthly fee (Chaury et al., 2004).

4.4 Case study 4: Bangladesh - Palli Bidyut Samities

4.4.1 Country background

Bangladesh has a population of approximately 160 million people, and is among the poorest countries in the world, since 65 million inhabitants live in absolute poverty. Although Bangladesh is endowed with a wide variety of renewable energy resources, many rural people lack access to energy services even to meet their cooking needs. A majority of the population relies on biomass to meet their energy requirements, as this accounts for 76 percent of total fuel consumption in rural areas. Electrification access rates are 10 percent for the rural population (Giri et al., 2004).

4.4.2 The energy sector in Bangladesh

The Government of Bangladesh (GOB) laid out a Vision and Policy Statement on Power Sector reforms in February, 2000. In this statement the following objectives were laid out, some of them are as follows: to service the entire country with electricity by the year 2020, increase reliability and efficiency of power delivery, make the power sector financially viable to help facilitate economic growth, increase private sector participation, and ensure a reasonable and affordable price for electricity by pursuing least cost options. In order to achieve an interim target of providing electricity to 60 percent of the population by 2010, it is currently around 43 percent. The GOB issued a Road Map for Institutional Reform 2008- 2010 for the realization of reaching electricity to all by 2020, which includes six monthly goals over the 3 year period. The primary objective of the three year institution reform program is to create an institutional foundation that will support large amounts of investments in the sector to support economic and reduce poverty (MPEMR, 2008). Currently energy distribution and management in Bangladesh has fallen under the responsibility of three organizations: the Bangladesh Power Development Board, Rural Energy Board (REB), and the Dhaka Electricity Supply Company. Bangladesh Power Development Board serves 29 percent of the consumers, REB serves 12 percent, and Dhaka Electricity Supply Company 59 percent (Alam, Kabir, Rahman, & M. Chowdhury, 2004). Under the road map, the cooperatives under the REB will remain and expand when necessary. Steps will be taken to improve REB's performance, based on a reorganization study, and an improvement in network expansion planning, based on advanced software tools, will be used to achieve the least cost option as stated above (MPEMR, 2008).

4.4.3 Project background: Rural Electrification Board and Palli Bidyut Samities

The GOB has recognized access to electricity helps to enable the achievement of many development goals for over three decades. The REB started operations in 1977 with the Rural Electrification Board Ordinance, when it took over responsibilities from the Bangladesh Power Development Board in 1977. There has been over 1.4 billion dollars has been spent on the program; which has lead to the laying of 155 000 km of electrical lines, 6.7 million

household connections, which has lead to electricity access to over 40 million people in 38,000 villages (GNESD, 2007). Aside from serving rural households, one of the mandates of REB was to provide electricity for non-farming activities such as cottage and agro-based industries, to improve productivity. Farms have also greatly benefited, as electricity access has also been brought to more than 114,000 irrigation pumping stations (Havet, S. Chowdhury, Takada, & Cantano, 2009). The REBs main strategy is to work with rural communities to set up Palli Bidyut Samities (PBS), local electrical cooperatives, to develop and manage electricity services. So far there are 70 PBS, that employ around 16,000 people.

4.4.4 Institutional Framework

Rural Electrification Board

The REB is the regulator of the electrical supply system for rural areas in different parts of the country. It is responsible to establish the electricity generation, transmission, transformation and distribution systems in rural areas. It has also been established to organize prospective consumers into formal and informal groups such as PBS, and other cooperatives, associations, or companies, in order to deliver electrical services. The REB makes by-laws for the PBS, as well as operational, technical, and administration standards for rural electrification. Additionally the REB, supports the PBS in planning and designing the distribution network, conducting initial organizational activities relating to institutional development, constructing sub-stations and electric lines, and providing training to PBS staff (R.M. Shrestha, Kumar, S. Sharma, & Todoc, n.d.). Once established, the REB also monitors the PBS's financial, operational, and management activities. The REB is empowered to received loans from the government and other organizations to collect funds to implement their electrification programs. They are also in the position to loan money to the PBSs for activities such as project appraisal and credit administration (Khan, 2003).

Palli Bidyut Samities

The program concept has been driven by the idea that the operation and management of the electricity system will be managed by the users themselves in a decentralized manner. Each PBS is responsible for the rural distribution system in its command area. These comprise of five to nine Thanas, that are sub-districts, covering between 700km and 1500km^{2}. The PBS is responsible for its management, operation and maintenance of the energy system ("REB," 2010).

National Rural Electric Cooperative Association

The National Rural Electric Cooperative Association (NRECA), has played an important role in Bangladeshes cooperative framework. They have acted as an advisor to the GOB and the REB to help them solve technical problems as they arise as well as issues around sourcing of

components. NRECA also monitors the activities of the PBS on a regular basis (Khan, 2003; NRECA, 2003).

Ministry of Power, Energy, and Mineral Resources

The Ministry of Power, Energy, and Mineral Resources, is entrusted with the overall responsibility of managing the power sector in Bangladesh. Therefore it overseas all aspects of power generation, transmission, and distribution.

4.4.5 Project Cycle

Project planning and construction

As stated above, the PBS is responsible for the project planning and implementation, and is supported by the REB. This said the REB has allowed for the establishment of two private sector service entities to implement the construction works, one being the Engineering Consultant, and the other the Electrical Construction Contractor. Since these are private sector organizations, they are not susceptible to the loss of expertise that is experienced by the REB in their staff rotation policies. The Engineering Consultant has trained employees to prepare the necessary construction documents, and inspect the construction sites to make sure that they are up to the set standards. While the Electrical Construction Contractor are well trained to construct transmission lines, the PBS undertakes the final inspection before it is handed over to the PBS by the REB and Engineering Consultant. The NRECA is also invited to carry out spot inspections as the works are supposed to meet their guidelines.

Operation and management

The organizational structure of the PBS consists of 10 to 15 baord members, who each represent a specific area of the PBS. In the beginning the REB is responsible for appointing the board of directors, but after some time this responsibility falls onto the consumers, and they elect the board members, including two women members that are appointed to the board of directors. An AGM must be held once a year, so that complaints can be heard, improvements can be suggested, and a presentation from the PBS can be given to the consumers, as well as appointing new board members. Although the REB is not on the organizational chart, under the overall institutional framework for the PBS, the REB acts as a central institution, and it provides financial, institutional, technical and procurement support for the PBS. There are a around 141 instructions laid out in REB by-laws, rules, instructions, manuals etc, that cover Engineering and Technical, Financial, and Management aspects, that the PBS follows in its day to day operation and maintenance. As the monitoring body, the REB will oversea the PBS operations, to make sure their technical and managerial standards are being met. In order to monitor the activities of the PBS, the REB requires that they send in performance reports once a month to the Monitoring Cell, and then in turn publishes the

information monthly. The NRECA also publishes its own quarterly reports discussing the PBS and REB performance (Khan, 2003).

4.4.6 Finances

In order to maximize the customer welfare, the PBS must operate on a "no-loss and no-profit" basis. It appears that the funds required for the REB and the PBS, are acquired through both government and international funding sources. The government will give the REB a grants and money coming from international donors is repaid over a 30 year period, with an interest rate of 0.75 percent for the first five years, and two percent for the following. In term, the REB advances the money to the PBS with a slightly higher interest rate (Khan, 2003). In the start-up period, PBS operating with a loss will receive direct subsidies, which can last up to six years.

The rural consumer's participation in the program is ensured through the co-operative principle, as every consumer in the area has to become a member of the cooperative. The membership costs USD .40 cents, and they must cover the installation and other charges, and the minimum bill for a consumer is around USD 1.20 cents. There are varied rates for different types of consumers, such as small and large industries, charitable institutions, farmers, and commercial users (Khan, 2003).

Meter-reading is carried out by individuals who are contracted by the PBS, and they are responsible for reading 3,000 meters and their contracts are renewed every three years. Any abnormalities are noted and reported to the PBS. Billing is done manually and each billing assistant is responsible to prepare bills and maintain records for 1,500 customers. Messengers deliver the bills to the customers and they must be paid within 20 days at district offices or banks. Electricity is disconnected if payment is not received within three months, that matches with the 3 month deposit that consumers must pay when they are connected. However, the billing and collection ratio of the program is very high at around 96 percent, and system losses are approximately 16 percent. Both of these rates are much lower than the other two state owned utility companies.

Financial support. The PBS receive subsidized financing through low-interest loans with long repayment periods. During the start-up period (up to six years), cooperatives with losses receive direct subsidies, and a common revolving fund allows them to benefit from cross-subsidies. Cooperatives also receive subsidies for investments in distribution infrastructures, and buy power from the national grid at a subsidized rate, negotiated by the REB.

4.5 Comparative analysis of the case studies

Based on the information that was presented in the previous section, the organizational models of the four case studies are presented in Table 4-1. There are some findings that can be drawn from the clusters (two or more check marks), and non-clusters, that have been plotted. The following section describes and highlights some of the key findings, for each stage of the project cycle, which can be identified from the patterns found between the organizational models.

Table 4-1: Depicts the four organizational models from the case studies. Each one displayed by their respective colored check-marks: √ = Nepal, √ = Indonesia, √ = India, √ = Bangladesh.

Project Cycle	Central Gov	Regional Gov.	Village Gov.	Community	National Bank	NGO	RESCO	International Org.
Project Initiation		√ √		√ √				√
Capacity Building	√	√ √				√ √		√
Planning	√	√ √		√ √ √		√		√
Construction		√		√ √			√ √ √	
Finance-Capital	√ √ √	√ √	√ √	√ √	√ √			√ √ √ √
Finance-O&M	√			√ √ √ √				
Continuing Support/monitoring	√	√		√ √ √ √		√ √		√ √
Management		√	√	√ √ √ √		√		√
Operation-Minor				√ √ √ √				

Operation-Major	√	√		√			√√√	
Ownership		√√	√	√√√				

Project initiation

Project initiation refers to the actors that show interest in undertaking the project, and then begin to initiate the project process. Based on Table 4-1, it can be seen that there are no strong patterns for the project initiation stage in the organizational models, but this could be attributed to two reasons. First, the E7 project in Indonesia is unique compared to the others, as it was developed by an international organization, and the communities needed to be identified by project staff, and then assessed for applicability. The second reason, is that Bangladesh is not included in the figure due to a lack of information. This is important to mention because, although it wasn't clearly stated in the literature, one could assume that the communities have initiated the projects because a cooperative approach is taken, and they have a history of being initiated at the grassroots level. Similarly, in the India and Nepal cases, the communities had to show interest in having electricity access to their local governments, and then the regional governments helped initiate the projects. Because the E7 project is not the "norm", it can be argued that the India and Nepal cases, where the communities showed interest first and then were supported by an outside organization, are appropriate for project initiation.

Capacity building

Activities that fall under capacity building, entail support for organizational, educational, and training activities. There are a number of different organizations that took part in building capacity for the local communities such as governments, NGOs, and international organizations. It does not appear to be better to have one group versus the other doing it, however, using local NGOs who have experience with the communities was highlighted as being important. When a significant amount of responsibility was placed on the community, the amount of time and resources dedicated to capacity building was fairly intensive. In Nepal and Indonesia, the communities have the responsibility of owning and managing the energy system, so local NGOs stayed in the community for up to two years until it was decided that the communities could begin to manage the projects themselves. In Bangladesh, the cooperatives are in charge of the energy system that can serve a large number of people, so one of REB's major tasks is to support the cooperative associations through training, guidance etc. Although the WBREDA projects in India case took on different forms, the communities were quite involved in decision making and minor maintenance, so capacity building for the users, LMC, and local youth, was a key component of the WBREDA approach. If

communities are going to take on major responsibilities throughout the project cycle of a rural energy project then it is evident that capacity building is highly important, but the cases have also shown that this cannot come from within the communities themselves, but rather from outside organizations.

Project Planning

Project planning involves deciding what kind of technology to use, where it will be installed, who will operate the equipment, who will manage the project, tariff rates, among other related things. It appears that the communities are capable of undertaking project planning because the involvement of the communities in project planning occurred in three of the four cases. The communities were involved in project planning because their local input was valuable to process, and it would also make the project more reflective of local needs and build a sense of local ownership. As discussed previously, the ability to undertake project planning is highly dependent on capacity building, since the communities that have undertaken a large role in project planning have been heavily supported by a government body or an NGO. In the case of Bangladesh, the cooperative is responsible for project planning, but it is heavily supported by the REB throughout the process. In the Nepal and Indonesian case, the bodies that undertake project planning are supported by an NGO for up to two years to facilitate the process. It is clear that communities can, and probably should, be involved in project planning, but they must be supported during this process.

Construction

Construction refers to the physical component of building and installing equipment, and not the financial side. Based on the figure, it is clear that RESCOS should be available to undertake the projects construction. In three of the cases, RESCOS were depended upon to undertake the major aspects of construction such as building and/or installing equipment. In two of the cases, the community did contribute their labor and basic materials, but it appears that they are not capable of undertaking all of the development works on their own. Because two of the projects did not have any community participation in the construction, it is evident that the community does not necessarily have to contribute to the construction of the project for it to be successful, however, if funding is an issue, community involvement in the construction can have the added benefits of reducing the construction costs. Furthermore, their involvement can help build a sense of local ownership, which is important according to the REA and TATEDO representatives who were interviewed during the field work component of the research (personal communication).

Capital costs

Capital costs refer to the total costs, minus capacity building and other educational activities, of purchasing and installing the production and distribution system. In all four cases, the majority of the capital financing came from a mix of funds from the government and an

international organization, and in two cases banks also contributed loans. It is evident, that due to the low incomes of rural people in developing countries, they cannot contribute any significant portion of the costs of the electrification programs. In the Nepal case, they were asked to contribute 20 percent of costs, but in order to do this, the ability to pay in free labor, materials, and land, seemed necessary for this to be achieved since their spare cash is limited.

In all of the cases, there was no involvement by the private sector to make investments, which leads one to question the interest and ability of private companies to get involved in rural energy projects with a high level of community involvement. Unless private companies are offered strong financial incentives to undertake a rural energy project through government policies, or manage to set up long-term payback programs such as leasing, it seems that these types of rural electrification programs will be dependent on both governments and international donors to cover capital costs.

Operation and maintenance costs

Operation and maintenance costs refer to the money that is needed to maintain and service the energy system, as well as the costs to pay staff. In all of the cases, it was expected that the community, the users, would have to pay the O&M costs through user fees and tariffs, since the long-term financial viability was stressed in all of the cases. However, since the tariff rates were set by the communities themselves, this did not always mean that the tariff rates were actually sustainable in the long-term. In the case of Nepal, one researcher found that many of the communities had managed to cover their operation and maintenance costs, but not the depreciation costs (Shrestha, Kumar, Martin, & Srinivasan, 2006). In one of the communities in the Sundarbans, the tariff rates set by the committee were not high enough to cover the cost of replacing the batteries for the Solar Homes (Shrank, 2008). It appears that finding a balance between affordability, and long-term financial viability, is a difficult task for the communities, but one that must be achieved in order to ensure the project is sustainable in long-term. This may be achieved when tariffs rates are negotiated between the community and the external implementing body, that occurred in the India and Indonesian programs.

Continuing support and monitoring

For this study, continuing support is the act of offering advice, information, and in some cases training after an energy system has been put in place. Monitoring includes financial audits, as well as conducting performance evaluations. Although the four projects were managed by the communities, there was an outside body that the communities could go to for support if needed. In a majority of the cases, these outside bodies were regional governments or government agencies, and in Indonesia they were supported by the E7 project staff. Although the NGOs were hired to offer support to the communities during the project initiation and planning stages, it does not seem that they are in a position to offer long-term support, therefore a government body may be in a better position to offer long-term support unless a long-term contract can be arranged with an NGO.

Financial and performance auditing/monitoring was undertaken by both internal and outside bodies. When outside bodies were involved, this could be undertaken by various organizations, depending on how the projects were organized. Internal monitoring was usually done by the local management committees, as well as at public meetings. Regardless of who undertakes these tasks, the need for it to occur was demonstrated as it was important to reduce corruption and maintain transparency, in order to build trust with the users and other actors.

Management

Management refers to the entity that is in charge of financial management, as well as making larger decisions, such as raising tariffs and expanding operations. All of the projects had a local management committee that was responsible to manage the energy system. In order to form these committees, support and training was a crucial element for their formation and success. In all cases, the management committees were made up of local people and in most cases elected by the communities. The type of people that participated, and the level of participation that was expected, varied between the projects. For example, the REDP program in Nepal was fairly strict on its policy to include vulnerable groups and women into the management staff, as well as having representatives of every households join a CO. While the Sundarbans model in India, at least in the case of Sagar Island, focused on including local leaders and user representatives. The cooperatives in Bangladesh also emphasized the participation of women, but not to the same extend as Nepal. Its organizational is slightly differently because the PBS tend to services many villages at a time so they have a lot of staff as well as a board of directors. It is clear that communities can undertake management duties in whatever form is taken, and the benefits of their involvement is evident as discussed in chapter two and in the case studies, such as local jobs, increased transparency, a sense of local ownership, increased collection rates, and local input into decision making.

Minor and major technical operations

In all of the cases, the local communities were involved in the technical operations of the power plants. Their involvement can help reduce costs, provide local jobs, and ensure problems are be fixed promptly when spare parts are available. Unless the community is a large cooperative body, as in the case with the Palli Bidyut Samities in Bangladesh, it is apparent that the communities are not capable of undertaking large repairs and complicated works, even when given skills training. Therefore, the availability of RESCOS are important to ensure that the rural energy projects can be repaired when complicated technical problems arise. The Nepal and Indonesian cases, have shown how contracts between the community management committee and RESCO, that outlines service agreements, can be highly beneficial to ensure repairs are made quickly.

Legal ownership

In three of the cases, the local communities retained legal ownership over the projects. It appears that this was important because the implementing bodies needed the community to take control of the projects because the responsibility of production and distribution of electricity was left to the communities, and there was no organization staying in the communities to ensure it was maintained. It was also thought that if the communities owned the infrastructure they would feel responsible for its continued operations. In the Sundarbans case, the WBREDA acted like a RESCO so it was responsible for ensuring the electricity was produced, so the ownership of the plants remained in their hands. However, a sense of responsibility over the project was achieved by including the communities in minor maintenance and management duties. It does not appear that one actor is better suited to own the plants over the other, however, if the implementing body, such as a government or an International Organization does not intend to remain within the community and ensure that the project is sustained in the future after the initial works and capital costs are covered, then it could make sense that the communities should own the plants, so that they take responsibility for its continued operations, as was discussed by Holland et al. (2001).

The role of policy

In Nepal, Bangladesh, and India, rural energy policy initiated at the national and regional levels of government, specifically outlined supported rural electrification projects with community involvement. In the case of Nepal, the decentralization of decision making was important because it give power and responsibility to the district governments, placing responsibility on district governments to undertake and support village level energy programs. Furthermore, the national governments electrification targets, de-regulations on small power producers, and subsidies for RE, has also made it easier for small power community oriented projects to be implemented. In Bangladesh, the establishment of the REB, with a goal of supporting community electricity cooperatives, has lead to the creation of 70 cooperatives, leading to the establishment of over 8 million connections ("REB," 2010). It is unclear if India's National Energy Policies have lead to significant rural electrification rates, however, the establishment of the WBREDA, has led to a significant number of households connections given it was established in 1997, and future targets are set to increase this number dramatically. In the case of Indonesia, National Energy Policy had little effect on the E7 project, but rather it was an international convention under the UNFCC, that helped stimulate the projects inception.

4.6 Transferability and bottleneck for scaling up

Successful community projects have been tested, and yet in most instances, the rates of rural electrification still remain low, or are increasing at a relatively slow pace. There are a number of components that need to be in-place and bottlenecks that must be surpassed in order for these projects to be expanded upon, or realized in another location. Given the limited

information about the case studies, it would be impossible to fully understand what all of these bottlenecks are, however, there are some financial, organizational, technical, and policy barriers that are evident from the cases presented.

Most of the cases have been dependent on funding from a variety of organizations. In all four cases, international donors have contributed to the projects capital cost, and if funding from these organizations was to increase, or decrease, it would direct affect the programs operations. The same can be said for contributions from local and national governments, as they have also made significant financial contributions in three of the cases. In two of the cases discussed, securing bank loans was also integral to fulfilling the capital costs of the projects. If a rural energy program was going to expand, bank loans would have to be made available to other interested communities. This could potentially be difficult because local banks may not be available, and in some cases, the financial profile of the communities and their previous borrowing histories could hinder their eligibility for loans. However, if in agreement, the government or an international organization to be a co-signer of the loans as was discussed in chapter three, and this would overcome these challenges. Regardless of where the funding comes from, it seems that rural energy projects will be dependent on a number of organizations for funding, and this places limitations on project expansion because funding from all of the various sources must be secured for this to take place.

In all of the cases, there was one or more organizations that helped initiate the projects and gave support. The availability, capacity, and interest of the coordinating organization, as well as supporting NGOs, would be a limiting factor for the scaling up and replicability of the projects. For example, at the outset of the project, the E7 group had no intention to expand their program in Indonesia. They wanted to use it as a pilot study, and they had limited ability to provide financial and managerial support, so they had to restrict the project to three communities. The E7 program also depended upon NGOs to support their work and build capacity in the communities, and according to the final report, at times they had problems securing well performing NGOs (E7, 2001). The commitment and capacity of coordinating and supporting organizations, must be in-place for a project to scaled-up.

Similarly, RESCOS were also instrumental to the success of the projects, and there availability to help install equipment and offer long-term support to communities is clearly a necessity. The REDP program placed an emphasis on stimulating the growth of RESCOS in rural areas, and supporting the creation of long-term contracts between them and communities. This helps to ensure RESCOS were available to service future projects in other communities, and that operational staff would not be left without technical support when complicated failures occur.

Furthermore, there are a number of technologies that can be used for rural electrification, such as wind, solar, biomass, diesel, and hydro. In order to for projects to follow a least costs approach, then project implementers, and support staff, have to be flexible with the technologies they adopt, in order to capitalize on local conditions. This requires that various

technologies are available, at a reasonable costs, and people are available who are technically trained to work with them.

At the center of these challenges, acting as either a major obstacle or a trigger, is government policy. The case studies have shown that rural energy policies can stimulate the creation and transfer of knowledge and skills, assemble financial capital, and promote the coordination between stakeholders, in order to implement rural energy programs. Government policy that has given jurisdiction for energy management, and built capacity with lower levels of government, has proven to be a supporting mechanism for three of the cases presented. The strengths of decentralization is especially seen in the REDP, REB, as well the Sundarbans example, where the regional/state governments have been pivotal in energy planning, delivery, and support. Furthermore, specific national policies, such as setting electrification targets, offering subsidies, and reducing administration barriers for renewables and small-scale energy projects, have proven to be supportive of community energy projects.

5 Tanzania's energy scenario

The following section presents a history of electrification in Tanzania, examples of community energy projects, as well as important background information on the main actors and policies that are related to rural energy delivery in the country. This will lay a good foundation and context for chapter six, that will utilize this information, as well as data collected from interviews to answer the second main research question of the thesis.

5.1.1 Energy profile

Tanzania has a population of over 40 million people, and approximately 75 percent of the population lives in rural areas. The country is heavily reliant on agriculture as it accounts for about half of the country's GDP, and a majority of the population is involved in this industry. Rural areas have limited access to markets and social services, poor economic structures, and limited secondary processing. Tanzania is one of the poorest countries in the world with a GDP per capita of around USD 251 ("MEM," 2010; Sawe, 2005)

Energy consumption has grown rapidly due to population growth, since Tanzania's annual population growth rate is 2.9 percent. The fuel most utilized is biomass-base fuels, that accounts for more than 90 percent of primary fuel. Petroleum accounts for eight percent and electricity account for 1.2 percent of primary energy. Coal, solar, and wind account for less than one percent of energy used. Renewables have been limited to the promotion of improved cook stoves, improved charcoal production, biogas, windmills, and small amounts of photovoltaics ("MEM," 2003).

5.1.2 History of electrification

Before British rule ended in 1961, electricity production and distribution had been dominated by a number of small privately owned companies. However, after independence, the Tanzanian Government showed interest in purchasing the companies, and bought all of their shares over the next decade. In 1964, the two main companies merged into the Tanzania Electricity Supply Company (TANESCO), and soon became nationalized. The aim of the new nationalization was to increase electricity services to the majority of the population. Under this set up, TANESCO was the sole distributor of power to the mainland, and sold its access power to Zanzibar. However, TANESCO, like other government run utilities in East Africa, was not achieving the results that were hoped. Its financial performance has been poor, and this was partly due to its inefficient debt collection and slow payments by the government. Rural electrification rates have remained at less than two percent, and overall electricity access has gone up and down over the last two decades ("TANESCO," 2010; Marandu, 2002). Figure 5-1, displays the current electricity grid in Tanzania, as shown, a significant proportion of the country does not have electricity access.

In 1992, TANESCO's monopoly was removed, and IPPs have been able to sell power to TANESCO consumers. After some delays due to speedy deals that lacked transparency, two major contracts were signed with two large private companies, Songas and IPTL. Although private sector participation in encouraged, TANESCO accounts for 98 percent of electricity supply (Marandu, 2002; personal communication, 2010). In 1999, the government decided to unbundled and privatize TANESCO to promote efficiency, private sector participation and introduction of competition in electricity market. From 2002 to 2006 TANESCO was managed by a private contractor, however the Tanzanian Government did not renew the contract for the third time, leaving TANESCO under government control ("TANESCO," 2010).

Figure 5-1: Map displaying the extent of the electricity grid in Tanzania in 2009. Source: (Kabaka & Gwang' ombe, 2007)

5.1.3 Community involvement in rural energy projects in Tanzania

Historically, in Tanzania, rural energy projects have mostly been uncoordinated and in an ad-hoc manner. The major financiers have been the Central Government, international organizations/Donors, and NGO's (Kabaka & Gwang' ombe, 2007). The potential for community involvement in rural energy projects has been demonstrated by these different actors in various projects they have supported. Examples of a community project sponsored

by an international organization, and a religious organization, are described in the following sub-section.

Village of Urambo Electric Consumers Co-operative

In a study conducted by the Stockholm Environmental Institute (SEI) which assessed the challenges facing energy development in Tanzania, one possible solution could be the promotion of electrification co-operatives that could manage their own power and set their own tariffs. As a result of this study, a pilot study was conducted between TANESCO and SEI in the village of Urambo, where TANESCO had cut services due to a lack of funds. It was decided that the electricity consumers in Urambo would form a electrification co-operative, that would own, maintain and develop the energy system (Ilskog et al., 2005). TANESCO offered to provide technical assistances if they were going to be paid for it, and SEI also offered to assist in the formulation of by-laws for the co-operative and provide training for the operators and an accountant. In 1993 the Urambo Electric Consumers Co-operative (UECCO) was formed. The organization managed to increase service from seven members in 1993, and by 2002, 241 members had joined. Although the consumers did learn to trust in the cooperative, the cooperative did not run perfectly, and had problems with maintenance issues due to shortcomings in technical training. Overconsumption was also a problem because there were not enough meters so flat rates were used. Furthermore, tariffs were not set high enough to make re-investments, making long-term sustainability unlikely without outside support. Although the cooperative ended when the community was connected to the grid, the project did show that there is potential for community managed energy projects to be successful in the country, when they are properly supported both economically and operationally.

Village of Mavanga

Religious organizations have had a long history of supporting rural energy projects in Tanzania. Many of them were initiated when the church buildings sought to have electricity, and through outside donor support, diesel generators were purchased or micro-hyrdro projects were constructed. The Catholic Church in the Iringa Region in Tanzania's southern highlands has built 10 hydro projects. Most of the hydro projects are still managed by the church and they sell the access electricity to the neighboring villages. But there are two cases where the church has handed control and ownership of the generation and transmission equipment over to the villages. The first project like this to occur, is in Mavanga village. Mavanga is located in the Iringa Region, and has a population of 6,246 people. The Micro Hydro project was financed by church members in Germany, the Diocese in Iringa, and the local community. The German partners donated cables, two 75 kW turbines, and electricity poles. The Diocese paid for transport of materials, and the community donated some local materials and labor, for example, each household had to dig one square meter of the inflow canal to the generator.

Since 2002, the MH project has been run by a community management committee. The members are elected every three years from their respective neighborhoods. There is a chairman, secretary, members at large, a church representative, a person responsible for collecting and distributing bills, security guards, and an engineer. The committee is responsible for ensuring electricity access for the people, maintaining the equipment, making decisions about new applicants, setting the tariff rate, among other things.

The number of people connected to the system has risen from 100 households in 2002, to 760 in 2010. There is also one health center, two churches, three primary schools, one secondary school, one dispensary, as well as businesses being supplied by the Micro Hydro project. Household consumers are charged based on the number of lights they have in the house, and if they want to have appliances they must be metered. The tariffs have been raised three times since the management committee took over operations. When the committee wants to increase the tariff, a community meeting is held and the committee makes their proposal to the community, a collective decision is then made. The fees are used to pay for O&M, salaries, the cost of two vehicles, and the extension costs for new customers.

The Chruch and an Italion NGO are sponsoring a new hydro project in Mawengi, and it will open in 2010. This project will be directly passed on to the control of the local community, and an electricity association is being formed to manage it. REA has also supported the project by paying for the transmission and distribution system.

5.1.4 Tanzania's energy policy

The first National Energy Policy in Tanzania was created in 1992. In order to adapt to structural changes that have occurred since then, namely the liberalization of markets and a change in roles by the government, the policy was revised in 2003. The new National Energy Policy outlined a number of principles for the Electricity Sector, as well as for renewable energy, that emphasizes the need to ("MEM," 2003):

- Have affordable and reliable energy supplies in the whole country
- Reform the market for energy services and establish an adequate institutional framework, which facilitates investment, expansion of services, efficient pricing mechanisms and other financial incentives
- Enhance the development and utilization of indigenous and renewable energy sources and technologies
- Adequately take into account environmental considerations for all energy activities
- Increase energy efficiency and conservation in all sectors

- Increase energy education and build gender-balanced capacity in energy planning, implementation and monitoring.

In order to help achieve these aforementioned goals, and to specifically improve access to modern energy for rural peoples, the Rural Energy Agency (REA), which will be describe further in the next section, was established by the Rural Energy Act of 2005. The Rural Energy Act, also outlines a number of principles for rural energy development ("GoT," 2005).

- Modern energy supply to rural areas promotes growth in economic production and productivity as well as social welfare.

- Sustainable development shall be achieved when modern energy services in rural areas are promoted, facilitated and supported through private and community initiative and involvement;

- The role of Government in rural energy service provision is that of a facilitator of activities and investments made by private and community entities

- The fulfillment of Government's role shall be managed through an institution that is independent of, but accountable to, the central organs of Government.

- The public institution designed to facilitate rural energy service provision shall have a small core administrative capacity, and shall rely on the technical and financial capacity of qualified private sector entities; and

- Facilitation of rural energy service provision shall take the form of financial support for the capital costs of investments, technical assistance to project preparation, training and other forms of capacity building.

5.1.5 Institutional actors

Rural Energy Agency

REA is an autonomous body under the Ministry of Energy and Minerals. Its operations are overseen by the Rural Energy Board (REB), which it is made up of representatives from the private sector, consumers, civil society, governments, and development organization. REA's mission and vision is to be a model of excellence for the promotion and facilitation of modern energy services in rural areas, for social and economic development. It works in partnership and collaboration with the private sector, Non Governmental Organizations, Community Based Organizations, and Government Agencies. In order to achieve its mission, the main functions carried out by REA are ("GoT," 2005):

- Promote, stimulate, facilitate and improve modern energy access for productive uses in rural areas in order to stimulate rural economic and social development.

- Promote rational and efficient production and use of energy, and facilitate identification and development of improved energy projects and activities in rural areas.

- Finance eligible rural energy projects through REF.

- Prepare and review application procedures, guidelines, selection criteria, standards and terms and conditions for grants allocation.

- Build capacity and provide technical assistance to project developers and rural communities.

- Facilitate preparation of bid documents for rural energy projects

The Rural Energy Fund (REF) was established in order to support REA in fulfilling its mandate. The fund can be used to cover some of the capital costs of projects that are implemented by both private and public entities, cooperatives, and community organizations. It can also be used to offer technical assistance, training, and other forms of technical training to build capacity to support project planning and implementation, prior to a groups application to REA. It can also offer co-finance for innovative pilot, demonstration, and renewable projects, when an organization also allocates funds for the project. The fund is financed from the central government, international organizations, REA service fees, levies on the commercial generation of the grid, as well as interests accrued ("REA," 2010).

TANESCO

Currently, TANESCO is a parastatal organization under the Ministry of Energy and Minerals. The company generates, transmits, distributes and sells electricity in Tanzania. TANESCO owns most of the electricity generating, transmitting and distributing facilities in Tanzania's mainland, and manages 98 percent of electricity supply ("TANESCO," 2010).

The Energy and Water Utilities Regulatory Authority

The Energy and Water Utilities Regulatory Authority (EWURA) is an autonomous, multi-sectoral regulatory authority. It is responsible for technical and economic regulation of the electricity, petroleum, natural gas and water sectors in Tanzania. Some of the functions of EWURA include: tariff review, licensing, monitoring performance and standards with regards to safety, quality, health and environment. Its responsibilities also include the promotion of effective competition and economic efficiency, protecting the interests of consumers, and

promoting the availability of regulated services to all consumers in the regulated areas including low income, rural, and disadvantaged consumers ("EWURA," 2010).

Non Governmental Organizations and Community Based Organizations

There are a number of NGOs and religious organizations who are present in Tanzania, and have been working in rural communities to increase access to modern fuels. The government has recognized their presence and previous efforts, as is shown in the Rural Energy Act. The MEM and REA is depending on NGOs, entrepreneurs, and CBOs, to support rural communities through planning, financing, and executing rural energy programs. It is hoped, as stated by MEM, that REA will help facilitate these projects with funding and other supporting measures, and that the projects will be owned and implemented by the private sector, NGOs and CBOs themselves ("MEM," 2010)

Private sector

The private sector has also been invited to partake in the generation and distribution of energy services as is shown in the National Energy Policy as well as the Rural Energy Act. Other then Songas and IPTL, private sector participation appears to be fairly limited, since two percent of energy supply is dominated by TANESCO.

6 Stakeholder interviews and model discussion

As shown, the Rural Energy Act, and the National Energy Policy, has outlined the significant role that the Tanzanian Government is expecting from NGO's, international organizations, religious organizations, and private companies to electrifying rural areas. It is clear that there have been efforts by these various actors to meet the energy needs of rural Tanzanians in the past, and they have been relatively successful at doing this on a small scale. However, to date, most of these projects have been organized in an ad-hoc manner, with little coordination between the various organizations and actors (Kabaka & Gwang' ombe, 2007). As shown by the two examples given, previous small-scale community electrification projects have the potential to improve energy access for rural communities, and researchers, as well as government departments such as REA, have called for greater participation by communities in rural energy delivery. Therefore, there is an opportunity to learn from other countries who have implemented successful rural energy programs with a high degree of community involvement.

In order to answer the second major research question of the thesis, the following section presents and analyzes information that was collected from interviews with various stakeholders while in Tanzania. During the interviews, three organizational models were presented: one based on the REDP model from Nepal, the other on the Sundarbans model from India, and the third is a private/public model created by the author. The models were chosen because they represent three different model types: community driven, government driven, and a private/public hybrid. With the information collected, as well as utilizing background information presented in the previous section, the applicability of the organizational models for Tanzania are assessed , and alternative organizational models are presented.

6.1 Model 1: Community energy model

Adapted to a Tanzanian context from the REDP program in Nepal, Model 1, the community energy model, was presented to all stakeholders listed in the methodology section. In order to include local actors, the project implementer was REA, the International Organization was UNDP, and the local NGO was TaTEDO. In general, all of respondents showed a positive response towards the model, and thought that it would be possible to set up this model in Tanzania. However, there was concerns expressed over the ability of the regional and village government, as well as the Banks and RESCO's, to fulfill their roles in the model. A summary of the discussions, and the major challenges and opportunities, are outline below.

6.1.1 Summary of discussion

The importance of including local governments and politicians in rural energy initiatives came up in discussions with all of the stakeholders. Both of the communities and TaTEDO stressed the importance of including the local village council, which was not placed on the diagram presented to the communities, since it was not stressed in the literature discussing the REDP program. The communities envisioned the village council as an overseer of the Functional Group, who manages the project on behalf of the community. REA, TANESCO, and TaTEDO expressed the importance of working with Regional Governments, such as identifying appropriate communities. They also highlighted the important role that local politicians can take in getting projects funded and implemented in their respective regions.

Although involving local governments is important, it was expressed by a number of respondents that the regional government is not in a position to offer energy development related support at this time because there are no staff dedicated to energy at this level of government, since the energy system in Tanzania is centralized. TaTEDO highlighted the need for there to be staff at the district level who are responsible for rural energy, like there is for agriculture. The communities expressed the need to have District Councils be properly trained to meet the needs of their rural peoples, and be held accountable for this because they did not think this was happening on Mafia Island.

Under the Community Energy Model, financial scheme, the communities have to pay 20 percent of the capital costs by either providing cash, labor, and/or materials. Both of the communities, as well as TANESCO, cited the financial situation of rural communities as a barrier. Because Chole community really wanted to have electricity access, they said that they could pay their 20 percent share of capital costs, but they would have a hard time doing so. The village of Mavanga did not think they could afford their share of the project costs if they had to pay cash, but said they could manage by providing labor and materials. Furthermore, the communities did not think that the village government was in the position to pay the five percent of the project costs, even if it was equity investment. They proposed that the district government take on 10 percent of the costs, however based on discussion with the priests in Njombe, this would involve some planning by the district government when they propose their budgets to the central government. Given that there is no staff dedicated to energy planning at the district level, it appears unlikely that this would take place, unless there was a dedicated organization to push for this.

Under the first models financial scheme, a loan from a National Bank covers 20 percent of the capital costs of the project. The respondents from Chole, REA, TaTEDO, and TANESCO, all expressed doubts about the ability of the community to receive loans from the bank, with a reasonable interest rate. REA said they were working on an arrangement with the banks to finance the energy projects, but negotiations were not finalized. However, when speaking with the Netherlands Development Organization (SNV), they did mention they have been able to arrange bank loans for their biogas entrepreneur program, with a interest rate of around 14 percent, that they believed was a good agreement.

There were some concerns by REA and TaTEDO about the capacity of communities to manage the projects, however all respondents did mentioned the importance of including communities in the process. The NGO and Chole community felt that one of the weaknesses of the model would be the ability of some actors to co-opt a project to meet their own interests. Chole was concerned that this could be done by local actors or the District Council, while the TaTEDO has experiences with local village governments taking control of energy projects, that have lead to their downfall because they are not properly trained to do so.

Although a lack of RESCOS to construct the project did not come up in discussions with the stakeholders, in a report by TaTEDO, it states that one of the major barriers to rural energy development is that there are few private businesses involved in the designing, manufacturing, and distribution, as well as installation/maintenance of rural energy technologies (Sawe, 2005). Given that rural energy rates are very low, there cannot be a strong supporting infrastructure in place, so this will be a challenge to any implementation model, including this model, that depends on RESCOS to construct the energy projects.

The Central government, through REA, is able to provide capital funding for the projects. It is uncertain if the District Government and the Village Government can pay the five percent of capital costs, and it is clear that the district government cannot provide continuing support for the communities, unless they were supported by an outside body. Based on responses from the community, they have said they are able to fulfill all of their respective duties. It is unclear if the Banks can offer reasonable loans to the communities, and it is also unclear if, RESCOS are available to offer long term support and undertake construction. Furthermore, the ability/interest of an organization such as UNDP is unknown, however, there are a number of development departments such as the Swedish Environment Development Agency, who have undertaken a number of projects in the country so the possibility is still open.

6.1.1.1 What components are present?

Most of the components that are currently in-place that would support the implementation of Model 1 in Tanzania have to do with the following actors: Communities, NGOs, and the Central Government. Based on discussions with Mavanga and Chole, they believe their communities can support the planning, construction, finance, and management of rural energy project in their communities. They have also stated that they are capable of owning the project once it has been constructed. The central government, in this case is REA, has shown that it can provide capital funding for the projects, however the amount that they have is unknown to the author. It is unclear how many communities or local governments know about REA, however, REA has invited various organizations to make applications to REA for funding if they want to undertake a rural energy project, so REA's interests is present. Discussions with TaTEDO have shown that it is in the position to offer communities support to build capacity and undertake energy planning. Given that this is one organization, there will have to be other

organizations available, or TaTEDO will have to expand, if a large scale energy program was to be put in-place like Model 1.

6.1.1.2 What components could potentially be present?

Regional governments do not have funding set aside to help pay the capital costs for rural energy projects since they traditionally do not undertake any energy planning. However, a representative of TaTEDO and a priest from Njombe, both said regional governments can make funding proposals to the central government if they plan ahead. Therefore, there is the possibility that regional governments could contribute, even if they do not currently.

Based on discussions with the communities, REA, and TaTEDO, it is clear that there may be difficulties for communities to take on loans from that bank and at an affordable interest rate. Because REA said that they are working on securing a loan agreement with a bank, and SNV, albeit an international organization, has managed to get good loans for their programs, this will remain uncertain.

It is also unclear if RESCOS as well as an international implementing organization, such as UNDP, are present, and available to fulfill their duties under this model. In follow up discussions with a TaTEDO staff, many RESCOS were named as working in Tanzania, however since they all operate from Dar Es Salaam, and few community energy projects currently exists in Tanzania, it is unclear if they would be interested to working on these types of small projects, and if they are able to offer the type of after service that would be required. Although there are a number of international organizations that operate within Tanzania, such as the Swedish International Development Agency, a model of this scale would require a lot of funding and support staff, so it is unclear if there is an organization that would be interested, and capable, of doing this in Tanzania.

6.1.1.3 What components are missing?

The clear gaps in implementing this model lay with the regional and village level governments. The regional governments are definitely not in a position to offer continuing support and monitoring at this time. The communities have stated that the village level governments are not in a financial position to offer any sort of funding for a rural energy project in their communities.

Table 6-1: Depicts aspects of the organizational model that are "present", "uncertain", or "missing", based on interviewee responses to the community energy model.

Project Cycle	Central Gov.	Regional Gov.	Village Gov.	Community	National Bank	NGO	RESCO	International Org.
Interest				Present				
Capacity Building						Present		
Planning				Present		Present		
Construction				Present			Uncertain	
Finance-Capital	Present	Uncertain	Missing	Present	Unclear			Uncertain
Finance-O&M				Present				
Continuing Support/monitoring		Missing		Present				Uncertain
Management				Present				
Operation-Minor				Present				
Operation-Major							Uncertain	
Ownership		Missing	Missing	Present				
Energy User				Present				

6.2 Model 2: Government energy model

The government energy model is based on the Sundarbans model in India. Because there is no Regional Energy Agency in Tanzania, like the WBREDA, in an attempt to adjust the model to make it relevant for Tanzania, the responsibilities were split between two actors. REA was place in the position of a program coordinator, accepting applications from communities and distributing funds to support the capital costs of energy production and delivery. TANESCO was placed in the role as the project implementer, applying for funds, constructing projects, and ensuring they were managed properly and electricity was delivered. The model was presented to three stakeholders groups, REA, TANESCO, and TaTEDO. The communities were not included because this model was less focused on the role of the communities compared to the first model. Based on discussions, it was found that the main challenges facing the implementation of this model in Tanzania resulted from a lack of regional and village government capacity, and barriers accessing funds from Banks and Local Governments. The ability of TANESCO to fulfill its role in the model was also questioned, as well as RESCOS. A summary of the discussions is presented in the following section.

6.2.1 Summary of discussions

The representative from REA and TaTEDO did not think the model would work well. The respondent from REA felt that TANESCO would not be involved in this type of activity because it needed to be focused on projects that offered a return on investment. It was suggested that TANESCO could be replaced by a project developer, leaving it open to various organizations who wanted to undertake these types of projects. The TaTEDO representative stated that this type of model, with TANESCO as the implementor, had been in operation in Tanzania for a long time, and it had not worked given the low electrification rates, so TANESCO should not be placed in charge of rural electrification.

In opposition to the other interviewees, TANSECO staff believed this model would work well and that TANESCO could fulfill its duties under the model. One representative said that TANESCO and REA have a good working relationship, since TANESCO has implemented a number of projects with REA's financial support. This interviewee also said the application procedure would work because REA was in a position to talk directly with the communities, and when plans were made, TANESCO could implement them based on guidance from REA. The other representative suggested that there was no need for a local management committee and that a RESCO, or TANESCO, would be able to undertake the responsibilities that are given to the local management committee in Model 2. The other representative, also felt that TANESCO would not like to work with communities when funding was short, unless they had funding from international donors because it can be costly to do so. But it was also stated that a balance was needed to be found, and their commitment on a basic level, such as providing security for the infrastructure was needed.

In the model presented, funding for the distribution system was covered by regional and central grants, as well as from a soft loan from a bank. This funding arrangement was sited as a problem by REA because there are no local or regional development grants available in Tanzania for rural energy projects, unlike India. As a REA representative said, "we have grants for road building, but not for energy" (personal communication, 2010). The bank loan was also a barrier because REA, as mentioned previously, has not arranged to have a bank provide loans with a reasonable interest rate over a long payback period. The TANESCO representative on the other hand did believe banks could offer loans for this project, referring to the fact that TANESCO had managed to receive large loans from a group of banks in the past. Whether these loans were received with low interest rates with longer payback periods is unknown.

The ability of communities to pay under this type of model was questioned by TaTEDO, because the representative believed from previous experiences, that projects run by utilities are more expensive then ones run by communities. The respondent also said that it would be hard for communities to contribute to the project, because under TANESCOS' guidelines, communities need to be reimbursed for their labor, land and other contributions. The communities financial situation was also questioned by TANESCO, as one representative was hesitant about the communities ability to pay for electricity, so productive uses of energy or economic activities would need to be encouraged, and TANECO stated could be covered by loans from the central government. All three actors recognized that REA could be a supporting actor in this model.

6.2.1.1 What components are present?

Based on the community's responses to the previous model, as well as seeing the village of Mavanga managed their own project, the communities are labeled as being in a position to fulfill a majority of their duties for model 2. Similarly, for the Utility Company TANESCO, it is in a position to fulfill almost all of its roles in the model because they have extensive experience undertaking electrification projects, both independently, as well as in conjunction with REA.

6.2.1.2 What components could potentially be present?

The only section that was labeled as unclear for the community was their ability to pay the tariffs under this type of model because this was questioned by TANESCO and TaTEDO during the interviews. It is also uncertain if TANESCO could offer capacity building for the communities, like WBREDA did in the case study, because this was left unclear after discussions with TANESCO. Similar to the previous model, the role of Banks and international organizations in providing funding, and RESCOS being present to undertake construction and management, was also uncertain.

6.2.1.3 What components are missing?

Due to a lack of experience of working on rural energy projects, the responsibilities that are given to the regional government in this model, specifically project planning and funding for distribution, is marked as missing.

Table 6-2: Depicts aspects of the organizational model that are "present", "uncertain", or "missing", based on interviewee responses to the government energy model.

Project Cycle	Central Gov.	Regional Gov.	Village Gov.	Community	Utility Comp.	National Bank	NGO	RESCO	Intern. Org.
Capacity Building					Uncertain				
Planning		Missing			Present				
Construction				Present	Present			Uncertain	
Finance-Capital	Present	Missing		Uncertain		Uncertain			Uncertain
Finance-O&M				Present					
Continuing Support/monitoring				Present	Present				
Management				Present	Present				
Operation-Minor				Present					
Operation-Major					Present			Uncertain	
Ownership					Present				

6.3 Model 3: Public private energy model

Two versions of Model three were presented to the different stakeholders. One was shown to the non-community stakeholders in order to get their thoughts on the private sector in rural energy projects, as well as the RPT financing scheme that was discussed in chapter Financing Rural Energy Projects section in chapter two. In this model a RESCO is responsible for producing electricity and selling it to TANESCO, and TANESCO pays the RESCO a premium tariff rate over 20 years. The community is given the electricity, and it owns the distribution system, and charges consumers a tariff rate in order to cover the costs of operation and maintenance.

6.3.1 Summary of discussions

The communities were shown a more basic model, but in this model the private company does not receive an RPT, but rather the capital costs are covered by funding from REA, the private company, and the community. The private company is ultimately responsible for energy production and delivery, but the operations are overseen by a community management committee, that has representatives from users, the local government, and the private company. This model was proposed by TaTEDO because it had problems with communities managing their projects after TaTEDO had left the communities, so they thought private sector involvement might deal with the communities' shortcomings and destructive local politics.

When shown the model, Chole community believed that the strengths were attributed to its openness, because community members could get access to information and make complaints to the management committee. They believed that the community could fulfill its role in the model, by electing user representatives, paying 20 of percent capital costs, and paying the monthly fees. Although they thought it might be more efficient to have a private company operate the energy plant, they did not think that there would be a private company that would be interested in working in their community. They also did not think the District Government would be able to fulfill their role of sitting on the committee, because they have not been responsive to the community's needs in the past, as they have been very slow to respond to proposals by the communities. When asked what they would do if they could create their own model, the respondents believed that the model should be similar to the Community Energy Model, and that the community should be trained to manage the energy system, and the private company should be left out. They suggested that the 30 percent of the funding that the private company was paying should come from the District Government.

Mavanga Community also did not like the model. They expressed a lack of trust with private companies, and had serious concerns over their motives, believing that they would not keep the interests of the community in mind because they always work on a for-profit basis. They acknowledged that by having a private company in charge, decisions might be fast-tracked which would have its benefits, but in the end they believed this would not benefit the poor, as

the community at large would have less chance to have input into operations. The ability of the District Government to fulfill its role by sitting on the committee was question because in rural areas, communication and transportation is an issue, so they thought it would be better not include the District Government on the Committee.

The REA representative did not think the Public Private RPT model would work. The respondent was mainly concerned with the long term contracts that would need to be made in order to secure a fixed price for electricity produced for over 20 years. This would be a problem given that REA was a new agency, and its future was uncertain, and because the respondent didn't believe the central government would want to co-sign funding contracts for this long of a period. The capacity of REA was also cited as a problem, because they operate with limited staff, of around 30 people, and it would be impossible to administer a number of different contracts with various IPPs. The REA representative suggested that the local governments at the district level might be in a better position to take responsibility for the distribution of funds and setting up payment programs with the various IPPs, instead of REA.

The TaTEDO representative did believe that TaTEDO would be able to support the community under this set-up through capacity building and long-term support, but in terms of the RPT, the respondent was not familiar with the concept and didn't have much to comment on. The respondent did stress that the local governments might have a problem implementing the program if it was left up to them, because they are not involved in energy planning and it would be a new area for them. However, the importance of including the local governments was stressed.

TANESCO respondents did think the RPT could work and local governments could administer it instead of REA. They believed the local communities could participate in the project, but would need outside support by an NGO, as it occurs in the model. It was also stressed that purchasing agreements between TANESCO and IPPs would need to be standardized to ensure IPPs were paid before a model like this was put in place.

6.3.1.1 What components are present?

Again, as similar to the previous model, almost all of the communities responsibilities are labeled as "present" because similar to the previous model, the communities said they could fulfill their duties, however, the only part that was questionable was whether they could afford the tariffs with a private company, and therefore it is labeled as uncertain.

6.3.1.2 What components could potentially be present?

Based on the previous discussions, the project cycle that fell under the responsibility of the RESCO are all labeled as uncertain because the communities were not sure if there were private companies available and willing to operate on small scale projects in rural Tanzania. The community's ability to pay for the Tariffs under a private model was also questioned by

the communities. Although it was suggested by REA and TaTEDO that the regional governments could be in the position to distribute funds instead of REA in this model, their capacity to work on energy related activities is not present, so it is labeled as uncertain.

6.3.1.3 What components are missing?

Because REA is not in a position to manage a number of contracts and finance operations over long periods which is required by the RPT, it currently cannot fulfill its duties under this model.

Table 6-3: Depicts aspects of the organizational model that are "present", "uncertain", or "missing", based on interviewee responses to the public private model.

Project Cycle	Central Gov.	Regional Gov.	Village Gov.	Community	Utility Comp.	National Bank	NGO	RESCO	Intern. org
Capacity Building							Present		
Planning				Present (with support)				Uncertain	
Construction								Uncertain	
Financed RPT	Missing	Uncertain							Uncertain
Finance Capital				Present					
Finance-O&M				Uncertain					
Continuing Support/monitoring				Present				Uncertain	
Management				Present				Uncertain	
Operation-Minor				Present (with support)					

Operation-Major								Uncertain	
Ownership				Present				Uncertain	

6.4 Discussion of key challenges and opportunities for model implementation in Tanzania

Based on field work findings, as well as a general document review, it is apparent that there are a number of obstacles and opportunities for implementing the three models that were presented to the various stakeholders. These challenges and opportunities are presented below. Following this discussion, in order to answer the second research question of the paper, two organizational models will be presented, that depict how community energy projects could be organized when considering the challenges and opportunities that were discussed. This will also include a brief discussion of the challenge and bottlenecks for the scaling up of these models. The first model, the "Business as Usual" model, shows how a community rural energy program could be organized taking into account Tanzania's current institutional framework. The second model, called "Building Energy Regions", presents a potentially more effective model, that could be implemented if changes were undertaken to Tanzania's institutional structures.

6.4.1 Challenges to implementing the models

Centralization of decision making and knowledge

Prior to the formation of REA, there has been no major government rural electrification program, and there has been a lack of legal and regulatory frameworks in-place to stimulate and enforce rural energy policies. Previous efforts in Tanzania left rural energy development in the hands of TANESCO, and due to various reason, their efforts have been focused on providing services to the 10 percent of the population in urban areas. Because rural electrification was a low priority, this has resulted in a centralized administrative framework, that tends to localize the knowledge, experiences, and skills in the ministries, as well as in TANESCO, leaving lower levels and local governments unskilled and un-networked (Kabaka & Gwang' ombe, 2007). Discussions with stakeholders have confirmed the centralization barrier, especially when presenting the "community energy model", as a major obstacle for rural energy development. The regional governments gap in knowledge, experience, and funds, makes it it difficult to include them in rural energy planning, even though it has been highlighted by all of the interviewees as important.

Lack of Capacity at REA

The gap in responsibility and experience has been attempted to be filled by the creation of REA. Although REA's policies are supportive of community energy projects, and has funds that communities can access, the interviews highlighted three shortcoming that REA is currently facing, that could have negative consequences for community energy projects and rural electrification in general. The first barrier is a lack of capacity, which can be partly attributed to the fact that REA has recently been established, so there are still learning curves being experienced by the staff. Furthermore, REA currently has just over 30 staff members, in comparison to TANESCO, who has over 5,000 employees **(**personal communication, 2010; "TANESCO," 2010). This lack of staff was highlighted as a limiting factor by the REA representative for the adoption of the Renewable Energy Premium Tariff, as discussed in chapter three. Given that REA has mainly supported grid extensions with TANESCO to rural areas, it appears that this lack of capacity may also be limiting REA's ability to accept and follow up with applications from small scale producers on a large scale. The third challenge limiting REA's work in rural areas that was highlighted in a discussion with a IPP manager, is a limited budget. In 2008, REA spent USD 18 million on rural energy projects ("REA," 2010). Although this is not a small amount of money, there are approximately 30 million people living in rural areas who need access to electricity, so this will take some time given the current budget of REA.

Uncoordinated efforts and communication between actors

Based on discussions with REA, TaTEDO, the Regional Development Office on Mafia Island, the communities of Chole and Mavanga, and the NGO SNV, there does not appear to be strong network to facilitate communication between the actors interviewed. From discussions, it seems that each organization was undertaking their own efforts, and their programs were disjointed from each other, each working in their respective areas for their own reasons. It also became apparent that the awareness of some of the organizations about other organizations activities were low or non-existent. For example, the Catholic Diocese of Njombe was not aware of TaTEDO, even though they were in a position to benefit from TaTEDO's experience. The Development Office on Mafia, nor did the village of Chole, even know about REA. Although these are a few examples, they are reflective of the overall energy sector, and the uncoordinated efforts that occur on a larger scale as noted by the director of TaTEDO (Sawe, 2005). This lack of awareness and coordination, may continue to leave the electrification of villages to be undertaken in an ad-hoc manner.

Availability and interest of RESCOS

It is clear from the case studies that the availability of RESCOS is an important component to ensuring the continued success of community energy projects. The director of TaTEDO highlighted the need to increase local capacity for rural technology delivery in a presentation in 2005 (Sawe, 2005). In discussion with a TaTEDO representative during the field visit, when asked if there were sufficient RESCOS in Tanzania, the representative identified a number of them, and said that the situation was improving. However, most of the RESCOS were located in larger city centers, and due to time constraints the author was not able to follow up with them to gage their interest in working on small scale community projects. Therefore, it remains to be unclear if there are enough RESCO's who are interested in small scale projects.

Availability and interests of IPPs

As discussed in chapter three, rural inhabitants have very low incomes, and can live far from the grid, therefore rural energy projects are considered high risk and for the most part unprofitable. Because TANESCO has to operate on a for-profit basis, this has severely limited its involvement in small scale rural electrification projects, even though they have substantial experience and personnel dedicated to electrification. Given the low involvement of other IPPs, it is apparent that their involvement is also restricted by low financial incentives among other factors that will not be discussed in this paper. When talking with a manager of an IPP, it was stated that his company was interested in undertaking projects that were between the size of .5 MW and 1.5 MW because it was easiest to get funding for this size of a project and it would be profitable enough (personal communication, 2010). Unfortunately, this appears to be large in comparison to the other village projects the author visited. Although this is one IPP, it is reflective of the current situation, where IPPs do not appear to be interested in undertaking small scale projects, as their involvement in rural areas to date has been insignificant. It was also expressed by the manager that funding from REA was not sufficient, as it only covered the costs of feasibility studies, but it was expressed that this may change in a couple years if more funding was secured from international donors or from the Central Government (personal communication, 2010).

Organizational differences on community involvement

All of the respondents felt that community involvement was important; however, the level of involvement that was sought after by the respondents differed. The TaTEDO representative stated that a high level of community involvement was needed from the beginning of the process, but it was important to ensure that village councils did not have decision making power over projects, because they did not have experience in this area. REA also stated that communities should be involved from the beginning, and communities should provide funding and other forms of support for projects, but also stated that politics could get in the way when community involvement occurs. TANESCO staff stated that they would prefer to limit community involvement to employing local people to provide security for the projects,

unless they were given additional money to seek input from the local communities etc. This was also echoed by the manager of the IPP, as it was also stated that they would be interested in having communities involved by offering security but not other duties. The communities thought that the best models for rural electrification would include a high level of community involvement in all aspects of the project cycle, and this was apparent from their dislike of the private public model (personal communication, 2010).

6.4.2 Opportunities

Community interest

Communities that were interviewed showed a high level of interests in getting electricity access. When talking with the Mavanga Energy Committee, they stated that previously people had come to the area to plant their crops and then they left because it had malaria, but since the community has electricity access, the population is increasing steadily (personal communication, 2010). Similarly, the community of Chole expressed a high level of interest in getting energy, and would be willing to pay for it. When given the opportunity, it is apparent that some communities would be willing to support rural electrification initiatives in any way possible.

REA

As the REA representative said, REA is fairly a new organization, and is still working out some of its policies and building capacity for the Agency. Although it has a small number of staff, they have a consistent revenue stream because of a levy that is placed on electricity sales by TANESCO. It is also able to charge for its consulting services and can accept money from international organizations. The monies collected are put in the Rural Energy Fund, and this can go to support the capital costs of a project, build capacity for a developer, and support innovative projects, among other things. The fund is available for various groups, such as cooperatives, private companies, NGOs, CBOs, as long as they are qualified developers ("REA," 2010). In theory, this supports a flexible environment where few limitations are placed on the type of organizations that can undertake rural energy projects and receive funding. Between 2008 and 2009, REA supported projects worth USD 18 million, but most of these projects were grid extension projects organized with TANESCO. Although communities and other organization can apply for funding from REA, they appear to be accessing a small portion of REA's funding.

TANESCO

It is clear that TANESCO is not in a position to work on rural energy projects without adequate financing, but it is an organization that has a lot of experience and staff for electrification activities. Both REA representatives and TANESCO representatives said that the two departments collaborate with each other, and as mentioned before, REA has

supported a number of grid extension projects that TANESCO has undertaken. Although there is a push to move away from TANESCO managed rural electrification, TANESCO can have a role in supporting IPPs with information and perhaps training, and they are also in a good position to undertake certain projects such as grid extensions.

NGO's and CBO's

CBOs, NGOs, and international organizations have played a significant role in supporting rural energy projects in Tanzania in the past. In the case of the Catholic Diocese, they are an organization that has a fairly long history in the country, and their presence in the communities will most likely continue well into the future. Because they are a community organization, they are in a position to undertake projects without large financial returns, and they can also target low income communities because of their mandates to support people in need. The Diocese of Njombe already manages 10 hydro projects, so their ability to offer electricity services has been demonstrated. Also, REA has supported a recent project undertaken by the Catholic Diocese, by offering funding for poles and electrical lines, and this allowed the electricity service to be provided to households in surrounding areas.

NGO's such as TaTEDO and SNV are also undertaking projects on their own, and they have significant experience doing this. They are much more willing to undertake smaller scale projects, for example, a TaTEDO representative said there organization would undertake a project as low as 30kW, which would supply electricity to approximately 150 households. However, it does not appear that there are many more NGO's in Tanzania who have the same amount of experience with rural energy delivery, which could be a limiting factor for depending on NGOs to make a significant contribution to electrification rates.

EWURA

EWURA was mentioned a number of times in discussions, as an organization that would have to be consulted when setting tariff rates for the models presented. If EWURA keeps the interests of consumers and IPPs in mind, it will act as an outside observer, helping to ensure each party is either paying, or receiving, a fair tariff rate. This can help reduce the opportunities for conflicts to occur, and increase transparency of the projects.

6.5 Proposed models for a Tanzanian context

Based on the inputs from interviews, and the barriers and opportunities that were highlighted in discussions, two community organizational models have been developed, the “Business as Usual Model” and the “Building Energy Regions Model”. Both of the models propose a high level of community involvement for the projects, ie. their involvement in planning, operation, and management, because this will help gain local ownership over the projects which all the respondents said was important. Their high level of involvement is also proposed because private companies currently do not make any significant contributions to rural electrification

rates in Tanzania, and it does not appear that this will change even with REA's new funding programs as shown in discussions with the IPP manager. Furthermore, the ability of communities to pay high tariffs to make the investments worthwhile for private companies is questionable, as shown from discussions with the two communities, REA, TaTEDO, and TANESCO. Also, NGOs are not in a position to manage rural energy projects themselves, but rather it is in their mandate to help communities manage their own projects. Therefore, if given enough support, as shown with Mavanga community, the community is in the best position to manage the projects because they have the most interest in making the project work.

The first proposed model looks at what could be feasible in the current situation if the energy environment in Tanzania was to remain static, so it is named "Business as Usual" model. This model proposes that projects are initiated by either communities themselves, NGOs, CBOs, or international organizations. The Central Government, REA in this case, and Regional Governments are not included because they are not in the position to initiate projects at this time. Capacity building for the communities should be undertaken by an NGO, or a CBO, who have experience with the communities, and funding for this activity could come from a variety of sources, including REA. As mentioned, the community can be involved in most of the project cycle, such as project planning, construction, O&M, and management. The construction could also be undertaken by a RESCO, and if an appropriate RESCO cannot be found, then TANESCO could also be approached. Capital funding should come from REA, the community, and if possible a Bank and an International Organization. Minor maintenance and O&M should be undertaken by the community, and fees to pay for this should come from user fees. Major complicated works should be undertaken by a RESCO, and again if this is not possible then TANESCO can be approached. Continuing support and monitoring could come from the community themselves, as well as with an NGO, and an international organization. The community is in the position to own the equipment, as it seems unlikely that another organization would be interested, unless it was a CBO in the community, such as the Catholic Church for example. Because there is limitations on how much money REA and Communities can contribute to the capital costs of a project, in order to guarantee good financing, appropriate financing would also be secured with domestic or international banks in this model. This would be preferable, as the REA and TaTEDO representatives said, to depending on outside grants from international donors, as there funding is usual fixed for a certain time, and has certain requirements (personal communication, 2010).

This model shows how a community energy project could be organized, but it is dependent on a number of factors to be successful. Many of the challenges facing the implementation for the three models would also be experienced with this model. These include the availability and interest of NGO's, RESCOS, CBOs. It would also depend on funding from REA, banks, or an international organization. Because of these limitations, the "Business as Usual Model" could only be implemented in areas where these supporting organizations could be found, and funding could be secured. The "Business as Usual" organizational model is shown below.

Table 6-4: Depicts proposed "Business as Usual" organizational model.

Project Cycle	REA	CBO	TANESCO	Community	National Bank	NGO	RESCO	Internationl Org.
Project Initiation		√		√		√		√
Capacity Building	√	√				√		
Planning				√				
Construction			√	√			√	
Finance-Capital	√	√		√	√			√
Finance-O&M				√				
Continuing Support/monitoring				√			√	√
Management				√				
Operation-Minor				√				
Operation-Major			√				√	
Ownership		√		√				

The second model, "Building Energy Regions", displays a more ideal situation, where the involvement of the Regional Governments is included. If capacity, knowledge and funding to support rural energy projects were gained at the regional level through the creation of a District Energy Office, the Regional Governments would be in a position to take on a larger

role, such as in the REDP and WBREDA models. Its duties, as outlined in the diagram, would be to help initiate projects, support project planning, offer funding, and help monitor and offer long-term support, as well as being a partial owner. This rural electrification program would be better coordinated because the Regional Governments would have to take responsibility for rural electrification in their respective areas. Again, this model also would also face some of the same barriers as the "Business as Usual" model, but there are actions that can be taken to increase the potential success of the models, and they will be proposed in the final chapter. The "Building Energy Regions" model is depicted below.

Table 6-5: Depicts proposed "Building Energy Regions" organizational model.

Project Cycle	REA	Regional Gov.	TANESCO	Community	National Bank	NGOO/CBO	RESCO	International Org.
Project Initiation		√		√		√		√
Capacity Building	√	√				√		
Planning		√		√				
Construction				√			√	
Finance-Capital	√	√		√	√			√
Finance-O&M				√				
Continuing Support/monitoring		√		√		√		√
Management				√				
Operation-Minor				√				
Operation-Major			√				√	

Ownership				√				

7 Conclusions and Recommendations

The purpose of this chapter is to summarize the research that was undertaken by the author and outline the works findings.

7.1 Introduction

The following chapter will briefly outline the research problem, questions, and objectives. Following this, a summary of the findings for the research questions will be presented, and also the problem statement will be re-evaluated taking into account the research's new findings. The chapter will conclude with a list of recommendations, and suggestions for further research.

7.2 Research problem and research questions

As was shown in the introduction, rural electrification rates in East Africa are among the lowest in the world. Researchers have called for a greater involvement of rural communities themselves, as a means to stimulate and improve rural electrification rates in developing countries, as well as Tanzania specifically.

Driven by the following research problem**- there is a lack of effective and timely strategies to address low electrification rates in rural areas in Tanzania –** the aim of this thesis was to help improve rural electrification rates in rural Tanzania, and potentially other developing countries. The research objective of this thesis was to contribute to an increased knowledge on alternative organizational models for rural electrification.

The scope of the research has been outlined by this problem statement, and the paper attempts to address the statement by answering the following research questions:

RQ1.

"How can organizational models, with strong links to communities, be designed to increase access to modern energy services?"

RQ2

"How could these models be adapted and implemented in Tanzania?

7.2.1 Summary of findings for the research questions

The following section outlines the researcher's findings for each research question.

RQ1

It was shown by the four case studies, community energy projects can be organized in various ways depending on who the implementing body is. Furthermore, the communities' role within the projects can vary, as exemplified by the REDP program in Nepal where each household had to participate in a committee, and the REB program in Bangladesh, where community members involvement mostly took place at annual general meetings. Although these differences were apparent, there were commonalities between the case studies that offer a general framework of how community energy projects can be organized.

It was found that communities are capable of undertaking project planning, construction, operation and management, and ownership in rural energy projects. However, the need for an outside organization to build capacity for the communities was integral to the project's success. For example, the availability of RESCOS to support the communities when complicated major repairs are needed, was demonstrated in the four case studies. It was also shown that community energy projects tend to rely on a mix of funding sources, meaning funding may have to be secured from communities themselves, government departments, banks, and international funders. It was apparent from the cases that the role of the private sector is non-existent when community projects are undertaken, however it is important to note that these case studies represent a small sample of case studies that could have been presented, therefore the role of the private sector in community energy projects should not be overlooked. The role of policy was also highlighted as supporting mechanism for community energy projects, such as the decentralization of decision making, as well as setting targets, reducing administrative barriers, and offering subsidies. Also, in order to address the transferability and scaling up of the case studies, bottlenecks were identified and discussed in chapter six.

RQ2

The interviews with stakeholders, have shown that there are a number of barriers and opportunities for implementing the three community models in Tanzania, as well as for rural energy delivery in general. On a government level, the findings reveal that there is a lack of capacity at the regional level governments, and a lack of staff, funding, and a lack of responsibility for rural energy delivery at REA, were also highlighted as potential challenges. Furthermore, because community energy projects are highly dependent on NGOs as well as RESCOS, their availability and interests to work on village sized projects is also shown to be a potential barrier. The same can be said for private companies, as their interests in working on small scale community projects have also not been demonstrated. The research supported previous findings, which have stated there is lack of coordination between the actors involved in rural energy delivery.

The research revealed a number of potential drivers and/or opportunities to increase community participation in rural electrification programs, as well as rural electrification in general. On a community level, the interest and ability of communities to undertake energy projects was demonstrated from discussions with representatives from Chole and Mavanga. Although REA was mentioned as a potential barrier, its policies support community energy projects, and therefore, it has the potential to be a driving force if given appropriate resources. TANESCO, CBOs, and NGOs, were also highlighted as having skills and resources that could be utilized for a broad scale community energy program.

In order to offer guidance to various actors in Tanzania who want to initiate community energy projects, two organizational models for community energy projects were presented by the author. They have been created based on the information that was collected during the interviews. One was reflective of what could be possible under the current rural energy framework in Tanzania, while the other model proposed a more "ideal" situation that could be worked towards, mainly defined by an increased capacity and responsibility for regional governments.

7.2.2 Conclusions about the research problem

The case studies have supported previous research that has stated that community energy projects provide a number of benefits to communities. Discussions with stakeholders have also shown that there is a potential for community energy projects to increase electrification rates for Tanzania's rural peoples, and there is an opportunity for this to take place with the establishment of REA, and the support of NGOs such as TaTEDO and CBOs like the Catholic Church. Although two organizational models were presented, offering potential frameworks to guide the establishment of a community oriented rural energy program, one must ask, linking back to the research problem, is a community oriented approach an appropriate method for Tanzania given the research findings?

Although this question is out of the scope of this thesis, the research that was conducted may offer some insights into answering a potentially crucial question. In terms of scale, it appears that if any significant strides will be achieved to surpass Tanzania's two percent electrification rate in rural areas, a broad scale energy program dedicated to electrifying rural villages will have to be undertaken, rather than the ad-hoc approach of the past. Although REA has been established to help support rural electrification and its policies support community and other small scale projects, given its low staff numbers it appears that its role will be mainly limited to offering funds, and less staff intensive projects such as grid extensions with TANESCO. Given the current economic situation of Tanzania and its rural peoples, it seems unlikely that REA sponsored grid extensions with TANESCO will be a financially viable solution to electrify all small villages. Nor does it appear that the private sector will be interested in filling this gap, unless financial incentives from REA and the Government are increased. This leaves communities and other interested organizations as being in the primary position to help

initiate and manage electrification projects in their respective areas, thus supporting the premise that community energy projects can increase electrification rates in Tanzania.

As shown from the research, communities are not in a position to initiate projects on their own, so they must be supported by outside organizations. Although there are organizations willing to work on community energy projects such as NGOs and CBOs in Tanzania, it has not been demonstrated that they are in a position to undertake this responsibility on their own. Because regional governments have permanent offices in all of the regions, support other development activities, and in theory have working relationships with the villages in their respective regions, it can be argued that district governments are in the best position to support and coordinate community energy projects with the support of, communities, NGOs, CBOs and REA. Therefore, it can be argued that the second proposed model "Building Energy Regions" could be the most appropriate model to increase rural electrification rates, if district governments can be given the resources to build capacity to undertake these tasks.

7.3 Recommendations

The research has shown that this model could not be implemented given the current challenges that were highlighted in chapter seven. In order to build an institutional framework that would support the second scenario, there are a number of recommendations listed below, each one premised by a short justification.

As discussed previously, regional governments do not have staff dedicated to energy, nor do they have any responsible for it, however, they have been identified as being the most appropriate body to coordinate rural energy projects. Therefore it is suggested that:

1. **Resources and responsibility should be given to regional governments for rural energy delivery.**

The research has shown that NGOs who are familiar with local communities can be effective at building community capacity, and this is instrumental for communities to be able to fulfill their duties in the projects. From the research, it does not appear that there are enough local or national NGOs to support a large scale rural energy program in the various regions of Tanzania. Therefore it is suggested:

2. **Establish local NGOs in each region, as well as work with already established national NGOs such as TaTEDO.**

The research has shown that RESCOS are instrumental to community energy projects because they can install equipment and undertake major repairs that the communities are not able to do themselves. They also support the creation of local jobs and can create spin-off affects further promoting rural energy delivery. It is not clear if there are enough RESCOS, nor if the

existing ones are interested in working on small scale energy projects in the various regions of Tanzania, therefore it is suggested to:

3. **Establish local RESCOS in each region.**

The research has shown that rural energy policies can be supportive of community energy projects, and some supportive policies are already in place in Tanzania. However, there does not appear to be any targets for rural electrification set by the Central Government, that can give legal backing and policy support to stimulate rural electrification initiatives. Therefore it is suggested to:

4. **Set targets and time-lines for rural electrification**

Discussions with interviewees have identified a lack of staff, funding, and knowledge of REA activities as limiting factors to REA's operations. Therefore it is suggested to:

5. **Increase capacity and funding for REA, as well as increase promotional activities of the organization.**

Community energy projects depend on a number of sources for funding, including bank loans. Based on discussion with interviewees, securing bank loans with favorable interest rates are a rarity. Therefore it is suggested:

6. **Secure loan agreements with banks for rural energy projects, perhaps regional governments could utilize economies of scale to secure reasonable rates.**

In order to coordinate a large scale rural energy program, communication between the various actors in the energy sector is key. The research, as well as other research, has shown that there is poor communication between the various stakeholders. Therefore it is suggested to:

7. **Increase coordination between organizations and government departments in relation to rural energy services.**

Community energy projects are not appropriate in all cases, and a commonly held belief is that private investments will also be needed to make significant gains in rural energy access. There are a number of examples around the world where entrepreneurs have met the energy needs of rural community members on a individual level. However, there does not appear to be many examples of where villages have worked with private companies on larger scale joint ventures. There are opportunities for communities and private companies to work together to meet both a communities energy needs, as well as a companies' financial requirements. Therefore it is proposed that:

8. **Synergies between private companies and communities for village scale rural energy projects be further explored through pilot studies in Tanzania.**

7.4 Recommendations for future research

Building on the last recommendation, it would be of interest to look at how communities and private companies could organize joint ventures that allowed communities and private companies to meet their respective needs, similar to the public private model that was shown to the communities. Another example is a proposed project by the Catholic Church in Njombe, as they are planning on undertaking a 10 Megawatt hydro project, nine Megawatts for private shareholders, and one Megawatt for the local communities. The community would be responsible for managing their portion, while the other nine would be managed by a private company for the shareholders. Although the details of this project are not complete as they are still seeking funding, researching private public partnership like this is of importance because it seems likely that private funding will also be needed to electrify rural areas in developing countries.

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