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The UNFCCC Technology Transfer Framework for deployment and diffusion of Low Carbon Technologies:

Is it working in Tanzania?

Kai Maembe

Supervisor

Luis Mundaca

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To my unborn child, I dedicate this thesis to you. I hope you get to read mommy's work sometime in the future.

Abstract

Climate change is a real challenge with global impacts in scope. The negative impacts of climate change are being experienced globally through raising temperatures, rising sea levels, melting ice and glaciers, extended drought and floods, soil erosion among others. The most vulnerable and affected by climate change are the developing countries that lack adaptive capacity to the impacts of climate change. The efforts to mitigate and adapt to the effects of climate change by governments, firms, international organizations and private entities include diffusion and deployment of clean technologies, as well as ecosystems based adaptation and reduction of emissions from deforestation & degradation (REDD).

In addressing climate change mitigation and adaptation to the least developed countries, this thesis has two main objectives: to contribute to global mitigation and adaptation efforts of climate change in developing countries by analyzing UNFCCC framework of technology transfer, using Tanzania as a case study. Second objective is to assess whether the framework developed by UNFCCC is sufficient to encourage deployment and diffusion of clean technologies by looking at climate entrepreneurs as the channel of diffusion for technology transfer in Tanzania.

The research uses multiple approaches to analyze data: by looking at existing literature on technology transfer and innovation frameworks, by applying the case of India as a pilot comparative study to identify experiences and lessons for case study of Tanzania, and by carrying out interviews to collect data in Tanzania.

Early findings of the thesis showed that despite existence of various drivers influencing technology transfer in Tanzania, a lot of efforts need to be deployed to create enabling environment to facilitate transfer of technology. On one hand, the host country needs to increase government commitment in renewable energy sector, set clear policy framework addressing RET, involve the participation of local entrepreneurs and increase incentives for private investment. On the other hand, the thesis revealed that UNFCCC framework needs to adapt the approach to fit host country specific needs, and implement a bottom up approach in order to facilitate local innovation, capacity building and increase resilience within the country's national and international boundaries.

Key words: Technology Transfer, Climate Entrepreneurship, Low Carbon Technologies, Capacity Building and Enabling Environment, Least Developed Countries.

Executive Summary

Developing nations are the most vulnerable and affected by the negative impacts of climate change. This fact is contributed by the lack of structural and financial resources by developing nations to mitigate and adapt to the impacts of climate change. In realizing the importance of enabling developing nations to participate in the journey to low carbon growth future, the United Nations enacted a convention on Climate Change to mobilize developed nations to cut down on GHG emission, as well as to enable developing countries to leapfrog opportunities in low carbon technologies. The result of the convention was the establishment of the UNFCCC technology transfer framework. The framework's purpose is to create the mechanisms so that low carbon technologies are transferred to the least developed country in an effective and sustainable manner.

In analyzing the role of UNFCCC technology transfer to the least developed countries, the research explores the case study of Tanzania. Tanzania is a developing country, with high dependence on biomass and imported petroleum as the sources of energy. Additionally, progress of application in low carbon technologies in Tanzania is slow and small scale. To assess the effectiveness of the transfer framework, the research has set the following objectives:

1. To identify existing enabling environment for diffusion of low carbon technologies.

2. To assess the capacity building in Tanzania for adaptive capacity capabilities of technology transfer in the country.

3. To identify and enhance channels for diffusion of low carbon technologies in Tanzania

4. Explore India's experiences in development of renewable energy sector, and associate India's lessons to Tanzania.

Given the above objectives, the thesis seeks to answer the following research questions?

- *What are the current 'enabling' conditions for technology transfer in Tanzania (i.e. technology transfer diagnosis)?*

- *What is the suitability of the UNFCCC technology transfer framework to promote diffusion of LCT's in Least Developed Countries?*

In order to gain an understanding to the UNFCCC technology transfer framework, multiple approaches were used to analyze data: extensive desk literature review was carried out, with emphasis given to the UNFCCC technology transfer framework. The conceptual framework based its analysis on the Cancun Mexico COP 16 Agreements, and integrated it with International Energy Agency Innovation Chain Model to influence policy instruments for technology transfer in developing countries. In addition to desk research, distributing a set of 10 semi-structured interviews to policy makers, climate entrepreneurs facilitated the collection of data. In the end, a 2 days workshop on household energy trends was carried out to analyze energy consumption in household and discuss alternative energy options.

Major outcomes of the research indicated that in Tanzania, the enabling environment for technology transfer is weak, characterized with low government commitment to the renewable

energy sector. A number of challenges exist for diffusion of low carbon technologies, including: lack of technical skills, poor development of infrastructure, unstable power supply for production, difficulties in financial grants and access to credit, corruption in government administrative systems etc. The results also showed no existence of policies to encourage renewable energy in the country, as well as insufficient capacity building measures in education institutions and innovation centers. Among other things, the findings indicated that the current energy crisis in the country put Tanzania in tremendous pressure to source energy sources and power supply. With this in mind, the research revealed that the energy situation in Tanzania forces the country to use any source of energy, with no particular attention given to low carbon technologies.

Given the fact that the research identified climate entrepreneurs as key players in the diffusion of LCT's in Tanzania, the government as well as other organizations advocating for diffusion of LCT's to developing country's should establish mechanisms that recognize the role of entrepreneurs in climate change mitigation and adaptation. Additionally, UNFCCC framework should work to establish mechanisms for technology transfer that encompasses local innovations, and make sure local participation is involved from the initial stages of creation of transferring mechanism. In other words, the framework for technology transfer needs to be country specific, other than region specific as well as adapt a bottom up approach in order to function well.

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Abbreviations

COSTECH	Commission for Science and Technology
EMP	Environmental Management and Policy
GEF	Global Environment Facility
GHG	Green House Gas Emissions
IEA	International Energy Agency
IIIEE	International Institute for Industrial Environment Economics
IPR	International Property Rights
LCT	Low Carbon Technologies
LDC	Least Developed Countries
MEM	Ministry of Energy and Resources
MNE	Multi National Enterprises
REA	Rural Energy Agency
REDD	Reduction of Emissions from Deforestation and Degradation
REF	Rural Energy Fund
RET	Renewable Energy Technologies
TNA	Technology Needs Assessment
TT	Technology Transfer
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

Climate change is a global threat currently facing the world. Among many effects of climate change are the rising sea levels, increased temperatures, melting of ice and glaciers, increased droughts and floods, increased prevalence of diseases like malaria, lowering agriculture productivity, just to name a few. Concerted efforts at international, regional and local levels in terms of cooperation and collaboration are required in order to curb the impacts of climate change, and mitigation of GHG emissions.

One of the agreed solutions to climate change mitigation and adaption is the research, development and deployment of low carbon technologies (LCT's) (UNFCCC, 2009). LCT's have been identified as a significant factor in influencing a low carbon future as they help to reduce the amount of GHG in the atmosphere. Currently, low-carbon technologies (LCT) and their role in reducing the problems of climate change are a part of the global strategy for combating climate change and a move towards a low carbon future (UNFCCC, 2011). However, the majority of LCT's has been researched, developed and demonstrated in the developed world (Tomlison, Zorlu, & Langley, 2008). Bridging the gap in between developed and developing world in LCT's, will contribute to the mitigation of impacts of climate change.

Developing nations, particularly least developing countries (LDC's) are gaining momentum in climate change talks with regard to technology transfer because of their vulnerability to the negative impacts of climate change (UNFCCC, 2011). Studies have shown that most LDC's lack structural resources and adaptive capacity to respond to the effects of climate change (UNFCCC, 2009). Moreover, the effects of climate change limit LDC's economic growth since many of LDC's depend on climate sensitive commodities such as agriculture, livestock and tourism for economic development (UNFCCC, 2011), hence the need for technology transfer to developing countries.

Technology Transfer is becoming an important topic in climate change negotiations because it is considered a significant approach to enable developing nations to be part of the journey towards low carbon future and to tackle the threats and negative impacts of climate change (UNFCCC, 2011). To facilitate transfer of technology to the LDC's, UNFCCC developed a framework model (figure 1) to facilitate the implementation of the transferring process. Since the UNFCCC framework has been in place, it has been revised and improvised to ensure that it encompasses all the required mechanisms necessary for smooth transferring process. The last conference of parties for UNFCCC was held in Cancun Mexico in 2010.

The rationale towards energy use challenge facing the globe is the shift towards cleaner technologies especially to nations that are still developing, as this is a significant step to ensuring a low carbon growth future. Technology transfer will enable developing nations to leapfrog clean technologies opportunities and participate in the transition towards global low carbon future.

1.1 Background to the research

In 1992 the United Nations organized an international conference in Rio de Janeiro, Brazil to discuss issues pertaining to global environment and development-UNCED (UNFCCC, 2007). The major outcome of the meeting was Agenda 21 that spelt out recommendations and obligations for UN member states to undertake in order to follow a path towards sustainable development (UNFCCC, 2007). A number of conventions were enacted after the Rio meeting

including the convention to combat climate change, desertification and biodiversity loss (Tayari, 2011). The Climate Change convention and its emergent Kyoto protocol addresses and deals with negative impacts of climate change; which led to the establishment of an International Treaty: the United Nations Framework Convention on Climate Change (UNFCCC).

The UNFCCC and Kyoto Protocol aim at helping developing nations to adapt and mitigate the effects of climate change by facilitating the development and diffusion of low carbon technologies and other investments in sustainable development projects that help to reduce the amount of GHG emissions in developing countries (UNFCCC, 2009).

To ensure effective implementation of technology transfer to LDC's and other developing nations, UNFCCC developed article 4.5[1] and 4.7[2] that outlines the roles of developing countries and developed nations in technology transfer. Article 4.5 and 4.7 of the UNFCCC address and discuss the roles and commitments of developed country parties and developing country parties in technology transfer (IISD, 2003). Both articles emphasize the significance of enabling developing nations with LCT's and know how for technology transferring mechanism and the provision of financial resources through clean development mechanism and other Kyoto Protocol commitments (UNFCCC, 2007), and equally the reciprocation of commitment from developing countries. The UNFCCC goes further to develop a framework and other enabling environment (figure 1) necessary for implementation of technology transfer to LDC's

Research, development, demonstration and diffusion of LCT's in particular renewable energies in LDC's is low compared to developed nations, because of small amount of R & D and policy framworks in support of LCT's (UNFCCC, 2010). As a result, most of LCT's transfered in developing countries is occuring through imports of LCT's products (Hoekman, Maskus, & Saggi, 2004). Studies have shown that entrepreneurs and companies that deal with importation of LCT's products: in this report refered to as climate entrepreneuers, are key players in diffusion of clean technologies. Climate entrepreneurs facilitate the diffusion and use of LCT's by importing and selling climate friendly products to final consumers, private entities, government and public insitutions and other interested consumers. However, little effort has been given in the framework for techology transfer with regard to climate entrepreneurs (Rutqvist, 2008). The thesis aims to explore the effectiveness of UNFCCC technology transfer framework, and the relationship between technology transfer and channels of diffusion for technology transfer.

1.2 Problem Definition

Although the role of entrepreneurship is highly advocated in climate change policy (Rutqvist, 2008) (WWF, 2011) and the UNFCCC Technology Transfer Framework (UNFCCC, 2010) (UNFCCC, 2011), not much attention has been given on how climate entrepreneurship or to what extent technology transfer frameworks may, or may not, stimulate such entrepreneurship as such.

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[1] Developed country parties and other developed parties "shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to environmentally sound technologies and know how to other parties, particularly developing country parties, to enable them to implement the provisions of the convention"

[2] "the extent to which developing country parties will effectively implement their commitments under the convention will depend on the effective implementation by the developed countries parties of their commitments related to financial resources and transfer of technology"

Previous research has shown development of clean technology in East Africa to be generally slow and mainly conducted in small scale (Innovation Cluster Systems Uganda, 2011; Msuya & Chisawilo, 2009). The fact that technology transfer in the majority of developing countries occurs mostly through trade of goods, services and importation of products (Bjorn, Mercedes, & Bamshad, 2011) (Ahuja, et al., 2007) makes climate entrepreneurs key players in the process of deployment and diffusion of LCT's in LDC's. The private sector plays a central role, through market and non-market channels to transfer technologies in developing countries (Rutqvist, 2008). This emphasizes the significance and importance of enabling and stimulating climate entrepreneurs in order to increase the share of RET and diffusion of low carbon technologies (UNFCCC, 2011).

If climate entrepreneurs – particularly national actors – are to diffuse low-carbon technologies (Rutqvist, 2008) on markets such as that in Tanzania, then effective enabling environment and capacity building will be vital (IISD, 2003) as this is a significant factor in technology transfer process. However, there is little regard given to the significance of climate entrepreneurs in the TT framework, as well as lack of available literature. For the case study of Tanzania, it is important that small to medium entrepreneurs that deal with selling and buying of renewable energy products are enabled because they are drivers to securing energy access to rural areas population. In exploring the role of climate entrepreneurs, low carbon technologies and the relationship to technology transfer framework developed by UNFCCC, the thesis intends to analyze the UNFCCC framework and eventually assess the relationship between technology transfer, entrepreneurship and diffusion of LCT's.

1.3 Objective and Research Questions

In light of the above, the purpose of this research is to contribute to a better understanding on how technology, knowledge and skills can be effectively transferred and diffused in Tanzania. In the end, the report aims to evaluate the effectiveness of the technology transfer framework, and whether the framework is appropriate for Tanzania so that diffusion of LCT's via climate entrepreneurs is stimulated and implemented in the short and long term.

When clean technologies are referred in this thesis, they mean renewable energy technologies: in particular solar, biomass and biodiesel as well as energy efficiency measures.

Research Questions

The research seeks to answer the following question:

- *What are the current 'enabling' conditions for climate innovations transfer in Tanzania (i.e. technology transfer diagnosis)?*

- *What is the suitability of the UNFCCC and IEA technology transfer frameworks to promote LCT's in developing countries?*

In order to understand the role of entrepreneurs in influencing technology transfer in developing countries, the research intends to answer the following sub question:

- *What channels and models of technology transfer need to be enhanced to effectively stimulate small to medium climate entrepreneurship in Tanzania?*

To provide insights to this question area, it is anticipated that the following objectives must be attained:

Task 1: Mapping Out climate entrepreneurship

- *Identify and map out technology needs with existing small and medium scale climate entrepreneurs*
- *Identification of climate entrepreneurial activity so as to choose a focus technology area (Solar, Biomass and Biodiesel)*

Task 2: Policies and Approaches

- *Identify existing government policies and approaches in support of small to medium LCT's and streamline them to solar, biodiesel, biomass and energy efficiency.*

1.4 Research methodology

The research used a multiple methods to analyze data. Analytical framework is done using UNFCCC technology transfer framework, emphasis given on the text developed in the Cancun December 2010 Conference of parties. Using the model developed by UNFCCC, the thesis investigated the enabling environment and capacity building efforts needed to facilitate technology transfer in Tanzania, and to identify existing policies for technology transfer. To complement UNFCCC technology transfer model, the report also used the innovation chain model adapted from International Energy Agency (IEA). Particular attention is given to diffusion of LCT's stage on the innovation chain. A business model developed by BoP was deployed to suggest alternatives to common challenges facing small to medium scale climate entrepreneurs in developing countries.

A number of semi-structured questionnaires (appendix 1) were distributed to both policy makers in private, public and government institutions (appendix 2). In the end, a workshop with wood fuel users and few entrepreneurs was held to understand energy consumption patterns for households in Dar Es Salaam. A survey (appendix 3) was distributed to 20 participants (appendix 4) to the workshop on wood fuel usage in Dar Es Salaam.

Analytical frameworks

The analytical framework for this research uses UNFCCC technology transfer framework and IEA innovation chain. A thorough review of the UNFCCC model on technology transfer was studied and analyzed in particular on the methodologies and mechanisms for technology transfer in developing countries. A business model for low-income markets was studied, to understand the challenges encountered by transmitters of tech technologies to developing countries, and some solutions to challenges were recommended.

UNFCCC Technology Transfer framework

According to UNFCCC technology transfer framework (illustrated in figure 1), in order to ensure technology transfer to the developing countries, a set of actions needs to be deployed within and outside UNFCCC. The research analyses the actions needed to be implemented outside the framework to enable transfer of technologies to developing countries. There are:

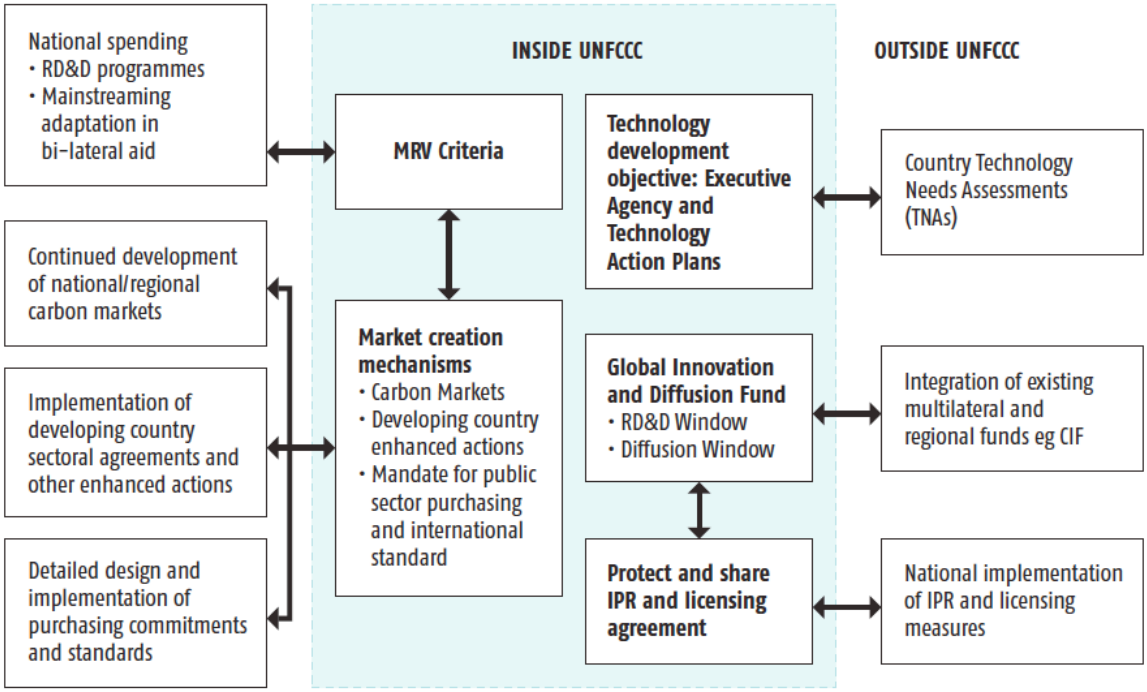

Figure 1: UNFCCC Technology Transfer Model. Source: (UNFCCC, 2007)

Technology Needs Assessments (TNA)

First, a country has to identify and assess their technology requirements to be addressed in the technology transfers process (UNFCCC, 2006).
Technology needs assessment (TNA) is defined "*a set of country-driven activities that identify and determine the mitigation and adaptation technology priorities of Parties other than developed country Parties, and other developed Parties not included in Annex II to the Convention, particularly developing country Parties"* (UNFCCC, 2006). The priority in TNA is the process of identification of barriers to technology transfer, and finding measures to address those barriers via sector analyses such as LCT's, regulatory options, fiscal and financial incentives, capacity building and removal of trade barriers(UNFCCC, 2006). Figure 1 below illustrates the process in identification of technology needs assessment.

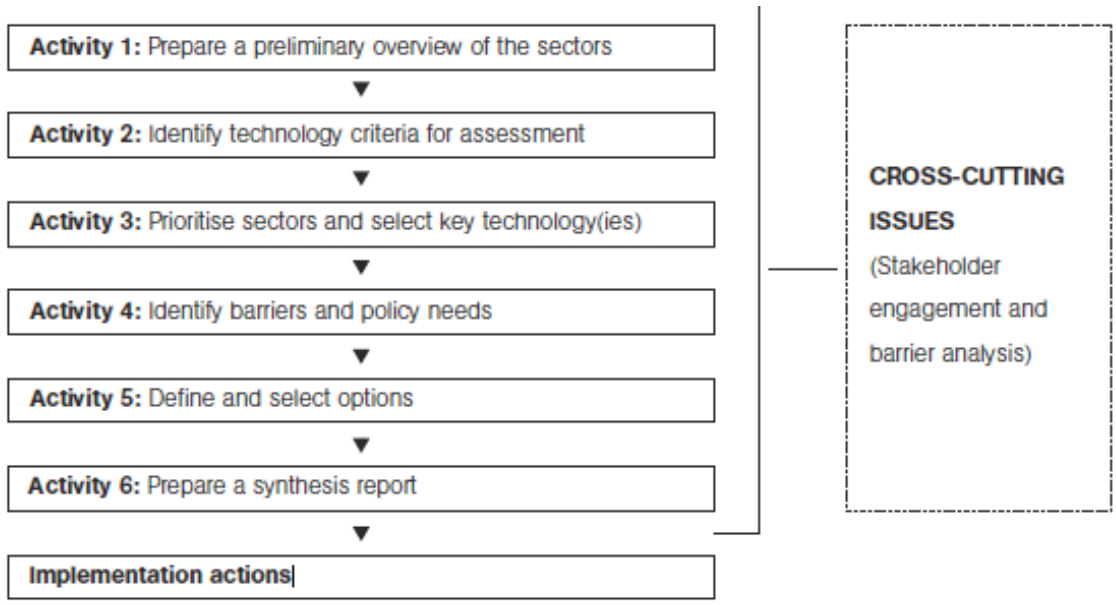

Figure 2: Technology Needs Assessment Process under UNFCCC[3]. Source (UNFCCC, 2007)

Technology Information

Given that technology needs have been established and identified, technology information needs to be disseminated (IISD, 2003). Technology information ensures that climate entrepreneurs and other interested parties in LCT's are aware of the means to facilitate flow of information and enhance technology transfer such as hardware, software, networks and technical parameters (UNFCCC, 2006).

Enabling Environment

Prerequisite to TT, enabling environment needs to be enhanced and established. These are the conditions and terms put in place to attract and facilitate transferring of technology from developed to developing countries (IISD, 2003). In the UNFCCC model and framework, enabling environments focuses on national and international incentives such as removal of legal, technical and administrative barriers, sound economic policy, regulatory frameworks and transparency (UNFCCC, 2006). Appropriate incentives and policies for large companies in host countries will increase the willingness for large companies to transfer technology to LDC's. In similar situation, channels of diffusion of LDC's will be facilitated to engage in transferring technologies from large MNC's and other LCT's companies in developed countries if there are the right incentives for business operations (IISD, 2003). In addressing technology transfer to least developed countries, the thesis bases the research on the enabling environment part of the framework, by looking the existing policies set in place to drive the diffusion and transferring of LCT.

Capacity Building

Within the context of enabling environment, the thesis evaluates capacity building. Capacity building is a significant factor in influencing technology transfer to LDC's by making sure adaptive capability of the technologies is available. Capacity building is defined as *"a process*

[3] Adapted from publication of Expert Group on Technology Transfer: Five Years of Work

which seeks to build, develop, strengthen, enhance and improve existing scientific and technical skills, capabilities and institutions in Parties other than developed country Parties, and other developed Parties not included in Annex II to the Convention, particularly developing country Parties, to enable them to assess, adapt, manage and develop LCT's." (UNFCCC, 2006).

Capacity building plays an important role in technology transfer, as it is the foundation of innovation of LCT's and ensures adaptive capacity within the receiver/host country (IPCC, 1996). Capacity building involves enabling of institutions in developing countries to develop technical skills, training and research and development of LCT's. For capacity building facilitation, UNFCCC recommends developing countries to initiate education programs that teach and train about LCT's, establishing curricula in the education systems on environment and low carbon technologies as well as training professionals through workshops and short courses on LCT's (IPCC, 1996).

Mechanisms for Technology Transfer

Finally, the UNFCCC framework discusses the mechanism for technology transfer in developing countries. Mechanisms for technology transfer there *are to facilitate the support of financial, institutional and methodological activities such as: (a) to enhance the coordination of the full range of stakeholders in different countries and regions; (b) to engage them in cooperative efforts to accelerate the development and diffusion, including transfer, of LCTTs, know-how and practices to and between Parties other than developed country Parties and other developed Parties not included in Annex II to the Convention, particularly developing country Parties, through technology cooperation and partnerships (public/public, private/) and (c) to facilitate the development of projects and programs to support such ends.* (UNFCCC, 2006).

As outlined in the analytical framework, the thesis bases its conceptual framework on the enbaling environment component of the UNFCCC technology transfer. This sections aims to dicuss different concepts that guide enabling environment and capacity building as far as technology transfer is refered.

Enabling Environment

The enabling environment under the UNFCCC is described as the conducive environment that government puts in terms of measures to ensure smooth transfer of the technology from source country to host country (UNFCCC, 2011b). The host government sets these measures. They include, inter alia, legal and policy frameworks, positive incentives, sustainable markets, standards and certifications.

Positive Incentives

The government through its institutions can provide grants, interest free loans or tax holidays for rural electrification and clean energy projects (Gradl & Knobloch, 2011). Positive incentives attract new investors in the sector. For example in India the government established a new ministry for RET that provided subsidizes in RET projects and offered credit lines to RET projects which encouraged and attracted new businesses in RET (Ministry of New and Renewable Energy India, 2009).

Sustainable Market Access

Renewable energy companies require open access to the energy market as part of the incentive for doing business in developing countries. Market access helps in attracting foreign private investors and foreign direct investment (Gradl & Knobloch, 2011). Programme such as public private investments can be used as an access mode to the market. Structural national programs like trade liberalization and privatization also creates easy access to the market. Once governments open up their market to internal and external traders, a free movement of goods will be facilitated via business ventures and other foreign investments.

Capacity Building

Capacity building seeks to build, develop, strengthen enhance and improve existing scientific and technical skills, capabilities and institutions particularly to developing countries (UNFCCC, 2007). A recipient's country ability to absorb and use the new technology effectively helps to strengthen the ability to develop and adapt innovations and technologies (Ahuja, et al., 2007)

To enable capacity building developing nations need to target climate change research in universities and other educational institutions, to increase and strengthen innovation infrastructure and put economic value to the human capital (intellectual property), so that it is possible for them to participate as owners of some of the climate innovation and technology in the global market (Cannady, 2009). Capacity building can as well be done through facilitation workshops, training, innovative financing, and technology for adaptation (adaptive capacity) etc. (UNFCCC, 2007).

Adaptive capacity for the least developed countries to the impacts of climate change has been found to be generally weak (UNFCCC, 2009). The progress in ensuring that LDC's are able to adapt to these effects is as well slow and weak (UNFCCC, 2009). Capacity building, both in terms of ensuring LDC's are able to respond to challenges of climate change and having the skills and ability to operate technologies that are transferred to them is necessary and required (UNFCCC, 2007).

Furthermore, it has been identified that innovation is an important factor in technology transfer and capacity building. Innovation is described as the process that involves research, development, demonstration and diffusion of technologies into the market (UNEP, IIIEE, IEI, 2000).

For the purpose of this research, climate innovation according to IPCC is defined as *a set of process involved to research, develop, demonstrate and diffuse innovations, which are related to climate change and have less impact on the environment such as renewable energy technologies.* Innovation is a significant part of the TT because before technology is transferred, it needs to be innovated via research, development, demonstrations and deployment and diffusion (Cannady, 2009). Reference to innovation chain model in the scope of this paper refers to the diffusion stage of the technology.

How can capacity building be implemented in the developing countries?

Cannady Cynthia (ICTSD) recommends each developing country to tailor innovation and technology transfer to its own needs and policies (Cannady, 2009). Specific recommendations for capacity building actions include training each country's professionals on issues concerning IP such as drafting patent claims, negotiation contracts and marketing technology so that developing nation can own their own technologies (Cannady, 2009) (Lema & Lema, 2010). Promoting of endogenous climate change research and development, through establishment

of institutional funds targeting climate change R & D and initiating a climate change technology commercialization facility where developed countries will be able to portray their technologies (Cannady, 2009). Increasing of education and awareness by encouraging country scientists and by writing and publishing articles, films and other educational media and investing in primary level science education to teach children on opportunities of becoming research scientists. Last, is to arrange periodic assessment of progress made on the projects undertaken in order to deliver practical and measurable results over time (Cannady, 2009).

IEA Innovation Chain

The IEA is another organization which like UNFCCC that has been involved and is a forefront player in low carbon technologies, by advocating the research, development and use of RET's and a shift from fossil fuels consumption to low carbon technologies (IEA, 2009c). IEA developed an innovation chain model and technology roadmaps to facilitate the development, research and diffusion of renewable energy technologies worldwide (IEA, OECD, 2003). The innovation scenarios designed by the IEA incorporated with UNFCCC framework are integrated in the thesis so that the theoretical considerations for the research more concrete, valid and applicable for the case country Tanzania.

The IEA innovation model in figure 3 deduces that technologies require the push of research, development and demonstrations (R, D&D) and the pull of market deployment. Moreover, innovation is a significant part in technology advancement (IEA, 2009c). Innovation accompanied by appropriate policy instruments helps to reshape energy systems around the world towards more sustainable development (UNEP, IIIEE, IEI, 2000). In this research innovation is defined as "*the creation and implementation of new processes, products, services and methods of delivery, which result in significant improvements in outcomes, efficiency, effectiveness or quality"* (Baeck, 2009).

The IEA innovation chain consists of several development stages: basic research, development, demonstration, deployment and commercialization (diffusion). The innovation chain model is none linear and cyclical (IEA, OECD, 2003), continually adapted and improved to fit current requirements as well as needs to overlap each other (UNEP, IIIEE, IEI, 2000). An innovation process is fully accomplished when the product developed has been commercialized and diffused in the market (UNEP, IIIEE, IEI, 2000). The report considers the diffusion stage of the chain, mainly because it deals with technology transfers whose role is to diffuse technology.

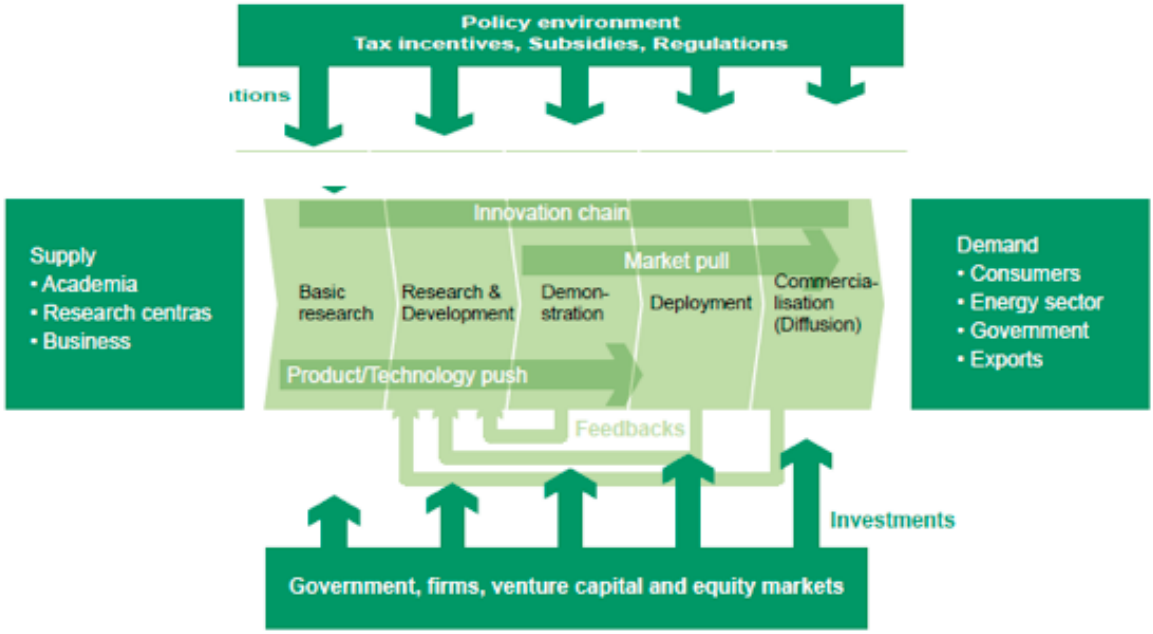

Figure 3: IEA Innovation Chain model. Adapted from: (WWF, 2011)

Similar to the framework developed by the UNFCCC, the IEA model emphasizes on the importance of appropriate policy environment for the diffusion of LCT's (IEA, OECD, 2003). Provision of tax incentives, regulations and subsidies are all-important aspects when considering the right environment for diffusion of technologies (IEA, 2009c) (IEA, 2010). Government, firms, equity markets, consumers and energy sector are all part of the innovation chain loop, through supply of investments, market interventions and provision of feedbacks.

Business model

Entrepreneurs like any other business entity, has the aim of profit making. Therefore, the research encompassed a business model as part of the analytical framework (figure 4) for climate businesses, addressing the challenges and constraints faced in conducting business in the developing world. The model outlines possible approaches to solve the constraints in a business sustainable manner. The model addresses low income markets due to the fact that the case study for the thesis is Tanzania, grouped as a developing country with majority of the people living with low incomes (Tanzania National Website, 2011).

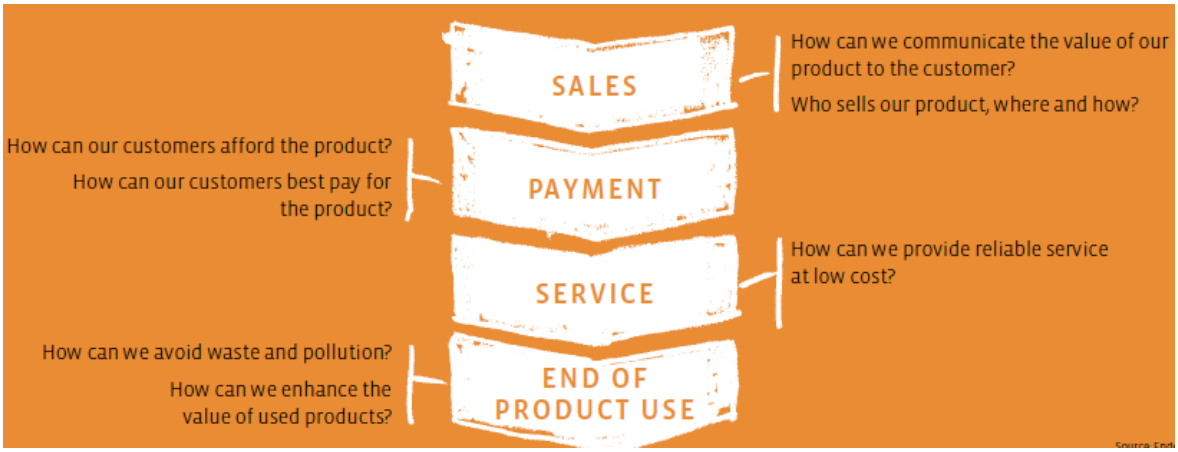

Figure 4: Low Income Markets Business Model. Adapted and illustrated by (Gradl & Knobloch, 2011)

The model discusses several processes in business entities that occur during business interactions, in low-income markets. The initial process in the business model for low-income markets is to ensure that there is customer interaction and interface. This is the process with which businesses can use to create a relationship with its markets to influence smooth running of business operations. Customer interface stage of the business model addresses 4 key areas: sales, payment, service and end of product. While discussing sales, payments, services and end of product life, customer interface answers the following questions:

1. *How can businesses communicate the value of their product to their customers? Who sales their products, how and where?*

2. *How can their customers afford their products and how can they best pay for their products?*

3. *How can businesses provide reliable services at low cost?*

4. *How can businesses avoid wastes and pollution and how can they enhance value of used products?*

Answers to customer interface questions are key for business in order to develop successful business models in low-income markets such as that of Tanzania. This is contributed by the fact that often times energy companies would be dealing with markets which lack information, do not have the financial means to afford the energy, do not have the capacity and ability to operate the technology and sometimes, illiterate (Ogwang, 2011). Since there is no economic development in most rural parts of developing countries, customers will often lack regulatory environment e.g. legal land titles, physical infrastructure (Ogwang, 2011). Additionally, people in remote areas are hard to reach and their living conditions are often characterized with harsh natural environment that sometimes lead to damage equipment's. Moreover, skills, knowledge and access to financial services particularly high up front costs associated with clean energy limit conducive business environment in the rural areas of developing countries(Gradl & Knobloch, 2011).

One of the key elements in a growing economy is the availability of affordable and clean technologies that can support that growth and facilitate reduction of dependency on fossil fuels. As energy is the third biggest expense in the low-income societies, after food and housing (Gradl & Knobloch, 2011) and there are 587 million people living without access to electricity and 657 depending on traditional biomass for cooking in Africa (Gradl & Knobloch, 2011), there is high market potential for energy companies in the African market. In Tanzania alone, analysis discussed above showed that 90% of the rural populations live without access to modern energy (Ministry of Energy and Minerals, 2010b).

Global statistics show that the world population will continue to grow at a high rate, from todays 7 billion people to 9 billion people by the year 2050 (Gradl & Knobloch, 2011) along side it economic growth, and most of this growth will occur in non OECD countries (Gradl & Knobloch, 2011). Innovative approaches will be required to fill in the gap of the people living without access to modern energy. Therefore it can be inarguably said that developing countries (non OECD) is a huge energy business market potential for energy companies.

Constraints associated with low-income markets cannot be ignored when companies are dealing with developing countries, energy companies likewise. Usually, the constraints are what differentiate low-income markets with upscale markets. In most developing countries,

there is lack of infrastructures; financial services and the markets are informal (Tessier, 2011) (Webb, 2011). This condition makes transaction costs high and business model applicability low. To try and overcome the barriers, interaction with customers is crucial for business to be successful (Gradl & Knobloch, 2011).

Once there is customer interface, companies need to acknowledge challenges that may arise from business transactions i.e. sales. These challenges arising from sales transactions are:

Limited understanding of customer preference: as business often lacks enough knowledge on the target group since most of the customers are in rural areas where there is no proper record keeping of statistics. Products are not going to succeed if they are not wanted, or they are considered inappropriate.

Lack of legal titles: as rural population in the developing countries do not have legal title deeds to their homes, or other pieces of land which are used under customary land ownership (Tayari, 2011) and without formal ownership certification it is difficult to sign contracts.

Inefficient delivery channels: Some rural villages do not have central shops or outlet points; have poor road conditions making the villages difficult to reach (Tessier, 2011) and making building distribution network more expensive than normal (Tessier, 2011).

Sometimes there is *lack of skills among local staff*: while for business to prosper good communication and negotiation skills is a necessity. In some cases, book keeping and computer literacy is non-existent to the staff (Gradl & Knobloch, 2011).

Limited knowledge of products and use: particularly with target customers because they are used to traditional energy supply i.e. charcoal and woods.

Income and profitability

As soon as business transactions has taken place, the issue of payment arises. Payment occurs when a customer has bought in goods or services, and is required to pay for those goods or services in cash or in credit. Due to lack of formal credit lines and access, many payments in low-income markets are often conducted on cash basis (Tessier, 2011), and are uncertain and irregular. This is caused by the lack of credit services in the rural areas. The fact that all payment has to be undertaken on a cash basis creates a challenge for the businesses and increases the risks of theft and robbery. Other challenges to be overcome from business transactions are mentioned below, but the list is not exhaustive:

Affordability: Businesses need to ensure that appropriate conditions are in place so that having access to energy for consumers feel that there is return to the investment they have made. Without positive impact on the economic situation to the consumers, they may feel ripped off by the investment they have made and become unwilling to pay for the product (Gradl & Knobloch, 2011).

Liquidity: Because of high upfront expenses associated with renewable energy (Raphael, 2011), low income customer sometimes lack sufficient savings or access to credit regardless the fact that return on the investment justifies the cost. In other words, consumers would be more at easy buying a product they feel secure they can re-sell if they are no longer in need of or dissatisfied with it.

Enforcement of Payment: Remote areas of the developing countries frequently lack proper and functioning law enforcement mechanisms. Relying on legal contracts may not prove to be successful in the long run and may results in corruption and bribery. Informal mechanisms built on trust and personal relationships in the village may prove to be the best way to receive payments from the villagers (Gradl & Knobloch, 2011).

Lack of Understanding: Villagers often do not understand cost structures. Sometimes villagers fail to see why they have to pay for energy service when in their normal way of life they had been able to survive without it (Raphael, 2011).

Service and product end-of-life

Once the product has been bought and delivered to the customer, a business needs to ensure that there is Service availability in case of repairs and maintenance, and that at the end of the life, the product is disposed off in a right manner. This part of the business model also tries to ensure the equipment is maintained reliably, and that immediate support is available when required by the consumers. Making sure that the service is available to the customers is important to secure customers and to make sure that customers do not take things into their own hands. Challenges in providing of service to low income markets are:

High Costs of service provision: Poor levels or bad conditions of infrastructure make it very expensive for companies to transport systems or spare parts to the villages (Raphael, 2011). Additionally, keeping skilled staff within the company can be expensive (Tessier, 2011).

Availability of spare parts: Keeping spare parts at local stores can be expensive as well as storing them in a storage room because it is going to be dead capital, unsure of how big or when next the consumers will want more of the product (Gradl & Knobloch, 2011).

Environmental Damage: Harsh environment subjected to the products can cause damage to the equipment. Sometimes due to poor housing conditions or lack of insulation, protection, extreme temperature fluctuations then the equipment can break or become damaged (Gradl & Knobloch, 2011).

Lack of customer skills: Due to low income or poor lifestyles, sometimes people in the developing world tend to install, service or repair their own products so that they can avoid the costs of doing so using the service providers (Tessier, 2011). In some situations, this may cause damage to the product, reducing the life of the product. In the end the customer will end up blaming the company for bad products.

Unskilled local representatives: Local labor market in the developing countries sometimes lacks labor skills and expertise to operate the products, provide maintenance and repairing services. Ensuring local representatives with competence to run and operate the products can become a challenging issue (Ogwang, 2011).

Last phase of the business model is the end of product use. To avoid the repercussions of environmental pollution, the business must consider the end of life of the product and how customers must deal with it afterwards. Rural villages lack waste management/disposal systems that may create a problem for non-degradable products e.g. solar lamps. Other challenges associated with end of product use are:

Disposal of Products: When products become broken and cannot be fixed anymore, they become wastes. Methods of disposing wastes off properly are not a common knowledge. It is possible to find wastes that may contain toxic substances disposed off in the street, causing pollution and becoming a health hazard to the society (Gradl & Knobloch, 2011).

Lack of wastes management systems: Most of the villages in rural areas and some urban centers are not equipped with waste management systems. As discussed in the disposal of products, this leads to products being disposed off unsafely and improperly leading to health and environmental pollution (Tayari, 2011). In case of products with toxic substances such as batteries, they can contaminate ground water, cause health problems to animals and humans.

The above discussed are some of the common challenges encountered by businesses whilst carrying out business transactions in developing countries and low-income markets. Nevertheless, companies need to be aware of such challenges and gear themselves to tacking them, by researching and studying their markets before venturing into business operations. Recommended solutions from BoP model on the challenges have been explained in appendix 5.

1.5 Data Collection

Three methodologies are used in the research to collect data: interviews, participatory approach and comparative case study.

Semi structured interviews with policy makers; climate entrepreneurs, private investors and climate change stakeholders were conducted. The purpose of the interviews was to find out the policies and approaches that are being employed to encourage transfer of technology in the Tanzania by the government, as well as gaining an understanding on the technology situation, drivers and constraints of conducting renewable energy business in Tanzania. A set of two questionnaires will be formulated: A questionnaire for policy makers, and a questionnaire for entrepreneurs involved in renewable technologies. A total number of ten (10) interviews were conducted to determine the current incentives and strategies that Tanzania is deploying to facilitate technology transfer of renewable energies and encourage climate change mitigation entrepreneurship. The interviews established that, there were not a lot of incentives that have been put in place to attract investment in renewable energy in Tanzania or to facilitate the transfer of renewable energy technology. Furthermore, here is no particular attention being paid to one sector of energy than the other, in a sense that all sources of energy in the country are grouped together, whether it is fossils fuels or renewable energies (Kiwele, 2011; Raphael, 2011).

A facilitation workshop with climate entrepreneurs and wood fuels users at the local level was conducted. The aim of the workshop was to bring together some of the entrepreneurs in conjunction with energy users in order to initiate a direct feedback loop where gaps could be identified on the technological needs from the consumers.

Since entrepreneurs are part of the target group for the research and an important channel for the spread and diffusion of low carbon technologies, the workshop will bring to light the needs and the views of the target group and therefore it will make it easier to come up with better innovative solutions to the research questions. Involvement of the vulnerable group was significant because through their experiences they could come up with practical solutions to the problems they face when using wood fuels and charcoal.

Integration of the above three methods for data collection helped the author to come to a better understanding of the real situation concerning technology transfer, channels for diffusion of LCT's and the real situation for effective implementation of the technology transfer in Tanzania.

1.6 Scope and Limitations

Climate entrepreneurs addressed in the research are small to medium sized companies that deal with importing; installing and maintaining low carbon technologies. In the scope of this paper, low carbon technologies referred as being to solar, biomass and bio diesel only.

Because of low level of clean technologies in the region, the study reviewed an integrated mix of energies without separating one from the other to gain an overall understanding but particular attention will be paid to solar, biomass and bio diesel.

The scope of the thesis is based on the UNFCCC model of technology transfer after 2010 Cancun COP 16 agreements. The research also involved another model in conjunction with the framework: IEA technology innovation chain. A highlight of other efforts by UNFCCC to enable developing world with LCT's and capacity building will be briefly evaluated in the paper.

A total number of 10 interviews were conducted (appendix 2). Efforts to interview more candidates particularly people in policy-making institutions failed due data collection time interference with on going parliamentary sessions. During the time the author was collecting the data, the ministry of energy and minerals (MEM) was presenting its yearly budget to the parliament. Most of the ministry's employees were in Dodoma for parliament budget sessions.

Due to power shortages in Dar Es Salaam, it was difficult for the author to carry out some of the interviews as offices were closed. Consequently, writing of the thesis was severely interrupted by constant power cuts. Electricity was available every other day, for the duration of 8-10 hours only. Unstable power supply limited my ability to write full time, in some situation I had to move from one area to another in search for locations with electricity.

The scope of the research had to be narrowed to Tanzania only. The initial intention of the research was to analyze three East African countries: Tanzania, Kenya and Uganda. Time limitation made it impossible to conduct the interviews in Kenya and Uganda. However, reference to this paper is not of the result of the analysis of Tanzania alone, but Uganda and Kenya's literature as well as other developing countries were reviewed.

1.7 Intended Audience

The thesis research is intended for the following groups of people, among others:

Policy Makers: Government bodies form a major and potential resource who conduct the process of policy making, provide the required enabling environment for technology transfer mechanisms to function, give incentives required to investors, as well as understand effective policies that have worked elsewhere in the world to increase application of renewable technologies. The aim of this research is to give policy makers a look of the real situation on renewable energy technologies from the viewpoint of a researcher, as well as contribute to the literature available on energy sector in Tanzania.

Public Private Investors: Prior to making any big investment decisions, investors need to understand incentives and business environment available in the potential country. This research will enable investors interested with renewable energy businesses in Tanzania to understand the prerequisite business conditions if they were to invest in Tanzania, as well as the favorable environment for business operations in the country.

International Organizations and NGO's: Tanzania's share of renewable energy is quite low. There is a lot of donor and international organizations that are involved in promoting renewable energy in Tanzania and Africa in general who advocate and positively influence policies. This group international organizations will find this research useful, because it will provide understanding of the current policies and incentives on renewable energy as well as giving them a picture of technology gaps that needs international attention and way to move forward on what is needed in the country to better the conditions so as to increase the contribution of renewable energy in the country.

All renewable energy sector stakeholders, and energy stakeholders in general in Tanzania will find this research of importance in order to understand energy sector in Tanzania.

2 Conceptual considerations

The conceptual framework developed for the thesis is guided by several concepts. As established by the technology transfer framework, TT is a complex issue involving an integrated mix of variables and concepts. To guide the research process for the thesis, the following concepts are further elaborated in the section of conceptual considerations: Technological Change, Technology Transfer, Policy Instruments, Intellectual Property Rights, Channels for Technology Transfer and Energy Systems.

2.1 Technological Change

Technology change is a continual process involving development of new and old technologies occurring over a period of time, developed and diffused by human beings (Ahuja, et al., 2007). Technological change is an important concept in technology transfer because technologies involve continious innovative process that are always changing to adapt to current needs and improve on the existing technologies.

Technology transfer has two defining characteristics: one, technological change is uncertain and unpredictable because time, cost and success of research and development of technologies are not assured (Foray, 2009). Secondly, technology is transferrable and a public good in nature and therefore, diffusion and spill overs of technology can be regulated but not always controlled, which makes it difficult to gain benefits of research and innovation (Ahuja, et al., 2007). The fact that once it has been created, its full value becomes difficult to measure makes the value of technology hard to quantify.

Ahuja, et al., divide technology change into a two process, the first one being the conceiving, creating and developing new technologies or enhancing existing old technologies and the second process is the deployment and diffusion of the technologies.

Drivers that enact new technologies are from three defined sources: research and development, spill overs and learning by doing. R & D involves a set of activities which governments, firms and interested stakeholders consume their resources to gain new knowledge or improve existing technologies (Ahuja, et al., 2007). R and D can focus on either providing long term knowledge or on new knowledge of technologies. Key players in R and D are the private sectors since innovation and development of new technologies increases their competitive advantage over their competitors. The benefits of R and D include the ability to reduce amount GHG emissions via innovation of clean technologies or energy efficient products.

Another technology change process is enhanced though learning by doing. Learning by doing occurs when employees consume technologies through market deployment (Hoekman, Maskus, & Saggi, 2004). The more an individual repeats a task, the more they understand it better and perfom it better, suggesting ideas for perfomance improvements. Learning by doing and R & D interlink through provision of feedback which enables improvements and adjustments in technologies to increase the overrall technology effectiveness and efficiency (Ahuja, et al., 2007).

Spillovers occurs when knowledge is transferred from one individual, firm or entity to another. Spillovers can occur between firms, industries as well as between country. Spillovers

create incentives for receiving countries but can limit innovation for source country as the return of investment on knowledge is minimal.

Technological change is an important aspect in technology transfer because of the nature of technologies. Technologies are always changing, they overlap, they are cyclical and are in constast development process (IEA, OECD, 2003). Due to this fact, technology transfer needs to encompass changes in technology to adapt to current technological needs.

2.2 Technology Transfer under UNFCCC

Technology Transfer is defined as "*a broad set of processes covering the flow of know how, experience and equipment for mitigating and adapting to climate change amongst different stakeholders such as private sector entities, financial institutions, governments, non government institutions and research/educational institutions*" (IPCC, 2000).

In the conference of parties in Cancun Mexico in December 2010, the UNFCCC and governments of the parties agreed on several measures to ensure technology is transferred to the developing countries. One of the agreements of the conference was to increase cooperation on mitigation and adaptation technologies and capacity building to developing countries (UNFCCC, 2011b). To do so, governments under UNFCCC established a technology mechanism for development of technologies: accountable to the COP. Within the technology mechanism, a Technology Executive Committee (TEC)[4] and Climate Technology Centre and Network (CTCN) were enacted for development and deployment of new clean technologies, increase public and private investment in TT, enhance clean technology capabilities and prompt action on existing technologies (UNFCCC, 2011).

The parties to the conference confirmed on the importance of international cooperation on the development and transfer of LCT's and recognized the urgent need for early rapid emission reductions, with diffusion of LCT's being a key player to the mitigation of emissions (UNFCCC, 2011c). The conference went on to stress the need for effective enabling environment and removal of trade barriers and decided on supporting action on mitigation and adaptation so that the implementation of the convention is achieved (UNFCCC, 2011c).

The conference put priority measures under the Convention to be: development of cooperative research, development and demonstration programs, deployment diffusion and know how of LCT's, public and private investment in the transfer of LCT's, climate change observation systems and technology innovation centers and lastly, enhancement of national technology plans on mitigation and adaptation (UNFCCC, 2011c).

2.3 Policy instruments

Policy instruments are hereby understood as the measures designed and implemented by governments to create incentives for encouraging the diffusion and commercialization of low carbon technologies and thus help the reduction of GHG emissions (IPCC, 1996). The IEA identified policy instruments as drivers to facilitation of low carbon diffusion and consumption, as they prove attractive environment for investors and entrepreneurs to engage in innovation of RET (IEA, OECD, 2003). Among the measures and policies that can be applied as a step towards low carbon technologies are:

[4] Technology Executive Committtee was initiated under the Technology Mechanisms in COP 16 in order to give overview of technological needs and analysis of policies and technical issues in development and transfer of LCT's.

Market-based policy instruments

Market based programs are policy instruments which are regulated by the market forces (Ahuja, et al., 2007). The following market based instruments play a role in shaping energy systems and attracting use of LCT's:

- Subsidies

Longman defines a subsidy as any form of economical benefit or financial aid provided by the government. Subsidies aim to reduce the price of an item lower than the cost of its production.

Fossil fuels and other forms of energy do not reflect the true costs in the prices because the governments subsidize them. This fact makes the prices of fossil fuels lower than their actual costs. The fact that governments subsidize fossil fuels creates an entry barrier for new clean technologies, because new technologies cannot compete in prices with subsidized fuels (IPCC, 1996). In order to create opportunities for entry of new technologies, subsidies should be eliminated or minimized, or directed towards energies that reduce GHG emissions such as renewable energies (IPCC, 1996).

- Tradable Emission Quotas and Permits

The IISD identified issuing of tradable quotas and permits as useful instruments to control and regulate the market. Fulfillment of quotas often times lead to companies being careful with emissions or facing the costs of trading for quotas with other companies or buying more permits (IISD, 2003). Tradable quotas and permit can therefore help to facilitate technology transfers because it can enforce companies to invest in climate friendly technologies to avoid the risks of surpassing their quotas (IISD, 2003).

- Financing Assistance

Most developing countries are faced with capital shortages required to implement climate change mitigation and adaptation options. Provision of start up loans and grants to GHG mitigation projects will help resolve financial difficulties faced by developing countries to carry out climate change projects.

Regulatory policy instruments

Like in the case of market based instruments, regulatory measures are aimed to making sure that the polluter pays for the pollution caused by his activities. The government can set environmental policy with uniform standards for the costs of projects pollution, thereby being able to regulate the pollution caused thus improve the environment. The uniform performance standard set by the government can give greater incentives to companies especially the ones that pollute less, but at the same time, the disadvantage is that standards sometimes costs incurred are unknown and can sometimes be higher than market based instruments (IPCC, 1996).

Research, Development and Demonstration

Innovation is a prerequisite for technological change and advancement, and a significant player in mitigation of GHG emissions and climate change. Investment in R, D & D will

ensure innovation of clean technologies that can be used to facilitate the global challenge on climate change. Governments need to establish strategies that support R, D & D such as renewable energies, low or zero GHG emitting technologies (IPCC, 1996).

Removal of Institutional Barriers, and Local & Regional environment measures

Removal of trade barriers like monopolistic government institutions can help to attract the private sector to invest in renewable energy technologies. Structural reforms, public private partnerships and deregulation can help to attract and motivate small and independent producers to enter into the sector. Furthermore, the integration of policies and measures can facilitate the reduction of environmental impacts at national, regional and local levels as energy consumption lead to local and regional environmental impacts (IPCC, 1996). The selection of the above measures was done in relation to the case study for the thesis, Tanzania. These measures would be more practical and applicable for Tanzania as some of the constraints in Tanzania are a result of these policy instruments. However, other policy instruments exist with regard to technology transfer in developing countries.

2.4 Intellectual Property rights

It is impossible to discuss and analyze technology transfer without referring to Intellectual Property Rights (IPR) and their role in technology transfer. IPR's play an important role in encouraging investment in innovation by establishing boundaries for technology developers to control and reduce free riding (Abbott, 2009). Enforcement of IPR is a complex issue in TT, which has no one resolution (UNFCCC, 2010). Companies are not willing to sell their technologies to developing countries firms when they are unsure whether the technology will be copied or sold to other companies by the local firms (Markowitz, 2007). The World Trade Organization (WTO) developed TRIPs agreements on technology transfer between developed and developing countries on basic protection of copyrights, industrial designs, trademarks and undisclosed information (Foray, 2009) to try and facilitate and at the same time promote technology transfer and IPR.

IPR is a two-sided agenda; on one hand it is believed to be a barrier to technology transfer (Lema & Lema, 2010) especially from the perspective of the developing countries because it imposes financial liability to the host country, and on the other hand it is considered to be a key element to facilitate innovative activities by developed countries technology companies (Foray, 2009). Therefore, in order for technology transfer to become effective, a win-win solution has to be identified where both parties gain mutual benefits in carrying out business (Cannady, 2009).

Developing countries policy makers often associate IP and payments for technology transfer as being beyond their capabilities and that TT does not contribute much to technological development in their respective countries (Ahuja, et al., 2007). In other cases, IPR has been found to hinder technology transfer as much absorption of technologies and their adaption is linked through informal mechanisms and imitation (ICTSD, 2009).

2.5 Channels for Technology Transfer

Technology is transferred through three types of flows: flows of capital goods, engineering services, equipment designs, two: flows of skills and know-how for operation and maintenance and three, flows of knowledge, experience and expertise for generating and managing technological change (Hoekman, Maskus, & Saggi, 2004). However, technology can be transferred from one country to another via a number of channels. In the UNFCCC

context, technology transfer to developing countries can be done using the following channels:

Trade in Goods and Services

Trade of goods and services between different countries, particularly between countries that are well developed industrially, and have high level of R & D can be one of the ways of transferring technology (Hoekman, Maskus, & Saggi, 2004). Local firms can gain access to new machinery and equipment through trade of goods with exporting countries. In the case of developing countries, the more trade going on with developed countries, the more technology it can receive through the trading process (Hoekman, Maskus, & Saggi, 2004). To facilitate this process, the host country should enact open trade policies that can work in the favor of the importing country as far as technology transfer is concerned (IPCC, 1996). In addition to trade policies, developing countries will need to have the capacity and ability to adapt to this new technology (Hoekman, Maskus, & Saggi, 2004) (Cannady, 2009). Technology transfer does not deal with the transfer of hardware products per se, but involves software necessary to run the hardware and the skills required to operate the technology sustainably, in other words, organizational ware (Dahllamar, Peck, Neij, & Mundaca, 2009). It is significant to note that international technology is easier transferred when there is not a large gap in R&D, domestic private and public research laboratories and universities as well as technical skills and human capital (Hoekman, Maskus, & Saggi, 2004). In Tanzania, the major importing country is China. Studies show that China will play a significant role in Africa's renewable energy sector: Tanzania's no different (Bjorn, Mercedes, & Bamshad, 2011). In the last decade, trade between China and African countries have increased by 33.5% (Bjorn, Mercedes, & Bamshad, 2011). There is evidence of China's intensified presence in Africa, in some cases, in the renewable energy business like large hydro power, and other renewable energies (Bjorn, Mercedes, & Bamshad, 2011).

Foreign Direct Investment

Foreign Direct Investment (FDI) is another method in which developing countries can use to attract international technology. Often, multinational enterprises (MNE's) transfer technologies to local firms that are suppliers or buyers of their output (Hoekman, Maskus, & Saggi, 2004). In this case, technology can be transferred to the host country through spillovers or labor turnover (IPCC, 1996). Labor turn over is more experienced in countries where local firms are too far behind MNE's giving the ability for local firms to absorb new technologies and get the technology through diffusion (Hoekman, Maskus, & Saggi, 2004). Movement of people within firms is another channel for international technology transfer particularly when foreign companies bring in source countries foreign nationals into the country, or when nationals working or studying abroad return to their home country (Hoekman, Maskus, & Saggi, 2004).

Licensing

Licensing is an important part of technology transfers because it involves the purchase of products, distribution, and technical information and know-how (Hoekman, Maskus, & Saggi, 2004). Licensing is, however preferred by investors in countries where there are substantial engineering skills and R & D programs for adaptation to avoid the risks that technologies are not copied; there is no industrial espionage, or technical personnel to move to competitor firms (Ahuja, et al., 2007). Chances of licensing can be very small or investors may choose to

license technologies that are lagging behind when investors feel that the host country may jeopardize the spread of technology (Hoekman, Maskus, & Saggi, 2004).

The major challenge that faces host countries in the transferring of technology is enabling environment. Factors that are crucial for TT are infrastructure, open trade policies, government stability, transparency, and domestic entrepreneurial, among other things (Ahuja, et al., 2007). For absorption of international technology transfer, local capacity is required in terms of R & D, engineering and management skills, education and training, telecommunications, e-commerce, bio technologies and cost saving technologies (Hoekman, Maskus, & Saggi, 2004). In most of the developing countries, these conditions are have not been met fully. Other common pathways for technology transfer are government assistance programs, direct purchases, joint ventures, co- production agreements, education and training and government direct investment (Ahuja, et al., 2007)

3 Case study: Tanzania

3.1 Economic aspects

The union between Tanganyika and Zanzibar forms the United Republic of Tanzania. Tanganyika attained its independence in December 1961 from the British. In 1964, Tanganyika and Zanzibar united to form a United Republic of Tanzania (Tanzania National Website, 2011). Tanzania is located on the East of Africa, sharing borders with Kenya and Uganda on the Northern side, Democratic republic of Congo on the western side, Zambia, Malawi, and Mozambique on the South and the Indian Ocean on the East (figure 5).

Tanzania is a democratic country holding democratic general elections every five years, of which the president can stay in office for a maximum of ten years. The current serving President in Tanzania is Hon. Jakaya Mrisho Kikwete. The Tanzanian Government regime is guided by three main components: The Executive, Judiciary and the Legal system (Tanzania National Website, 2011).

Poverty and Natural Resources

Being one of the world's poorest countries, Tanzania ranks as one of the world's poorest nations, together with Malawi and Zambia. 35% of the populations in Tanzania live below the poverty line (World Bank, 2009). The majority of the people in Tanzania depend on agriculture, characterized with subsistence farming for economic activities and food security (World Bank, 2009). Education system and health services in Tanzania are inefficient and insufficient and often lack manpower facilities resources.

Despite its position as one of the world's poor countries, Tanzania has abundant natural resources that have the potential to be exploited for economic growth. Availability of abundant water bodies (figure 5) rewards Tanzania with plenty of waters for fisheries. Tanzania is also home to several mining zones such as Shinyanga where diamond and gold is mined and Arusha: the only place in the world where Tanzanite is found and mined (Tanzania National Website, 2011). There are also several gemstones found in the country. There are rangelands and savanna grassland with numerous wildlife and potential for livestock as well as vast arable land for agriculture. Recently, studies have shown that Tanzania has a potential for oil reserves and uranium although none of the oil has been found yet (Tanzania National Website, 2011). In term of sources of renewable energy, Tanzania being in the tropics is blessed with solar for almost all year round and wind in selected parts of the country.

Tanzania Country Profile

Name: The United Republic of Tanzania

Capital and Area: Dodoma and 947,300 km^2

Currency: Tanzanian Shilling

Population: 43.2 million

GDP: $ 23 billion

Inflation: 9.7%

Economic Activities: Agriculture, Tourism Mining, Manufacturing, Fishing

Exports Products: Gold, copper, diamond tanzanite, natural gas, cotton, sisal, coffee.

Source:
http://www.tradingeconomics.com/tanzania/indicator

There are several oil exploration companies from Brazil and China in conducting oil exploration activities in Tanzania.

Although Tanzania has massive opportunities in natural resources, Tanzanian economy is still dependent on agriculture as the main contributor to its socio-economic growth. Agriculture is the largest contributor to the country's GDP (Tanzania National Website, 2011). The agriculture sector account for 46.5% of the national GDP and contributes 50% of the country's foreign currency earnings. Additionally, agriculture is the main source of employment, employing ¾ of total population in the country (Vice President's Office, 2008).

In the mid 90's the Government of Tanzania initiated structural economical, social and political reforms as recommended by IMF and World Bank. The aim of the reforms was to broaden and strengthen the role of free market, to encourage investments, promote democracy and liberalize trade. All these structural reforms targeted creation of enabling environment for the private sector (Tanzania National Website, 2011). Government structural reforms have helped to increase the amount of private investors in Tanzania (Lyimo, 2011).

Figure 5: Map of East Africa Region. Source: http://www.sitesatlas.com

3.2 Energy aspects and Power Shortages

Tanzania energy sector is characterized by high consumption of wood fuels (biomass base) as the source of energy (Ministry of Energy and Minerals, 2010b). It is estimated that 90% of the population in Tanzania use wood fuels as the source of energy for heating and cooking (Sawe, 2011). The remaining 10% of the energy comes from imported petroleum (8%), 1% from electricity and 1% from renewables and other sources (Sawe, 2011).

Large and small hydropower plants supply Tanzania with 560MW and 4 MW of electricity respectively. Despite hydropower having the potential of 5000 MW (Tanzania Ministry of

Energy and Minerals, 2003), the amount of power supply from its sources is still minimal. Tanzania has other power generating reserves that could be exploited for electricity production (Sawe, 2011). In Tanzania, coal reserves are estimated to be at 1200 million tones of which only a small amount (almost negligible) is being mined for electricity generation (Tanzania Ministry of Energy and Minerals, 2003). Natural gas reserves are estimated to be at 45 billion m^3. Regardless of the sources available, all petroleum in the country is being imported (Tanzania Ministry of Energy and Minerals, 2003).

In 2007, national grid electricity generation was 4185 GWh, 60% of it coming from hydropower, 3% from coal and 1% from diesel (Ministry of Energy and Minerals, 2010). The remaining electricity is imported from Uganda and Zambia (Ministry of Energy and Minerals, 2010).

Major energy users in terms of sectors are transport sector in Tanzania, consuming 40% of imported petroleum, manufacturing sector, mining sector, which has an annual growth of 15%, household sector, agriculture sector, commerce sector and information technology sector (Tanzania Ministry of Energy and Minerals, 2003).

In Tanzania, only 14% of the population has access to electricity (Sawe, 2011). The population in Tanzania is growing at a rate of 2.9% annually, and the economy at a rate of 6% per year (Tanzania Ministry of Energy and Minerals, 2003). The demand for electricity is expected to triple by the year 2020 (Tanzania Ministry of Energy and Minerals, 2003). More energy sources are required to meet the growing electricity and energy demand of growing economy and population. Population growth and lack of affordable energy substitutes will continue to increase the dependency of Tanzanians on wood fuels, fossil fuels and increase Tanzania's energy insecurity.

In the rural parts of the country, only 2.5% of the population is connected to the national electricity grid (Sawe, 2011). The rest of the population in rural Tanzania depends on wood fuels for heating and cooking energy and kerosene for lighting. The dependency on wood fuels and kerosene increases deforestation activities, pollution and soil degradation (Tayari, 2011). Since agriculture is the main economic activity in the rural areas and main source of national and domestic revenue, deforestation and soil degradation affect economic growth and livelihood of rural population of Tanzania, increasing the country's poverty levels.

Government efforts to increase electricity production, and reduce biomass dependency, share of renewable energy technology in the Tanzania is still very low, currently standing at 2% of the total energy source in the country (Msuya & Chisawilo, 2009). As UNEP, WWF and other international environment organizations are working towards a goal to reduce the amount of greenhouse gas emissions by 50% in the year 2050 (International Energy Agency, 2009), and 80% by WWF: the on-going efforts to make East Africa region and Tanzania in particular a renewable energy region will increase the demand for clean technology products. Moreover, in efforts to combat climate change, rapid dissemination of clean energy technologies will increase the demand for LCT's in Tanzania (International Energy Agency, 2009).

This year of 2011, Tanzania is facing a major challenge in terms of drought and lack of rainfalls. Low levels of water in the hydro power generation plants associated to climate change (prolonged droughts), has led the country to experience long intervals of power blackouts and power rationing (Ministry of Energy and Minerals, 2010a). These energy and power problems are caused by low water level in the dams that generate electricity reduces electricity production causing power black outs in the country. Energy and electricity

problems are limiting the country's productivity, affecting investors' portfolio and perception and limit social activities (Webb, 2011). The ministry of energy and minerals in Tanzania announced via the media that the 12-hour daytime power cuts would affect 15 regions of the country (The Citizen Newspaper, 2011). The secretary to the ministry explained further that the government is on the lookout for long term and short term solutions to the problem (The Citizen Newspaper, 2011). Power rationing in the country is not expected to end anytime soon.

"*The situation is critical and if we generate electricity at full blast we might be forced to close the Mtera dam sooner than later."*
The situation is worse because we have a deficit of more than 200 megawatts in the national grid... the alternative projects to help out will take a long time to do so"
Statements from (Ministry of Energy and Minerals, 2010)

The government of Tanzania has been working on finding alternative means of energy supply in the country, including use of Songo Songo Natural gas and other forms of energy from private companies (Ngeleja, 2011). Lack of electricity in the country has initiated strong debate in the parliament, leading to a suspension from work of the secretary general of the ministry of Energy and Minerals (Clouds Media Group, 2011).

As far as alternate solutions to the energy crisis in Tanzania is concerned, the Tanzanian energy policy considers the renewable energy sector to be at the stage of demonstration and commercialization but does not have any particular policy dealing or encouraging with renewable energies per se (Tanzania Ministry of Energy and Minerals, 2003). There is no renewable energy policy guiding the renewable energy sector in the country.

Renewable energy (mainly minimal solar, wind and biodiesel) contribution to the national grid is less than 1.2% (Sawe, 2011). The Renewable Energy sector in Tanzania is made up of small scale to medium size solar products entrepreneurs, wind turbines installation companies, emerging biodiesel plantations, mini hydro plants, NGO's and private entities conducting feasibility studies on potential areas for renewable energy technologies (Ministry of Energy and Minerals, 2010a).

Solar Energy

Solar energy was the subject of interest to the author because solar is used mainly by a number of individuals in the country, NGO's and religious organizations that can afford to finance costly initial investments associated with solar infrastructure (Tayari, 2011) (Tessier, 2011).

There is plenty of sunshine in Tanzania almost throughout the year and compared to other renewable energies, the diffusion of solar technology to the rural areas of Tanzania is more widespread (Tessier, 2011), because usage of solar involves directly the consumers, unlike other sources of renewable energy such as wind, geothermal etc. Some of the solar products are affordable to the locals, which is a major driver in the diffusion of solar products use (Tessier, 2011).

Companies dealing with solar energy businesses consist of small-scale entrepreneurial companies who are mainly involved in importation and installation solar products, selling them to final consumers (Tessier, 2011). A few medium sized company deal with installing solar panels, which are expensive for an ordinary person to buy and have high initial costs for normal rural household family to afford. Solar panels are therefore installed into selected

health centers, primary schools and other village institutions as a source of electricity where there was none or back ups power.

Figure 6: Consolata Mission Centre Solar PV Back up in Dar Es Salaam. Photo credit: Sylvester Maembe

For example, ARTI TZ Ltd, an organization in Dar Es Salam that deals with importing, installation and maintenance of solar equipment sells the "plug and play" solar systems: smaller ones - 1.5 watts - 15 watts for mostly lighting and phone charging, which come from Barefoot Power an Australian company. The larger solar systems are procured in pieces with solar panels generally coming from Europe and China; the Batteries are from U.S.A, Kenya, Canada or India (Tessier, 2011). The inverters are usually from Holland, US, France or India. The Charge controllers are either from Germany, Holland or USA (Tessier, 2011). Wiring and installation accessories are bought and done locally.

Bio Diesel

Bio diesel is the new and emerging renewable energy business in Tanzania. Tanzania's land composition, structure and geographic position make it a favorable country to grow bio diesel crops because of its tropical location (Kiwele, 2011). A number of companies in Tanzania are involved in growing bio diesel crops for production of bio diesel such as jatropha, sugarcane, sunflower and cottonseeds.

The challenges facing the sector include lack of awareness and understanding of the available practices, and unavailability of proper policy and institutional framework to guide bio diesel production in Tanzania. The government through the ministry of energy and minerals is working on establishing the policies for bio diesel production. The current bio diesel plantations are operating on a business as usual basis, with a set of guideline (Ministry of Energy and Minerals, 2010b). The fact that there is no set policy on bio diesel production in Tanzania makes it a disincentive, especially considering the controversy associated with bio diesel farming vs. agricultural farming and its impacts to food security (Webb, 2011).

In 2006, a National Bio diesel task force was established. The function of the task force was to support bio diesel development in Tanzania, develop guidelines for bio diesel farming and

production in Tanzania while the policy and institutional framwork for monitoring was been made (Kiwele, 2011). At the moment, already a number of investors are operationg bio diesel farms, e.g. Agro Eco Energy, a Swedish company which produces bio diesel from sugar cane in Bagamoyo (Kiwele, 2011), Sun Biofuel who produce bio diesel from jatropha plants in Kisarawe, and Procorn in Mpanda region, which uses local farmers to produce bio diesel from mejalocapas croton (Kiwele, 2011).

Since bio diesel is an emerging energy sector in Tanzania, the ministry had no policy guiding bio diesel crop production. In 2010, the ministry of energy and minerals formulated guidelines on bio diesel production (Ministry of Energy and Minerals, 2010a) (Kiwele, 2011). At the moment, the sector is operating on a "business as usual" basis while the ministry of energy and environment is working on formulating the policy for bio diesel (Kiwele, 2011).

3.3 Environment al aspects

Tanzania does not depend entirely upon fossil fuels as the sources of energy (Sawe, 2011). Wood fuels and charcoal are major sources of cooking energy, while industries and household lighting consume electricity produced by hydropower. Almost 99% of electricity in Tanzania is generated from hydropower (Sawe, 2011). Use of charcoal and wood fuels as the sources of energy by a large percentage of the population and logging activities contribute significantly to deforestation in Tanzania (Sawe, 2011). Other contributors to GHG are the transport sector and manufacturing industries.

In Tanzania, the main source of GHG emanates from deforestation for woof fuels and charcoal purposes (Sawe, 2011). High rate of forest harvesting to meet the demand for wood fuels and charcoal has led to massive cut down of trees (World Bank, 2009). As a result, deforestation is increasing at an alarming level, which has prompted the government to act on guidelines and policies on forest harvesting. However, policies for charcoal consumption and production have not been formulated yet (Sawe, 2011). High consumption of charcoal and wood fuels has also raised the attention of international organization, and currently Tanzania is under REDD+ initiative working with a number of projects on reforestation, and control of forest sources.

Due to intensive charcoal use, enabling Tanzania in technologies especially the ones that will help to reduce the use of wood fuels would be a major step towards mitigation of and adaptation to climate change. For example, development of cooking stoves that are energy efficient (figure 6) and consume fewer amounts of charcoal and wood would help in the reduction of deforestation activities. Cooking stoves have been experimented and found out that they produce the same required energy with fewer charcoal materials, and emit less CO as compared to conventional traditional cooking stoves.

Figure 7: An example of energy efficient cooking stoves. Source: TaTEDO

The fact that wood fuels will continue to be the source of energy in the foreseeable future in Tanzania (Ministry of Energy and Minerals, 2010) is of concern. Over exploitation of wood fuels is contributing to Tanzania's carbon footprints, GHG emissions and economic underdevelopment. Additionally, wood and charcoal production, use and marketing are conducted in an informal basis costing the country income on tax revenues (Sawe, 2011). In 2007, 95.6% of the households cooked with biomass, an increase of 3.1% from 2001 statistics. The annual charcoal consumption is 1 million tones, almost half of it being consumed by the residents in Dar Es Salaam (Ogwang, 2011).

Per year, charcoal business activities produce approximately USD 650 million (Sawe, 2011), which are not formally booked into the government statistics. The continual unsustainable production and consumption of wood fuels in Tanzania (figure 8) as the energy source for cooking purposes will result, inter alia, to severe climate change and adverse health effects, poverty and famine (Ogwang, 2011). The government needs to include charcoal and wood consumption measure in the energy and budgetary polices (Ogwang, 2011).

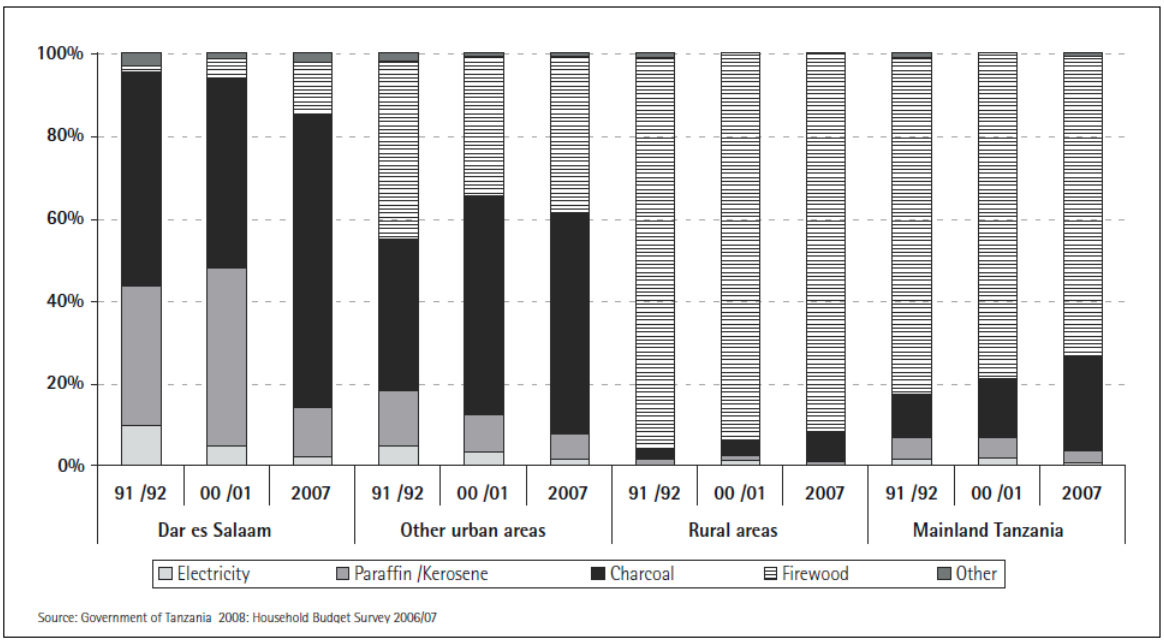

Figure 8: Percentage Energy Use for cooking purposes. Source: World Bank[5]

In the National Development Vision 2025, the government has set two targets that also address renewable energy sector and biomass use: one is to decrease the country's dependency on woodfuels including charcoal from 2000 levels of 90% to 80% by the year 2010 and two, to increase the percentage of the population using efficient bimass technologies from 10% in 2000 to 50% in the year 2010. These targets are yet to be met (Ogwang, 2011).

A need for formulation of proper policies addressing wood fuels production and use is required, as well as policies and strategies to facilitate and promote use of other sources of energy, most importantly, renewable energies and energy efficiency measures (World Bank, 2009). The questionnaires formulated will try to look at and understand the policies and strategies that Tanzania is applying to increase the share of alternate low carbon energy technologies, in specific, renewable energy.

Energy efficiency is of significance to Tanzania, because wood fuels are expected to continue being the supplier of energy (Ministry of Energy and Minerals, 2010), to the majority of the population. Designing of equipment for cooking that will use less amount of wood and charcoal will help to reduce the amount of trees being cut down for wood and for charcoal. The traditional three stone cooking stoves used in open air by the majority of rural dwellers leads to heat losses of up to 50% of due to wind and air open cooking (Tayari, 2011). Most rural dwellers use wood for cooking (figure 8) while less than 10% of rural families use charcoal or paraffin for cooking. Those who use charcoal use cooking stoves with very little heat efficiency (Tayari, 2011).

A few companies are working with local communities to facilitate the use of energy efficient stoves and improved charcoal making kilns. Energy efficient cooking stoves do emit minimal smoke when cooking (Tayari, 2011), thus reducing health risks coming from CO emitted when cooking with traditonal three stone stoves in the houses that are poorly ventilated. Energy efficient stoves are in the implementation stages with some of NGO's that are working with renewable energy technologies e.g. TaTEDO and ARTI (T) Ltd (Tayari, 2011). These NGOs are trying to use the energy policy to come up with renewable energy technologies for sustainable development. Since there is no specific renewable energy policy in Tanzania, this paper sights the case of India which can inspire Tanzania and other East African countries to forge ahead with policy considerations for renewable energy technologies.

[5] World Bank Report on Transforming the Charcoal Sector in Tanzania

4 Findings

This section is going to discuss the findings collected from carried out interviews and the given workshop. Findings will be divided into the following categories: Institutional aspects, innovation knowledge based, public investment mechanisms, private sector initiatives, channels for technology transfer and households energy trends.

4.1 Institutional aspects

Findings from the research has shown that, with the current energy crisis in the country, the Tanzanian government major concern is to ensure that there is enough energy in the country for economic growth (Msofe, 2011) (Ministry of Energy and Minerals, 2010a) and households' use, regardless of the source of that energy (Ministry of Energy and Minerals, 2010b). So the government of Tanzania is exploring all the resources available within the national boundaries and international, in order to procure energy supply in the country.

There are, however a few government institutions with departments that to a certain degree, deal with and address technology transfer and renewable energies. These are:

Ministry of Energy and Minerals

The ministry of Energy and Minerals is the main government' institution that deals with policy issues related to energy in Tanzania (Kiwele, 2011). The ministry formulates guidelines and policies for both general and renewable energies in Tanzania; sources of renewable energies include solar, thermal, bio fuels, large and mini hydro, wind etc. (Ministry of Energy and Minerals, 2010a).

In addition to policymaking and formulation of guidelines, the ministry conducts feasibility studies to find potential areas for renewable energy projects in the country (Kiwele, 2011). For example, the ministry conducted a study on areas where wind turbines to generate electricity can be installed in Kigamboni, Mtwara and Karatu. Findings showed that all the three areas were not feasible for wind turbines installation because of insufficient velocity: the maximum speed found in those area was 4.5m/s. (Kiwele, 2011) Another study was carried out in Mkumbara and Kititimo region and these areas were determined appropriate for wind energy production, as they both has wind velocity of 8m/s (Kiwele, 2011). After this study, this information was made available for the investors interested in wind turbine installation projects. Currently there are several large companies working on installation of wind turbines in the identified potential areas (Kiwele, 2011).

The government through the ministry of energy and minerals encourages renewable energy and climate entrepreneurs by exempting taxes all the renewable energy imported products. Renewable energy companies in Tanzania generating not more than 30kW of electricity are exempted from import duties, excise duty and VAT (Kiwele, 2011) (Adam, 2011).

However, solar products and other renewable energies are still very expensive to buy especially for final consumers despite tax exemption provided by the government (Tessier, 2011). This is contributed by, inter alia, high port charges and delays incurred at the Tanzania Ports Authority, heavy corruption in the administration and poor infrstructure for transportation of goods to reach the final consumer (Webb, 2011) (Tessier, 2011).

National Energy Policy

The National Energy Policy 2003 supports and promotes the use of renewable energy through the "diversification of energy sources" section in the policy (Kiwele, 2011). As far as renewable energies are concerned, this is the formal address of RET in the energy policy of 2003 . The "diversification of energy sources" is the part of the policy that address the renewable energy sector in the country. The term 'diversification of energy sources' in the policy means that the government encourages energy production from variety of sources and allows independent power producers (Kiwele, 2011). Independent energy companies producing electricity below 10MW in Tanzania, the price must use standardized power purchase agreement. Companies that generate more than 10MW have to consult EWURA for other power purchase agreements (Kiwele, 2011).

Tanzania Energy Policy 2003
Mission: *Ensure availability of reliable and affordable energy supply in their use in a rational and sustainable manner in order to support national development goals. The national energy policy therefore aims to establish efficient energy production, procurement, transportation, distribution and and end use systems in an environmentally sound manner.*

Table 1: Tanzania Energy Policy of 2003. Source: (Ministry of Energy and Minerals, 2010a)

4.2 Innovation-knowledge based

Tanzania Commission for Science and (COSTECH) is a research based institution operated by the Tanzanian government under the ministry of Communication, Science and Technology (MCST). The purpose of COSTECH is to deal with institutions that work with research on science and technology in Tanzania (COSTECH, 2009). The objectives of COSTECH are to advise the government on matters relating to scientific research and technology development, assist in the formulation of policies on the development of science and technology, to monitor and coordinate all scientific research and technology development, to dissiminiate scientific and technological information, to support R & D by mobilizing funds from internal and external sources, to facilitate regional and international cooperation in scientific research and technology development and to populize science technology and innovation (COSTECH, 2009).

The interview conducted with the director of technology transfer at COSTECH revealed that besides the National Energy Policy of 2003, there is no specific policy on one particular energy in Tanzania (Raphael, 2011). There is however, guidelines on each source of energy (Raphael, 2011). Generally, to attract RET investment in Tanzania, there is a public private partnership policy (PPP) of 2009 (Raphael, 2011). The PPP is a partnership between the public and private sectors to renovate, reconstruct, operate, maintain and manage a public facility by policy promotes and facilitates the running of public institutions by private investors (Prime Minister's Office, 2009). The PPP policy is run through privatization and trade liberalization policies, and its puprose is to have the participation of the private sector in Tanzania addressing government sectors which are facing problems due to budgetary contraints facing the country (Prime Minister's Office, 2009).

How does an interested investorr start a renewable energy business in Tanzania?

When an investor sees a potential in conducting a certain type of ernegy business in Tanzania, for example, lets take in the scope of this study, either production or importation of solar products, then he has the responsibility of doing a feasibility study on different aspects of solar business in Tanzania e.g.. the producers of solar products, worldwide, contact them and initiate proceedings for importation on the products into Tanzania (Raphael, 2011). COSTECH can faciliate this process by helping the investor/ entrepreneur by offering a list of known business contacts in the same business area and/or by providing information on where the product is needed or the project can be operated/conducted (Raphael, 2011). TIC can promote the business by offering the certificate of incentives which will exempt the company from import duty, VAT and excise duty on all capital goods (Adam, 2011).

4.3 Public Investment mechanisms

In order to facilitate the access of modern energy to the majority of Tanzania, the government established a Rural Energy Agency (REA), to undertake public interest in energy sector investments. REA is a government subsidiary established in 2005 to promote investment in the modern energy services specific to rural areas (Msofe, 2011). REA is part of the Ministry of Energy and Minerals, although its conducts its activities separately. REA works in partnerships with private investors, entrepreneurs, NGO's, Community Developments Projects and other government institutions (Msofe, 2011).

The objectives of REA are to: improve access to energy for rural Tanzanians through development of rural energy sources, technologies and projects in social sectors (Ogwang, 2011) and two: promote energy for productive use to accelerate rural economic development and associated benefits (Ogwang, 2011).

REA has an organized fund for its projects under Rural Energy Fund (REF) that is managed and co financed in collaboration with the Swedish and World Bank (Msofe, 2011). The fund works with mini hydro projects and grid extensions in areas where TANESCO has not been able to reach, and operates a credit line for renewable energy projects (Msofe, 2011) that REA takes the responsibility as a funder of part of the project costs. REA also assists NGO in biomass projects by training charcoal producers on energy efficient cooking stoves and kilns, briquette making (Ogwang, 2011).

Via Tanzania Investment Centre (TIC) investors receive incentives for business operations in Tanzania (Lyimo, 2011). Once an investor has followed all the procedures for opening a company in Tanzania he then requests for a certificate of incentive from Tanzania Investment Centre (TIC) by registering the company with TIC and following the procedures for obtaining the certificate of incentives. Among other things, the certificate of incentives from TIC helps the investors' company to receive the recognition from the government of Tanzania on its operations (Lyimo, 2011), protection of private property against non-commercial risks, zero per cent (0%) import duty on project capital goods, ten per cent import duty on semi processed inputs, 15% per cent import duty on fully processed goods and 25% import duty for final consumers (Adam, 2011). The investor also receives an abolition of the mandatory pre-shipment on imported raw materials that have zero rate of import duty (Adam, 2011), deferment of VAT payment on project capital goods and other incentives Adam, 2011).

For an investor to receive the certificate of incentives from TIC, s/he is required to fulfill a number of requirements, which are found in appendix 5:

4.4 Private sector initiatives

Tanzania Renewable Energy Association (TAREA) is the only association of renewable energy stakeholders in Tanzania, representing and addressing for recognition of the excellence of renewable energy technologies (TAREA, 2011). It is an association registered under the ministry of home affairs in 2001 (Msigwa, 2011). TAREA's mission is to promote and develop rational use of direct and indirect renewable energy through its members (TAREA, 2011). The functions of TAREA is to encourage research and education in the renewable energy, to disseminate knowledge and information in the field of renewable energy, to provide expert advise on RET matters, and assist in recommending standards and codes in the application of technology and related fields (TAREA, 2011).

TAREA also works in networking stakeholders in RET field by providing a forum for discussion on the development and dissemination of RET through conferences, workshops, symposia and exhibitions, providing forum for young RET looking for practical real world vice about career development (TAREA, 2011). TAREA does work in renewable energy market development, quality standards and code of practice for Tanzania and project development and implementation (appendix) (TAREA, 2011).

Among other things, the benefits of being a member of TAREA include the ability for RET businesses to network within the sector, getting access to TAREA database, tenders, website and promotion in the TAREA website and media channels, invitation to TAREA events, exhibitions, job opportunities and research opportunities (TAREA, 2011). TAREA is a good platform and one step on the ladder towards application of renewable energy sector in Tanzania.

4.5 Channels for Technologies transfers

As Tanzania is still in the developing stage, there is no state of the art research and development in renewable energy being undertaken in the country. Public institutions are mostly involved in giving education of LCT's, rather than conducting research and innovation of LCT themselves. As a result, the most common channel for diffusion of technologies in Tanzania is through imports, and trade of goods and services (Tessier, 2011) (Raphael, 2011).

Small to medium scale entrepreneurs are able to import products in the country, and diffuse into the local market through normal business activities such as selling and buying of goods. Most of the local LCT's products are diffused via this method.

However, large companies that do not directly deal with final consumers technology is transferred in the country via foreign direct investment (Kiwele, 2011). Once companies have established business activities in the country, they will be necessitated to bring in the expertise and technical skills from the original country, since the labor market in Tanzania does not have sufficient technical skills and the expertise. This way, technologies and know how is diffused into the local labor market via spillovers, and labor turn over as the local employees will receive training from the foreign companies (Cannady, 2009).

In Tanzania, for example, small and medium entrepreneurs who import solar products from China, India, Kenya, Germany and the Netherlands have managed to enable the diffusion of renewable energy technologies particularly solar products in the rural parts of the country. Climate entrepreneurs conduct their business by selling solar products to small retailers, final consumers, public institutions and other interested stakeholders. Therefore, it is through climate entrepreneurs that Tanzania has began and established the use of solar products to

rural areas of Tanzania where the majority of population is not connected to the national grid. Prior to solar products use, households in the rural areas depended on wood fuels for cooking, and kerosene for lighting: some of these households still do. Wood fuels and kerosene have effects to both human and animal health as well as the environment. Among other things, the effects of wood fuels use and kerosene are deforestation, drought, soil erosion, lung diseases and eyesight defects.

4.6 Households Energy Use Trends

The workshop conducted on household energy users showed that energy use in households is affected by a number of factors: size of the family, income level and availability of technologies for energy use. Paying particular attention to energy used for cooking for Dar Es Salaam residents, the research has shown that middle and high income earners use gas for cooking while low income earners depend on charcoal and wood for cooking.

The key answer to the usage of gas as the energy for cooking is the convenience of gas stoves, and easy access. For charcoal and wood users, the reason behind consumption of this type of energy is the affordability and availability. The fact that wood and charcoal can be purchased in small quantities at low prices makes charcoal and wood an attractive means of energy supply.

As long as charcoal will continue to be available at affordable rates and in small quantities, low income earning household will continue to consume it as the source of energy for cooking.

The results from the survey have also shown that 99% of urban households use electricity for lighting purposes. In events of power shortages, the alternate form of energy for lighting in households is the

5 Analysis and Discussion

Using the framework developed by the UNFCCC, the analysis of the collected field data is done by dividing the findings into four sub sections: enabling environment, capacity building, drivers and constraints of technology transfer and finally, the business model for low income markets.

5.1 Enabling environment

The UNFCCC framework stresses the importance of ensuring there is enabling environment (legal and policy frameworks, availability of positive incentives, market access) and removal of trade barriers in source and host country, in order to facilitate transfer of technologies.

Focus of policy environment

The results of the survey conducted in Tanzania (mainly Dar Es Salaam and Coast Region and literature review) showed that there are a number of issues when it comes to the country`s renewable energy development and technology transfer. The availability of enabling environment as emphasized in the framework by UNFCCC exists, but there is limited commitment to LCT's.

One, due to unstable electricity supply in the country, the mind set of the government and its institutions is not on the specific source of energy, or its repercussions to the environment but rather on the assurance of constant supply of energy to its consumers (Kiwele, 2011) (Raphael, 2011). So the policies being formulated by the government do not particularly favor one type of energy to the other, as long as that source of energy is secure, affordable and stable. This fact gives limited incentives to the investors and entrepreneurs of renewable energy technologies. On top of government not paying particular attention to RET and the contribution it has to reduction of climate change effects, there is also the feeling within the policy makers that climate change and GHG emissions globally has been caused primarily by the developed world, and the industrial revolution which has led to economy growth for the developed world (Raphael, 2011) (Kiwele, 2011). The sense is that it is the developed world responsibility to reduce climate change and GHG is huge. Policy makers feel that the developed nations are demanding developing world to cut down on GHG emissions and increase the use of renewable energy technology is a controversial discussion. The research showed that to the Tanzanian government, the most important issue at hand is ensuring that Tanzania receives stable and constant electricity supply, which is affordable to the citizens rather than experts from another side of the world telling them where they should source their energy and why they should do it in this particular manner (Kiwele, 2011) (Raphael, 2011). This feeling has come up in more than one interview with the policy makers.

The recognition for renewable energy and its significance to climate change mitigation and adaptation as illustrated by the frameworks are available, especially to government-established institutions for this purpose (Msofe, 2011). The main objective of the institutions however has been identifies as to provide electricity to rural areas that are not connected to national grid system and not necessarily to increase the share of renewables in the country (Msofe, 2011). NGO's and other private companies work hand in hand with government institutions in making sure the rural population of Tanzania reduces the use of wood fuels, through education and awareness energy efficiency equipment and use of renewable products e.g. solar for lighting. The government is also more concerned with climate change mitigation through REDD projects which advocate more tree planting and a number of development partners are sponsoring these activities. For example the Government of Norway is supporting the Wildlife Conservation Society of Tanzania (NGO) to work with communities to plant trees around Pugu and Kazimzumbwi forests in Coast region that is a source of charcoal and fuel wood for Dar Es Salaam city. Over the last 20 years these forests have been heavily degraded due to over extraction of wood fuels (Kiwele and Tayari, 2011). There are also other development partners in the country who support such REDD initiatives.

Focus of climate entrepreneurs

The results from the finding have indicated that entrepreneurs are among the significant players in the diffusion of LCT's in the country. For climate entrepreneurs, the motivation for doing renewable energy business in Tanzania does not solely come from profit making, although profit making is an important factor in business operations. The fact that profit is part of the business and is important for the company's operations and return on investment does not stop entrepreneurs from deriving other personal, social and economical satisfactions (Tessier, 2011). For example, in the case of solar entrepreneurs, through donor funds and government subsidies, ARTI TZ has been able to install solar panels to rural health centers, primary schools and other village institutions enabling health care services to take place 24 hours, enabling school teachers to conduct extra tuitions to students who need it, assisting students to be able to read at night and many other social benefits to the society

Case Study

Solar PV Back Up at Bukumbi Hospital

Bukumbi Hospital in Mwanza Region locate
40 kms away from the district hospital o
Misungwi was founded by Catholic Diocese i
1912. In 1957 it was developed to become
hospital from the dispensary level. It has 15
beds, offers services of out patient, maternity
X rays and ultra sound, examinatio
operations reproductive and child health an
laboratory services.

Although Bukumbi Hospital was connected t
the national grid system for power supply, th
hospital was experiencing high electricity cost
and unstable power supply that damage
electronic equipment when there was powe
blackouts.

In 2002, Bukumbi hospital installed a Sola
Photovoltaic system, which covered 80% o
the hospital's energy demand. The system wa
able to produce 10,560W of electricity.

The development of solar PV at the Bukumb
hospital has resulted in improved quality o
health services, saving lives of wome
experiencing obstructive labor and children.

Source: (TAREA, 2011)

"*The first time you turn a solar light on at a school or a clinic where they have never seen light before, there is nothing more satisfying than to see the smiles on people's faces. Bringing change to the society, and to be part of that change is very rewarding.*" Dennis Tessier, ARTI TZ - Programs Director

Table 2: Extracted from the interview on response for incentives of doing business in Tanzania

For the particular case of bio diesel plantations, results show that investors have engaged in partnerships with the locals whereby investors buy from local farmers crops for bio diesel production at a contracted price enabling farmers to earn income from farming bio diesel crops (Webb, 2011). Benefits such as these, have given investors the willingness to conduct RET businesses in Tanzania as it is possible to buy crops from the local farmers at a slightly lower price than the cost they would incur if conducted farming themselves (Webb, 2011), and provide employment to the locals at the same time.

The global consensus that new economic growth, which is occurring in the developing world at a large rate, needs to decouple growth with intensive greenhouse gas emission (UNFCCC, 2011b) (WWF, 2011), as was the case with the developed world (Cannady, 2009). Where it is possible and applicable, use of clean technologies should be adapted although this should not necessarily have to cost developing countries the ability to develop economically, at the expense of green economies (Raphael and Kiwele).

For example, it is understood that innovation is a prerequisite for low carbon growth in any country. But for Tanzania, there is very low amount of innovation going on in terms of R & D of renewable energy (Sawe, 2011). RET in the country are mainly imported from India, China and some developed countries. Despite the fact that there is open trade policies since trade liberalization and privatization of the 1990s, Tanzania still depends on the outside world for increment of share of RET (Sawe 2011).

5.2 Capacity building

In Tanzania, some efforts have been taken to include programs on renewable energy in tertiary learning institutions. Ardhi University of Dar Es Salaam in 2010 started two masters programs on environmental management and policy, as well as environmental engineering (Raphael, 2011). University of Dar Es Salaam Engineering College has been offering a bachelor degree Programme on Environmental Engineering for over a decade, and recently the Sokoine and Dar Es Salaam University (under the Institute of Resource Assessment) has started masters level programs on Environmental Studies (Raphael, 2011).

The Institute of Resource Assessment (IRA) at the University of Dar Es Salaam has also introduced the Mwalimu Nyerere Environmental and Climate Change Chair. The purpose of the chair is to organize trainings, seminars and workshops pertaining to environmental issues in the country, by inviting experts globally and locally to give lectures, talks and training on global environmental issues and climate change in association with Tanzania (Institute of Resource Assessment, 2011). The Mwalimu Nyerere Chair trainings are open to the professionals, academia, government institutions and the general public, and they are free of charge (Raphael, 2011). The institute is also providing scholarships to about 25 research projects on climate change adaptation and policies field of approximately USD 10,000 each to Tanzanians yearly. The aim of the scholarships is to promote global research capabilities in Tanzania (Institute of Resource Assessment, 2011).

The efforts outlined above are stepping stones to capacity building in the country, but more effort in required to ensure there is adaptive capacity for the majority of Tanzania in RET and climate change adaptation and mitigation. For example, the division of environment under vice president's office should initiate more environmental awareness programs country wide to give people knowledge on environmental matters (Bakanga, 2011). Currently, environmental awareness among the locals is very limited, which in some instances limits the spread and use of LCT's (Tessier, 2011).

5.3 Technology Transfer

A variety of drivers exist to encourage and stimulate climate entrepreneurship and TT in Tanzania. Likewise, there are constraints, which limit the progress of renewable energy sector, in Tanzania. Findings on the drivers and constraints for climate entrepreneurs from the interviews conducted are discussed in the sub section below:

Drivers

Among the mentioned advantages of conducting business in Tanzania is the Certificate of incentives from Tanzania Investment Centre that exempts companies from Value Added Tax (VAT), Excise and Import duty on all capital goods as well as solar and wind products. The research showed that certificate of incentives is a strong driver for start up companies, especially large scale companies as well as companies importing solar and wind products in the country. Importation of all solar and wind products in the country are tax-free. The only costs associated with such products are the port fees.

High Market potential exists for business that deal with power products in Tanzania. 90% of population does not have access to electricity. This is a huge group that could potentially be future costumers. Awareness of the importance and benefits of using solar products needs to be increased and communicated, and effects of using biomass and kerosene for cooking and heating communicated to the societies. The findings showed that for products that were affordable, people from the rural areas were willing to buy them for household use. The key aspect for successful spread and use of RE products is the affordability.

Tanzania favorable climatic condition makes it a potential country for growth of bio diesel crops such as sunflower, jatropha, sugar cane, corn etc. is a strong driver for investors to engage in bio diesel farming.. Also, the fact that land availability in Tanzania is huge is an attracting factor. Tanzania is a large country with plenty of space (see Tanzania country profile). As long as all the requirements for attaining land title are fulfilled, there is potential for investors to find marginal land to grow biodiesel crops.

Donor Funds: Tanzania is among the countries that have been on the receiving end of a large amount of funds from International Organizations and donors such as World Bank, UNDP, and GEF. Initiating and establishing renewable energy projects in Tanzania will most likely result in international organization's recognition and aid.

A GEF project in Tanzania on the transformation of solar PV market was designed to incorporate learns from former earlier solar projects. Findings of the reports indicated that the project was part of the force that helped to facilitate the removal of taxes on all PV products in Tanzania. The project has also enacted the Rural Energy Agency (REA) and development of Rural Energy Master Plan. Furthermore, the project has managed to raise awareness of solar PV among the decision makers on the district level via seminars.

Additionally, The project provided training on sizing, installing, repairing and maintenance of solar PV.

Table 3: one of GEF project in Tanzania. Source: (Global Environment Facility, 2008)

Cheap labor: There is abundant of cheap labor in the countries that RET companies can gain easy access to. This helps in reducing operating costs for the companies, as they can get labor at low costs.

Stable government: Unlike other African countries, Tanzania has been a peaceful country since it acquired independence in 1961. This political stability has marketed Tanzania as a safe country to carry out investments because investors are assured of their safety and security.

Constraints

The interviews conducted showed that despite having conducive environment as the drivers for the renewable energy sector development in Tanzania are a number of constraints which act as a barrier to spread of renewable energy production, importation and use in Tanzania. These barriers include:

Lack of clear policy and framework on renewable energy in Tanzania: A few sets of guidelines exist for some sects of the renewable energies (Ministry of Energy and Minerals, 2010a), but there is no developed clear policies to guide the renewable energy sector in the country. The Tanzanian government is still working on establishing these policies, for example, in the case of bio diesel farming, Tanzanian government is still working to formulate a policy on bio diesels (Kiwele, 2011).

Intellectual Property Rights, which is sometimes seen as a barrier to technology transfer in developing countries. Owners of technology usually impose IPR on their technologies to avoid copies and imitation (Ahuja, et al., 2007). This is not so much the case in the situation of Tanzania as most of the RET is being imported rather than being innovated, developed and produced in the country.

Lack of Technical Skills, Experience and Expertise: The majority of workforces in Tanzania do not have the expertise and skills to design, operate and implement renewable energy products. To source of local labor force in the country, the entrepreneur needs to invest in training of the local staff on how to operate the products (Tessier, 2011) or bring in work force from outside the country. This can prove to be costly to the businesses.

Unreliable Market: Although there is high market potential in Tanzania, not all the people in the parts of the country that do not have access to electricity, can afford to pay for RE products (Raphael, 2011). For example, in the case of solar lights, the cheapest solar product is sold for not less than TZS[6] 35,000/: a high price for an average rural consumer to afford.

Cheap vs. Quality products: The majority of the market (consumers) in Tanzania, particularly in the rural areas and sometimes in urban areas prefer to buy cheap products rather than durable and of high quality product (Tessier, 2011). One of the reasons contributing to this is the ability to afford a better quality product and low income. This poses a business challenge to the supplier as he is looking to make profits, and increases the risks of competition from companies who sell low quality and fake products (Msigwa, 2011)

[6] One (1) US Dollar is equivalent to TZS 1600, exchange rate on 14th August 2011.

Lack of proper and well developed infrastructure: in order to reach the 90% of the population of rural Tanzania like good networks of infrastructure need to be in place. The level and quality of roads to rural parts of Tanzania is very poor, unpaved and in bad condition especially during the rainy season (Webb, 2011). Poor road conditions limits the ability to transport products to parts where the products are needed most (Tessier, 2011), or if they get transport during this time, then the chances of being broken whilst on transit increases which causes losses of products.

Fake Product Companies: fake products, most of them from China are attacking Renewable Energy products market especially solar products in Tanzania (Tessier, 2011). These fake products are below the standards, cheap and distorting the market and the sector because consumers prefer to buy cheaper products to quality products (Msigwa, 2011). TAREA is working towards identifying, penalizing and prohibiting fake companies (Msigwa, 2011).

Lack of Financial Resources: Like in any other developing country, local climate entrepreneurs lack capital investment for running renewable energy projects. Commercial Banks do not fund RE companies claiming high business risks associated with RET (Msofe, 2011). Although REA through its rural energy fund is co financing some of the projects in Renewable energy, it cannot afford to organize funds to all the projects.

Lack of awareness: Rural areas populations are not aware of the benefits of using renewable energy v. traditional sources. They still depend heavily on wood fuels and kerosene for cooking and lighting (Msofe, 2011). Increased awareness to the rural market would increase market potential.

There is high corruption rate in government administrative systems (Webb, 2011) (Tessier, 2011) particularly when entrepreneurs need certificates and permits, ports authorities to clear containers of products and materials etc. This is a challenge because the processes take longer than expected, delaying productivity and other activities for the company. Additionally, it adds more costs to the company because in many cases the companies have to pay bribes government officials to clear their cargos or to get permits quickly.

Unstable Power Supply: Tanzania has been experiencing continuous power supply problems recently. The unstable supply of power limits local and foreign industries productivity. For example, production has to stop every time there is no power from the national power supply company, or incur a cost of buying and operating an external source of power like a diesel generator. Additional costs such as this, brings unexpected costs to the investor and can jeopardize future investments. Currently, power cuts occur everyday, for at least 5-8 hours.

The barriers for renewable energy business in Tanzania have been analyzed from the interviews carried out by the author, but most of them are also applicable to other developing countries. The discussion around the barriers comes up tot the same conclusion: the government and its institutions are aware of these constraints. Some of the literature available on Tanzania explicitly identifies similar issues as barriers to technology transfer and deployment of low carbon technology. But the commitment and support by the government needed to remove the barriers is non-existent, and where there is little support available, it is not well coordinated.

The following chapter is going to discuss business model for low-income markets and other challenges businesses in developing countries face. The challenges in the model are common to low income markets, which overlap with Tanzanian challenges. A reference will be made

from the list of interviewee's responses when the barrier in the model has also been identified from the interviews conducted. The corresponding solutions to the challenges can help build resilient businesses in Tanzania and in other LDC's.

5.4 India's experiences in Renewable Energy Development

Like Tanzania, more than 40% of the population in India has no access to electricity, while electricity shortage is a common problem to households that are connected to the national grid system (Ministry of New and Renewable Energy India, 2009). India is importing more than 80% of its energy, making energy security a potential problem to the country due to energy price fluctuations and political conflicts associated with energy exporting countries. In 2008-2009, 80% of India's electricity came from coal, gas and diesel, contributing to 42% of carbon emissions (Ministry of New and Renewable Energy India, 2009). Additionally, India had to find alternate means of clean energy solution because of pressures it was facing due to its CO^2 emissions levels.

The efforts of the Indian government to embark on achieving this goal can serve well as a pilot for Tanzania to grow its renewable energy sector. India and Tanzania are both developing countries, with large growing population and a growing economy.

Comparative strategies for Renewable Energy in India & Tanzania

The ministry of New and Renewable Energy was established to deal with all matters relating to New and Renewable Energy in India. The responsibility of the ministry is to facilitate the implementation of programs that are in support of research, design and development of renewable energy technologies, and harnessing renewable energy technology use in the rural and urban households, commerce and industries.

5.5 Public Initiatives

India Renewable Energy Development Agency (IREDA)

India established an agency for market development and financing of renewable energy in 1987, (IREDA). The agency's sole task is to provide finance to institutions that are involved in renewable energy and energy efficiency (Ministry of New and Renewable Energy India, 2009). The agency offers loans to new and renewable energy projects at interest rates that are better than commercial banks.

In Tanzania, the only government agency facilitating and promoting rural energy provision is Rural Energy Agency - REA (Msofe, 2011). REA provides loans to private companies and NGO's for 5 years grace period, and thereafter at charges with very low interests rates (Msofe, 2011). Tanzania Commission for Science and Technology (COSTECH) is another state owned agency promoting and

India's Country Profile

Name: Republic of India

Capital and Area: New Delhi & 3,287,263 k

Currency: Indian Rupee[7]

Population: 1,210,193,422

GDP: $4.060 Trillion

Inflation: 8.62%

Economic Activities: agric manufacturing, mining, agricultural produ

Exports: Gems and Jewerly, textiles, chem leather.

Source: http://www.tradingeconomics.com/india/ind

[7] One (1) Indian Rupee is equivalent to $ 0.2144 (exchange rate of 29th August 2011)

supporting diffusion of renewable energies in Tanzania. Through the department of Technology Transfer, COSTECH offers guidance to private companies interested in investing in renewable energies in Tanzania (Raphael, 2011).

5.6 Government Initiatives

Policy for grid renewable power

The national Electricity Act of 2003 in India mandates the state electricity regulatory commissions to promote generation of renewable energy by giving measures for connectivity with the grid sale of electricity, to any person or institution, and fixes minimum requirement for purchase of renewable energy in the area of distribution (Ministry of New and Renewable Energy India, 2009).

In Tanzania, the Tanzania National Electricity Supply Company (TANESCO) used to be the government monopolistic institution dealing with production and distribution of electricity in the country up until the last decade when the government started trade liberalization and privatization policies (Prime Minister's Office, 2009). TANESCO is also the owner of the entire infrastructure for distribution of electricity in the country (Raphael, 2011). Through EWURA, feed in tariffs from other energy sources has been fixed to ensure consumer's affordability (Raphael, 2011). The fixed rate of feed in tariffs makes it difficult for private renewable energy institutions to compete with TANESCO as the Tanzanian government heavily subsidizes TANESCO (Tessier, 2011) (Raphael, 2011).

Financial and Fiscal Incentives

The Indian government has been supporting the renewable energy sector in the country through promotion of private investment, and setting up renewable energy projects. Renewable Energy projects are given capital or interest subsidy (from 10-90% of the project cost), and charged no excise or custom duties (Ministry of New and Renewable Energy India, 2009).

Strong and clear policy framework and investor friendly environment in India has put it in a good position for renewable energy investment and has helped increase the number of private investment and renewable capacity in India (Ministry of New and Renewable Energy India, 2009). India is marked as the world's 4th most attractive country for renewable energy investment, next to USA, China and Germany (Ministry of New and Renewable Energy India, 2009). The US Department of Commerce values India renewable energy market at $ 500 million, with an annual growth of 15% (Markowitz, 2007).

Other than International aid, TIC certificate of incentives and REA start up loans, there are no provisions of financial and fiscal incentives by the government in Tanzania. The ministry of energy and minerals conducts feasibility studies for the interested projects only.

Setting up a Vision and Target

The ministry of Renewable Energy enacted an 11-year plan to increase the share of the renewable energy in India. The target of the ministry is to have 10% of the electricity coming from renewable sources, excluding large hydro plants (Ministry of New and Renewable Energy India, 2009).

Tanzania, unlike India, has not set targets on renewable energy increment in the country. Renewable energy companies operate on a private basis, often times statistics of their production not known to the ministry of energy and minerals (Kiwele, 2011). On the other hand, most small to medium scale renewable energy companies do not generate enough electricity to be fed into the national grid system (Tessier, 2011). Electricity generated from solar sources serves small and rural households and small social institutions such as health centers and schools (Tessier, 2011).

5.7 Capacity Building in India

Education and Research, Development & Demonstration

Through a National Action Plan on Climate Change, India has created 10.5 million jobs to Indians by providing fellowship post graduate and doctoral programs on renewable energy to 400 students per year (Ministry of New and Renewable Energy India, 2009). India has also incorporated and integrated into the national course curriculum programs on renewable energy, as well as offering training programs to professionals working for the state, NGO's, private institutions, community based organizations, research and development institutions etc. The ministry of new and renewable energy also offers a fellowship to 10 scientists of Indian Rupees 1 million annually (Ministry of New and Renewable Energy India, 2009).

Capacity building in Tanzania has been a recent effort by tertiary institutions in the country. The University of Dar Es Salaam via IRA and Ardhi University has established new courses on environmental studies. However, the courses are still new and first batch of graduates have not finished yet. The IRA is also involved in carrying out seminars and workshops for the public for the purpose of increase environmental awareness to the public regarding on going environmental issues

Channels for Technology Transfer in India

With the mechanisms and policies in place to facilitate and promote investment and application of renewable energy, the local enabling environment for technology transfer in India became attractive to foreign companies as well as local entrepreneurs. Thus, technology was/is transferred to India via the following three approaches: licensing of patents; collaboration and acquisitions, such as strategic alliances, and joint ventures and other equity relations; and in-house R&D.

In addition, collaboration with national research institutions and use of expired patents has been key inputs for growth of RET in India (Lema & Lema, 2010). For example, large number of solar PV production patents for mature mono- and multi-crystalline silicon cells in India has expired and many Indian manufacturers have picked up the technology. In more advanced technologies where patents remain, it has been easy for Indian companies to acquire the technology through licensing agreements (Lema & Lema, 2010). However, Indian owned PV patents are on the rise and the domestic engineering and technical capabilities have proved important to pick up and refine technologies, and produce at a low cost (Lema & Lema, 2010).

Despite challenges experienced by India in its efforts for technology transfer in making viable use of renewable energy technologies, Tanzania can still learn from their experiences and get some best lessons to kick start its journey towards vibrant renewable energy transformation and low carbon economy by establishing institutions specially researching in advancement of

this agenda. The recommendation section of this report proposes how Tanzania can advance RET through capacity building.

6 Conclusion

Despite various drivers, which to some extent adhere to the framework organized by the UNFCCC, application of LCT's and technology transfer in Tanzania has been found to be particularly small. A lot more effort is required to complement the work towards making Tanzania a renewable energy country and increase the share of LCT's in the country as well as reduce GHG emissions. A development mechanism that can stimulate channels for technology transfer e.g. climate entrepreneurs is required to attain the necessary knowledge and skills for production, application or transfer of climate technologies, to produce/transfer climate innovations that the market will be able to afford and to ensure that there is enough resources (technical, organization and expertise) for sustainable production of the technology.

Does the UNFCCC Technology Transfer framework work in favor Tanzania?

Results from the data showed that climate entrepreneurs are the link to diffusion and technology transfer in Tanzania. Thus, their role in the transferring of technologies need to be emphasized by the UNFCCC framework. The findings suggest that this may not be the case. Despite the fact that UNFCCC model establishes the underlying policies and approaches for technology transfer to developing countries, the model is theory driven rather than case driven. Tanzania, like many other developing countries, is faced with energy crisis, and the majority of the population has no access to modern energy. The fact that Tanzania is vulnerable to the threats of climate change does not guarantee its commitment to LCT's. Given that Tanzania is a growing economy, its current efforts are not directed towards environmentally sound technologies, when there is no stable energy supply and no access to energy for more than half of the population. Looking at things from the perspective of the local situation, the ultimate concern of the Tanzanian government is to provide access of energy to the majority of the population depending on affordability.

The findings indicate that there is no argument that: yes, enabling environment for technology transfer is mandatory for wide spread use of RET and yes: capacity building is crucial for adaptive capacity of the RE technologies to the country. But what is the next step? What happens when the technology has been transferred into the country by private investors, and successfully manage to generate electricity, but demand premium prices for feed in tariffs, as is the case with some private energy companies in the country? It is of particular importance to remember that Tanzania is a poor country, with 35% of the population living below the poverty line (Vice President's Office, 2008). How does a rural household family afford electricity produced from renewable energy by an investor with profit making in mind?

Because of its nature, renewable energies are usually expensive to produce and consequently expensive to buy for an average consumer. The characteristics of renewable energy with regard to climate change mitigation and adaption make it for a good marketing strategy for end users.

Factoring in the country conditions of Tanzania: lack of infrastructure, lack of technical skills and expertise, unstable energy supply and unreliable markets, all add up to the final price of renewable energy making it more expensive than conventional energy. Eventually we end up with the same problem: how does a climate entrepreneur produce/import renewable energy product so that an average consumer is able to afford it?

Finally situation such as this brings up government `intervention that tries to protect its consumers from over pricing, setting up standards for feed in tariffs at a price that the government is sure the consumers will be able to afford.

So what role does UNFCCC and technology transfer framework play to a country such as Tanzania?

The UNFCCC technology transfer model needs to differentiate between the poor and middle income-developing world, and adapt the model according to country needs. When technology assessments reports are being conducted, it is significant to pay special attention to specific country needs, in Tanzania those needs being energy efficiency and reduction of dependency on biomass as the source of energy and stable energy supply. For example, for the case of China and India, it is possible to discuss innovation and production when referring to TT because India and China both have the capacity and means to innovate and adapt technologies from other countries, as well as innovate technologies of its own.

This is not the case of Tanzania where R & D for renewable energy is small. The model would have to adapt to the case of Tanzania, and concentrate on frameworks for encouraging local capacity and capabilities to advance indigenous technologies that will be easily accessible to the local market, and at the same time, affordable. For example, the majority of the rural population in Tanzania depends on biomass for heating and cooking purposes. The required action in this case would be to create policies that will favor the usage of energy efficient cook stoves, to reduce charcoal and woof fuels use.

7 Recommendations

The findings from the thesis showed that the most crucial thing that Tanzania lacks in terms of clean technologies and application is the lack of clear and set policies addressing new and clean technologies in the country. The significant step for the government would be to adopt a strategy for **formulations of policies** that address RET, energy efficiency measures in buildings and industries. In Tanzania, energy supply, does not meet the energy demand. Shortage of energy supply calls for measures to cut down on the use of available energy capacity. The recommendation for the government is to initiate command and control measures on usage of energy efficiency measures in all new building, and facilitate change of tradition conventional energy intensive equipment in old buildings and households.

What is the next step for UNFCCC and countries such as Tanzania with regard to LCT's and technology diffusion?

Bottom- Up Approach

The author of the thesis, judging from the result of the research, believes that for Tanzania and many other developing countries for that matter, a bottom up approach is most appropriate to facilitate transfers of technologies in the country. This is because the results of the research showed that national actors- climate entrepreneurs as well as policy makers in the government sectors have a large role to play in increasing the shares of low carbon technologies. Like many other international policies, international frameworks can be used to lay the base and foundation for best practices. The lead work, should, however be placed in the hands of the national actors to enable local actors to make use of the country's situation, both socially, economically, politically and technically. Monitoring and evaluation measures can then be enhanced by international organizations, with subordination from the local participants.

Adapt country specific framework: The results from data collection showed that will be more productive and practical for UNFCCC model of technology transfer to become country, or region specific. The process of making frameworks country specific can be facilitated by involving local participation in decision making. This way, the model will be able to pay particular attention to that country's important and immediate needs in terms of which technologies are required, and how they should be sourced. In depth analysis needs to be done to identify the right pathways needed to facilitate technology transfer, and adapt and mitigate climate change.

Localized Innovation: Another approach that could facilitate technology transfer is to use localized innovation and R & D. Localized innovation is beneficial to the developing country as it is the same people of the country who understand their needs best, and their approaches to their technological needs may be appropriate to their cases. Localized innovation also helps to reduce the costs of technology transfer because issues of Intellectual property rights would not be of concern, as well as production costs will be lowered. Another advantage of localized innovation and local R & D is that it will increase the country's technological capacities, advance its renewable energy industry and become self sufficient to mitigate and adapt to the effect of climate change.

What recommendations are given to the policy makers, to stimulate technology transfer in Tanzania?

The most effective option for technology transfer in Tanzania is to:

Prioritize and specify technology needs: Once technology needs have been identified, then entrepreneurs can concentrate on those needs that need immediate solutions. For example, it has been identified in Tanzania that charcoal use is a major problem that requires immediate action from the government in terms of policies, from entrepreneurs in terms of innovation and technology supply and from international organizations in terms of aid and funds to reduce its inefficient use and impacts to the environment. This implies that entrepreneurs can engage in the finding suppliers for wood efficient products, e.g. efficient cooking stoves etc. or search for local or international designers or innovators appropriate technologies that can assist in solving the problem of insufficient use of biomass. As entrepreneurs have been revealed to be the key players in bridging the technology gaps through trade, this will be an opportunity for them to increase their business transactions as well as help to mitigate problems associated with deforestation.

Government involvement and commitment: In order to motivate local climate entrepreneurs, the government needs to increase its involvement, commitment and participation in local renewable initiatives. The author identified a very weak link in coordination between government activities and entrepreneur's activities. If there were more coordination and recognition between government and private sector, both in terms of technical and financial support, entrepreneurs would be motivated to increase technology activities. COSTECH and REA are both government institutions, but their participation is not sufficient to encourage climate entrepreneurship. Their work is concentrated with international cooperation's and large companies. Similar public institutions are needed, particularly the ones that identify and support local climate entrepreneurship.

Mindset Shift: The rationale that developed world is responsible for GHG emissions and that the responsibility of combating climate change is largely their concern is wide spread within the government sector and to a degree, in the local communities. More attention should be paid to bring awareness that climate change is a universal problem and everyone has a role to play in ensuring activities that foster climate change do no continue. Awareness can be facilitated by expertise training, workshops, seminars and media attention.

Creation of a database platform: Lack of adequate data resource Centre has been raised by a number of people who were interviewed, both from the policy making side and the private sector. The government should establish a platform where all data for renewable energy sector in the country is stored. For example, COSTECH can initiate a department in the institute where data is available for the public to access. This way, information access will not be as difficult as it is at the moment to find.

Increase Awareness to Consumers and general public: Solar products are being used by people currently, not because they realize the importance of using LCT's and its contribution to climate change, but because there is unstable power supply, giving solar and other renewable products an attractive chance to be used as a source of energy for lighting. If awareness measures are taken to educate users of the benefits of using RET products, then the population that can afford such technologies would shift the mindset from depending on electricity from the national provider. This would also help to reduce the overload of dependents of the national grid electricity users.

Conclusively, channels for technology transfer needs to be enhanced in order to facilitate the process of technology transfer. Results from the study has identified climate entrepreneurs as being one of the key players in the diffusion of LCT's. Therefore, governments and other international organizations need to recognize the role of entrepreneurs in the diffusion of LCT's and advocate for more participation of entrepeneurs. Additionally, like in the case of business model, similar options apply to technology transfer process. The thesis showed that although mechanisms are established to facilitate technology trasnfers, the most important aspect is the identification of country specific needs, then adapting the needs to the framework in transfering technology in order to be sure the transfer is addressing the needed technologies.

The author recommends stakeholders of technology transfer to developing countries including Tanzania, to adapt specific needs to mechanisms developed by experts, by making sure local participation is involved from the initial stages of the process.

As a long term measure, the author recommends governments to establish a state of the art innovative institutions to deal with research, deveopment and diffusion of LCT's. The institutions could develop technologies that are country specific, and claim IPR on the technologies. The institution could also help to reduce the country's dependency on technology transfers from developed world, create environmental engineers and employment opportunities

In Tanzania we have a saying that goes*" you can take a cow to the river, but you can not force it to drink the water"*. Similar situation applies to developing countries and technology transfer, experts can identify that a certain technology is required in a particular country, but they can not force them to use it. The right approach to that solution is to involve the cow from initial stages in identifying the needs and assess whether what is needed is what is being considered. That way, a win-win situation is created.

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Appendix 1: Sample questionnaire for interviews

Interview for Data Collection on Climate Entrepreneurs and Technology Transfer

Name of Interviewee:	
Date, Time and Place:	
Organization and **Position:**	
Contact Information: **Phone** **Email**	

Questions

1. What is your take on Tanzania and RET (Renewable Energy Technology) in general? (What is the status quo on the sect of RET i.e. what does RET consist of? Should there be more to it?)
2. What is your role in the RET sector? (Policy maker, entrepreneur, investor, private sector? (For how long, why join in and what is the current situation with your company?)
3. Do you believe that Tanzania has attractive enabling environment for transfer of RET? (E.g. policies, infrastructure, financial capacity, productivity, market?) If yes, why and which ones and if no why not?
4. What policies are in place to facilitate and attract investment in RET? Any revised and new policies in the energy sector?
5. What do you believe should be done to create this enabling environment for development of RET? By who? How?
6. What steps should be taken to encourage climate entrepreneurship in the country and how? (Development wise, market side, financial concerns, policy, infrastructure etc.)
7. Do you think that technology transfer especially from developed countries to developing countries like Tanzania will play a significant role in increasing the share of RET in Tanzania? How so? From which countries, and why?
8. What RET would be more appropriate for transferring to the country (consumer needs)? Why?

9. What channels should be used to transfer the technology? (E.g. RET companies to climate entrepreneurs, government, research institutes? Why this channel?
10. How should RET be monitored and evaluated, once the transferring of technology is complete to make sure it s sustained?
11. An analysis conducted by WWF showed that among Tanzania, Kenya and Uganda: Tanzania has the lowest share of RET. In your opinion, why is there low use of RET in Tanzania?
12. What should be done to make consumers in Tanzania aware and willing to accept RET as part of their energy source? (Diffusion of RET).
13. In your opinion, what are the challenges of the Renewable Energy Entrepreneurship in Tanzania?

Appendix 2: List of interviewed people

	Name Of Interviewee	Organization, Position & Contact	Date and Place
1	Eng. Bengiel Msofe	Rural Energy Agency Director of Technical Services Email: bmsofe@rea.go.tz Tel: +255 22 2412001-3	27.07.2011 REA Offices 3rd Flr, Sam Nujoma
2	Prof. Paul M. Kiwele	Ministry of Energy and Minerals Principal Forrest Officer Email: morispak@yahoo.com Tel: +255 22 2119158	28.07.2011 MEM Offices, 6th Flr
3	Dr. Matheo L. Raphael	Tanzania Commission for Science & Technology (COSTECH) Director: Centre for Development and Transfer of Technology Email: rmatheo@costech.or.tz Tel: +255 22 2700751	19.07.2011 COSTECH, Sayansi DSM
4	Anna L. Kessy	Tanzania Investment Centre Research and Planning Manager Email: alyimo@tic.co.tz Tel: +255 22 2116328	27.07.2011 TIC Offices, DSM.
5	Adam	Tanzania Revenue Authority TIC Attaché Email: addieling@yahoo.com	27.07.2011 TIC Offices, DSM.
6	Godwin Msigwa	Ensol Tanzania Ltd. / TAREA Sales and Marketing Manager Email: godwinsolar@gmail.com Tel: +255 22 2450468	28.07.2011 TAREA offices Ubungo, DSM
7	Dennis Tessier	ARTI TZ Ltd Programs Director Email: aswiftsword@hotmail.com Tel: +255 715 235126	28.07.2011 ARTI Offices Mbezi, DSM
8	Harold T. Webb	Tendaji Group Manager Email: harrywebb@mweb.co.za Tel: +255 759 334877	30.07.2011 Epidor, DSM
9	Geofrey E. Bakanga	Vice President's Office Environment Division Chemical waste and Ozone Pollution Email: bakgef@yahoo.com Tel: +255 756 538875	21.07.2011 VP's Office
10	Anna Tayari	National Environmental Management Council Former Director for Environmental Information, Communication and Outreach Email: nemctz@yahoo.com Tel: +255 754 481052	03.08.2011 Bunju, DSM.

Appendix 3: Workshop Survey Questions

Name:

Residence:

Age:

Occupation:

1. How big is your family?
    a. Less than 4 people
    b. 4 people
    c. 5 people
    d. 6 people
    e. More than 6 people
2. Do you live in a shared house or family house?
    a. Shared House
    b. Family House
3. Is your house connected to TANESCO power supply?
    a. Yes
    b. No
    c. Other……..
4. How much per month do you pay for electricity?
    a. 0-20,000 Tshs
    b. 21,000-40,000 Tshs
    c. 41,000-60,000 Tshs
    d. More than 60,000 Tshs
5. What is electricity used for in your household?
    a. Lighting
    b. Electric Appliances
6. What do you use for cooking?
    a. Electricity
    b. Gas

c. Charcoal

d. Wood (Kuni)

7. How much do you spend per day on cooking energy?

_____

8. Why do you use this form of energy for cooking?
    a. Cheap
    b. Easily available
    c. Other……..
9. What stove do you use for cooking?
    a. 3 stones stove
    b. Energy saving stove
    c. Metal charcoal stove
    d. Electrical Stove
    e. Gas Stove
10. What would motivate you to use energy efficient stove?
    a. If it used less charcoal/wood
    b. If it was cheap
    c. If I can find it in stores
    d. Other……..

Appendix 4: Workshop Participants

	First Name, Last Name	Age	Residence	Occupation
1	Scolastica Wambali	49	Sinza, DSM	Food Caterer
2	Agnes Ndomba	28	Kinondoni, DSM	Customer Care
3	Grace Mhally	28	Muhimbili, DSM	Doctor
4	Bhoke Egina	26	Sinza, DSM	TV Presenter
5	Salma Mkusa	27	Sinza DSM	Administration
6	Asteria Ntemi	25	Sinza, DSM	Researcher
7	Ndyanao Mgweno	28	Changanyikeni	Civil Servant
8	Anna Steven	28	Changanyikeni	Administrator
9	Cecilia Maembe	25	Gongo la Mboto	Hotelier
10	Happy Singu	28	Ukonga, DSM	Researcher
11	Eunice Chuonyo	29	Mbezi, DSM	Housewife
12	Kabula Nshimo	28	Mwenge, DSM	Brand Manager
13	Gertrude Alphonce	28	Mwenge, DSM	Civil Servant
14	Marcelina Mtalo	28	Kijitonyama	Banker
15	Aneth Johnson	28	Sinza DSM	Student
16	Mama Msini	47	Sinza DSM	Food Caterer
17	Queen Arnold	28	Kijitonyama	Banker
18	Rehema Shija	29	Mbezi DSM	Lawyer

19	Dotto Katundu	34	Bunju DSM	Housewife
20	Mwamini Kaganda	45	Sinza DSM	Divorced

Appendix 5: Procedure to obtain TIC Certificate of Incentives

In order to receive certificate of incentives, a company needs to submit the following documents to TIC:

1. A feasibility study/ business plan containing clear statement of the project objective, information regarding the investor, details of investment costs, how the proposed investment will be financed, specific sources of finance for the project, terms and conditions of the loan if applicable, sources of technology if applicable, project financial and economical analysis, market study, project capacity, production process, environmental impact assessment, expected employment generation, proposed implementation schedule.

2. 3 dully filled copies of TIC application forms which are issued by the Centre at the fee of USD 100, also available at TIC website.

3. In case of expansion/rehabilitation a copy of audited account for the past three years

4. A copy of the company's memorandum of understanding

5. A certified copy of the company's incorporation

6. A brief profile of the investor

7. Evidence of sufficient finance capital available to implement the project

8. Evidence of land ownership for the location of the project

9. Company board resolution to register the project with TIC

10. Project implementation schedule

11. An overall covering letter to which all the above are attached

Once the company qualifies for TIC certificate of incentives, they are required to pay a fee of USD 750 for the certificate.

Appendix 6: Recommended solutions by BoP Business Model

For the particular case of business model on low-income markets, the following recommendations are elaborated by (Gradl & Knobloch, 2011):

Potential that can be applied to **customer interface** challenges that can be applied. The solutions are not necessarily self-sufficient. Business should try to gather information and establish other alternatives according to country needs:

- Conducting a market research at different times and testing the products with customers, as well as to formulate a feedback process to be able to adjust the products according to customer needs.

- Provide good customer service, by regularly visiting customers for feedback and maintenance. Provide warranty for the products, and stick to the warranty, regardless of the natural living environment of the rural population. Make it as easy as possible for customers to be able to pay for the services to avoid unwanted delays.

- Ensure local representation, especially in terms of local stores in case of requirements for spare parts. Business can as well open own franchise or subsidiaries.

- Educate Stakeholders and train customers through the company's staff or use of local representatives. Make sure that there is public awareness as well as local authorities are involved and collaborate through this process.

According to the challenges identified in relation to sales, business can opt for solutions such as:

- Making sure a thorough market research is conducted, paying attention to the target group to understand their capacities, knowledge, profiles and cultures. Test the products with the customers through workshops, training, market fares, community meetings or auctions. This will help the company understand the consumer and their mind set on the product and their willingness to accept the product and willingness to pay for the product.

- Collaborating with local authorities by engaging local community leaders. Most of the times, villages show enthusiasms towards projects that have the support of their local leaders and affect their decisions.

- Creating local representation: it will often help to build local community trust if business have stores within the community with the presence of the local staff from the community. At the same time, using existing networks can also be in favor of the company, such as trusted NGO's, micro finance banks etc.

- Training staff and local representatives: by developing local training processes focused on the frequent challenges. Organize on the job training through practical training of new representatives or learning by seeing and doing from their superiors.

- Educating target group by using local communication channels, such as posters, radios etc. Educating customers by using local representatives on the product, the use and the maintenance is an effective way to guide customers (Sanga & Meena, 2008).

Collection of payments always comes with difficulties, particularly when dealing with people of low incomes. Businesses will need to pay attention to payments systems in the regions. Other solutions that can be applied to overcome difficulties in payment collection are:

To Collect Payment Locally

Ask the company's local representatives to collect the money, by making regular visits to the customers house; this will make it more convenient for the customers to deal with payments than having themselves to go and find payment points. Sometimes the companies can use the mini grids that are installed with pre payment meters, forcing customers to pay for the service in advance time (Sanga & Meena, 2008).

Customize Payment Methods

Businesses can do this by rescheduling payments time according to consumers' payments time. Sometimes villagers in remote areas are positioned to pay their bills during the middle of month because this is the time when they sell the produce from their farms or allow for delayed payments.

Connect Customer to Microcredit

Connecting energy services to micro finance organizations can help the company to deal with details of payments with low-income populations. The energy company handles the technical aspect of the business while the microfinance company deals with the financial part.

Establishing Additional Revenue Streams

Many times energy sources and supply are subsidized. It will benefit the energy companies to provide subsidies for services such as installation of devices or grid connections in order to help the customers to reduce high upfront costs that come with energy services.

Introduction of Income generating solutions

This can be done by introducing productive inputs for local crafts or another incentive for the consumers to want to buy from the company as part of the product offering. The company can also create new market opportunity by starting up local activities that were prior not available due to lack of access to technology. Market opportunity can make the consumers feel that the return to their investment is rewarding by generating income to their households.

Maintainance and repairs is an important aspect of a product life. When products are reguraly repaired and maintained, their life expentancy can be longer. Businesses need to establish regural maintance schedules to the customers to increase product durability. Below, a list of suggested soultions in terms or repairs are recommended. Finally all products eventually come to the end of life cycle. Producers need to extend their responsibilities in order to ensure business operations do not cause pollution to the environment and to the people. It is therefore important for businesses to establish mechanisms that can deal with end of life products. These solutions could be

Provide regular maintenance visits

Regular visits to the customers will give them ease access to spare parts if they need any, and help them with technical support if it is required. If the products include a warranty, then this will increase customer's trust on the product and reduce uninformed repairs by the users.

Train local representatives to preform common service visits

It is always useful to train local staff, as the lever of technical capability is usually low particularly on foreign products. This, as has been discussed above, can be a good way of transferring technology and technical know how to the host country. Additionally, it is wise to divide tasks, giving responsibility of complex tasks to the trained staff and easier services done by the customers themselves.

Supply spare parts locally

The company should ensure that the local stores have enough spare parts in stocks in case customers require them; this will reduce delays to customers when they need to service their products, and will help to solve common problems quickly.

Do-skill product installation and maintenance

It will simplify things to make things simple for customers with normal and common knowledge to able to handle. Provide information on how to handle the most common problems that may arise. It also pays off to adjust/ redesign products in a way that it is safe for customers with little training to assemble parts. They need to be able to persevere environmental damages, wear and tear etc.

Educate Customers

Providing training to customers is always useful and may save the company a lot of costs, as customers will be able to handle small services and repair concerning the product. Training will also help to reduce damages to the products, as customers will be able to handle the product properly. Try to make sure the instructions provided with the products are in the language that can be understood by the customers.

Use local fuels

Usage of local fuels and fuels produced locally for example bio fuels from jatropha palm, sunflower and other fats. Fire woods and charcoal for improved cook stoves

may also be produced by local people, generating income for the society and reducing carbon emissions associated with imported fuels.

Use environmentally friendly materials

Use materials that are degradable, environmentally friendly and replace resource and energy intensive materials with environmentally friendly ones. Such materials will increase the quality of products. A challenge associated with this action is the fact that rural area customers value price in comparison to quality, so they may not be willing to pay a premium price for quality goods but rather buy a product cheaply and last for a short while.

Maintain and re-use equipment

Prolong product lifeline for example by providing warranties and doing regular check ups and maintenance services. A company can also design the products such that some of the spare parts can be re used when it's broken or there is unused equipment. The use of standardized and training on re-use of broken parts can help to facilitate re-use of products.

Recycling

If it is within the company's budget, the company should establish a recycling system to collect all the used and broken products and parts, establish collection points or collaborate with external recycling services. A good incentive for customers to take products or parts to recycling collection point is when they receive a refund for the product returned.