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FACULTY OF ECONOMICS

MASTER'S THESIS

**AN ENTREPRENEURIAL RENEWABLE ENERGY BUSINESS MODEL:
CASES FROM DEVELOPING COUNTRIES**

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INTRODUCTION

Climate change coupled with the overexploitation and high dependence on natural resources such as coal and fossil fuels, pose a big threat for the world and its future. However, at the same time this opens a room full of great opportunities for new, innovative and environmentally friendly solutions that would bring the world sustainable living. Sustainable development, clean energy and energy efficiency choices are of immense importance for the humanity, since they have direct impact on the quality of our living, our health and our environment. According to the Renewable Energy Policy Network for the 21st Century (hereinafter: REN21) (2015a) there are still around 1.3 billion people around the world without access to electricity and 2.2 billion people in 2011 living in extreme poverty on less than 1.8 Euros (hereinafter: EUR) (or 2 dollars, hereinafter: USD) per day (Poverty Overview, 2015). Over 80% of the people who lack access to electricity live in the rural areas which places the rural electrification high on the priority agenda of the international actors and initiatives in reducing poverty and fostering development (Alliance for Rural Electrification, 2008; Behrens, Nunez Ferrer, Carraro, Lahn, & Dreblow, 2011).

The United Nations' (hereinafter: UN) initiative Sustainable Energy for All (hereinafter: SE4All) strongly encourages the involvement of all stakeholders in the realisation of the vision for making the sustainable energy for all a reality. "Developing and deploying business models that deliver and build value from sustainable energy solutions" is one of the illustrative actions that the business sector stakeholders can commit to (UN, 2012, p. 14).

According to Hart & Prahalad (2002, p. 2), the real source of market promise are the 4 billion (back then) of the poorest people, named as the "Bottom of the Pyramid" (hereinafter: BoP), while the countries they live in can be "the ground for developing environmentally friendly technologies and products for the entire world". Simaniset al. (2008) make 3 important notes in their second generation Base of the Pyramid (hereinafter: BoP 2.0) strategy: very low purchasing power of the poor people i.e. inability to buy the products; while well-intentioned the BoP strategy could result in "corporate imperialism"; consumerism does not address the fundamental problems of poverty and sustainable development; and the most important, the poor themselves are excluded from the ultimate goal of improving their living conditions. Second generation BoP strategies, renamed into the 'Base of the Pyramid' consider co-invention and business co-creation that would result into personal business partnership with the BoP communities. BoP 2.0 strategies are about bringing to life new business ideas and models that would exceed either partner's expectations by creatively merging each other's resources, capabilities and energies (Simanis et al., 2008).

"In line with that bottom-up, micro-level perspective, the overall debate has moved towards the role of smaller, local companies, and to a broader interest in reconciling the 'social good' with economic objectives, i.e. beyond corporate social responsibility or philanthropy only, and in such a way that it can reach sufficient scale to address urgent and huge unmet needs of the poor"

(Kolk & van den Buuse, 2012, p. 2). Although academics and wider practitioners highlight business-based approaches and the businesses themselves as a key to the development of the poor regions by drawing entrepreneurs attention to the vast environmental potential, especially in terms of renewable energy (hereinafter: RE) that these countries are holding, “there is still lack of insight into the ‘whether and how’ of viable business models, in environmental, social and economic terms”(Kolk & van den Buuse, 2012, p. 2). In the urgency of reaching the poor through innovative business models that would ultimately improve the conditions of living for these people, the question of ‘what is an economically viable business model’ remains quite ‘blur’.

According to the Frankfurt School, United Nations Environment Programme (hereinafter: UNEP) Centre, & Bloomberg New Energy Finance (hereinafter: BNEF)(2014) and REN21(2015a), over the past decade (2004-2014) RE evolution has shown an immense progress. In 2012, approximately 19% of the world’s final energy consumption was supplied by renewables. Over the 10-year period total global renewable power installed capacity has marked an almost six-fold increase, from 99 GW in 2004 to 560 GW at the end of 2013 (excluding large hydro). Total global RE investments over the same 10-year period increased fivefold. In 2004, investments accounted for approximately EUR 36.7 billion and increased to EUR 199.4 billion¹ in 2013. If a decade ago only the European Union (hereinafter: EU) and the United States of America (hereinafter: USA) were praised for having the highest concentration of RE technologies, today the global RE community can praise the fact that RE deployment has reached all continents. However, a lot has yet to be done, especially in the developing world, which holds huge untapped potential for clean energy solutions.

There is no doubt that support to the RE industry through appropriate policy frameworks and innovative financing mechanisms is necessary for making its commercial use a wide accepted reality. However, there is also urgent need for entrepreneurs who are willing to take the risk and the endeavour of leading a RE venture to its viability. Doing business in developing countries differs substantially from doing business in the developed world due to the many challenges entrepreneurs have to face in terms of: unstable macroeconomic environment and high political risk, non-existent or underdeveloped financial systems, no rule of law and high administrative burdens, lack of modern infrastructure, unskilled labour, high poverty rates i.e. very low purchasing power of people, high percentage of rural population in the total population living in remote areas, etc. That is the reason why there is urgency for devoted entrepreneurs with the capabilities to build innovative and viable business models. The Renewable Energy and Energy Efficiency Partnership (hereinafter: REEEP) (2014, p.16) that is working on the transition from public and donor funding to growth stage commercial investment in RE and energy efficiency in developing countries, points out that “the biggest hurdle to this transition is not the lack of investors per se, but rather of bankable, investment-worthy projects”.

¹ The original amounts of global investments in RE are in US dollars and account for 39.5 billion USD in 2004 and 214.4 billion USD at the end of 2013. The amount in Euros is calculated according to the Bloomberg Business exchange rate as of 20th of April 2015 where 1 EUR=1.0750 USD. <http://www.bloomberg.com/quote/EURUSD:CUR>.

Despite the clarity and wide recognition of the importance of access to energy in developing countries, the topic has not yet received the needed, mainstream attention of the academic business and management literature. Most of the research covers the macro-economic conditions and regulatory and/or policy frameworks in terms of delivery and financing mechanisms for renewable energy (Kolk & van den Buuse, 2012). Therefore, this research was an additional challenge because the topic is not sufficiently explored, but is very important for the development of the business environment, living conditions and development of these regions in general.

The **purpose** of the master thesis is to understand renewable energy business models (hereinafter: REBMs) in middle and low-income developing countries by conducting case studies of two companies, Tecnosol based in Nicaragua and enterprise X based in Kenya. The **main objectives** of the master thesis are:

1. to research and analyse the field of entrepreneurial business models as factor of success for achieving economic viability of renewable energy projects and businesses in developing countries;
2. to enrich the research in the REBM field by analysing real cases in developing countries and determining their peculiarities; and
3. to determine models and characterize the effective REBM(s).

The interest in gaining rich understanding of the context of this research, as well as the processes being enacted, led to the decision to choose case study as a method of analytical approach. By using the case study method, the following **research questions** will be explored and explained:

1. how can REBMs be characterized?
2. what are the characteristics of viable REBMs?

Qualitative data were collected with semi-structured interviews facilitated by the use of Internet, based on the framework for characterization of business models developed by Morris, Schindehutte, & Allen (2005) due to its applicability to firms and projects in general while at the same time serving the needs of the individual entrepreneur.

The master thesis is structured in nine parts. The first chapter covers RE definition, overview of international actors, agreements and initiatives on sustainable development and RE. Furthermore, overview of the past decade of RE development is included, analysis of global investments and future prospects of RE development, as well as challenges to the RE development. The chapter ends with analysis of the importance of access to energy in developing countries, socio-economic impacts and overview of the water-food-energy nexus. The second chapter is dedicated to presenting financing options for renewable energy, as a crucial element for a successful business story, viability of a business and RE market development. The third chapter

includes theoretical background on who an entrepreneur is and what entrepreneurship is, with an overview of environmental entrepreneurship or ‘ecopreneurship’. The fourth chapter covers the theoretical background of business models including the elements of a business model. The fifth chapter presents the principle of creating shared value (hereinafter: CSV). The sixth chapter presents the organization REEEP as an example of a model of public-private partnership for accelerating RE markets in low and middle-income developing countries. The seventh chapter of this master thesis covers the analysis of the external environment of businesses developing RE projects in Nicaragua and Kenya. It covers analysis of the economic and financial environment, competitiveness and business environment, political and legal environment, and environmental and climate change overview, as well as overviews of Nicaragua’s energy sector, RE and access to energy, and overview of Kenya’s agricultural sector. The eight chapter presents the data collection and methodology, as well as limitations to this research. The final, ninth chapter covers the cases for characterizing REBMs of the two companies, Tecnosol in Nicaragua and enterprise X in Kenya.

1 DEFINITION AND IMPORTANCE OF RENEWABLE ENERGY

1.1 Defining Renewable Energy

Population growth coupled with climate change and overexploitation of natural resources pose great challenges for the humanity. According to the Food and Agriculture Organization of the United Nations (hereinafter: FAO) (2014) growing population translates into growing demand for energy and increasing scarcity of water and food. Energy is essential for further development of humanity. It is a vital input in the production of almost every good and service in the economy and is the engine of economic growth.

According to the United Nations Department of Economic and Social Affairs (hereinafter: UNDESA) (2015), the International Energy Agency (hereinafter: IEA) (2014a) and FAO (2014) by 2040 more than 9 billion people are projected to live on this planet, energy demand is projected to increase by 37% and water availability is expected to decrease in many regions, while by 2030 water demand is expected to increase by 30%. These trends pose a growing burden on the natural environment and call for immediate action towards sustainable use of natural resources. Nowadays renewables are perceived as a solution for many pressing needs, such as: reducing dependency on fossil fuels, reducing energy poverty; reducing harmful health and environmental impacts associated with fossil and nuclear energy; mitigating greenhouse gas emissions, reducing poverty and enabling prosperity. According to the IEA (2011) there are three main drivers behind RE deployment:

1. improving energy security,
2. encouraging economic development, particularly associated with rural and agricultural sectors, as well as innovation and high-tech manufacturing, and
3. protection of climate and natural environment from negative impacts of fossil fuels use.

RE is a clean energy source that is continually being replenished by nature. It can be derived directly from the sun (such as thermal, photo-chemical, and photo-electric), indirectly from the sun (such as wind, hydropower, and photosynthetic energy stored in biomass) or from other natural movements and mechanisms of the environment (such as geothermal and tidal energy). With the help of renewable energy technologies (RETs) these natural energy sources are turned into usable forms of energy i.e. electricity, heat and fuels. RE is nothing connected to fossil fuels, which are non-renewable sources, or inorganic sources. It does not include energy sources derived from fossil fuels, waste products from fossil sources, or waste products from inorganic sources (Ellabban, Abu-Rub, & Blaabjerg, 2014).

International organizations, government institutions, and regional commissions have come up with a broad consensus on what constitutes RE. However, they employ legal or formal definitions that vary slightly in the types of resources and sustainability considerations included, that result in lack of common or global definition of RE.

The International Renewable Energy Agency (hereinafter: IRENA) in its Statute (2009, p. 4 - 5) defines RE as "...all forms of energy produced from renewable sources in a sustainable manner, which include inter alia: bioenergy, geothermal energy, hydropower, ocean energy, including inter alia tidal, wave and ocean thermal energy, solar energy and wind energy". This definition is ratified by 108 members including the EU. According to IEA (2015) RE is energy derived from natural processes (e.g. sunlight and wind) that are replenished at a higher rate than they are consumed. Sources of renewable energy are: solar, wind, geothermal, hydropower, bioenergy and ocean power.

Eurostat, the statistical office of the EU, defines RE sources as sources that naturally replenish or renew themselves, such as solar, wind and tidal energy. These sources include: biomass and wastes, hydropower, geothermal, wind energy and solar energy (Glossary: Renewable energy sources, 2015). The Organization for Economic Co-operation and Development (hereinafter: OECD) offers a definition of "new and renewable energy sources" which besides the above mentioned sources includes also draught animal power, fuel wood, peat, oil shale and tar sands (New and Renewable Energy Sources, 2015).

For the purpose of the thesis, IRENA's and IEA's definitions of RE will be used. Thus, RE is energy generated from renewable sources that are naturally replenished or renewed at a rate higher than their consumption rate, where renewable sources comprise: bioenergy, geothermal energy, hydropower, solar energy, wind energy, and ocean energy, including tidal, wave and ocean thermal energy.

1.2 Overview of International Actors on Sustainable Development and Renewable Energy

The following organizations are the leading and most important in combating climate change, building a sustainable future and incentivizing the RE policy and market development.

“UNEP is the leading global environmental authority that sets the global environmental agenda, promotes the coherent implementation of the environmental dimension of sustainable development within the UN system and serves as an authoritative advocate for the global environment” (About UNEP, 2015). UNEP directs its activities towards the following focus areas: climate change, disasters and conflicts, ecosystem management, environmental governance, chemicals and waste, resource efficiency and environment under review. UNEP helps governments of developing countries in overcoming barriers in the deployment of RETs by undertaking assessments of solar and wind energy sources, commission research studies to overcome information barriers, works with local banks to set up end-user financing mechanisms, and with international finance industry, such as banks and insurance companies, to lower risks for larger projects with the aim of overcoming financial barriers, advises developing countries’ governments on broad policy pathways to strengthening RE sources and supports the creation of an enabling environment for small- and micro-businesses in the area of RE (Climate Change Mitigation-Renewable Energy, 2016).

United Nations Development Programme (hereinafter: UNDP) is UN’s global network for development with a status of executive board in the UN General Assembly. With activities in 170 countries and territories, UNDP aims at helping countries to eradicate poverty, and reduce inequalities and exclusion. UNDP helps governments in identifying and implementing public de-risking instruments, which contribute to mobilizing private sector investment in large scale, on-grid renewable electricity technologies. Moreover, it supports governments in RE market transformation by eliminating barriers to RE investment and creating enabling environment for private sector involvement. With the creation of comprehensive programs on energy access, RE, and energy efficiency, it has supported over 120 developing countries over the past 20 years. UNDP is recognized as a senior partner of the SE4ALL initiative (Renewable Energy, 2016).

The World Bank is the international financial institution and very important source of financial and technical assistance to the developing countries around the world. It is made up of the International Bank for Reconstruction and Development (hereinafter: IBRD) and the International Development Association (hereinafter: IDA) that are part of the World Bank Group (hereinafter: WBG) comprised of five institutions. The two objectives of the WBG to be achieved by 2030 are: “ending extreme poverty by decreasing the percentage of people living on less than USD 1.25 a day to no more than 3% and promoting shared prosperity by fostering income growth of the bottom 40% for every country” (What we do, 2015). Since access to energy is one of the fundamental preconditions for eradicating poverty, the World Bank engages

in supporting developing countries to secure affordable, reliable and sustainable energy supply. The World Bank is a co-leader of the UN's SE4All initiative.

IEA is an autonomous organization established in 1974 with the initial aim to provide help to countries in the co-ordination of a collective response to the oil crisis in 1973-74. Over the years IEA evolved and expanded. It is one of the main actors in the global dialogue on energy, providing reliable statistics and analysis, as well as advocating policies to enhance reliability, affordability and sustainability of energy in its 29 members and beyond. It works in four focus areas: energy security, economic development, environmental awareness and engagement worldwide (International Energy Agency, 2014d; About Us, 2016b).

IRENA is an intergovernmental organization, which supports countries in the transition to a sustainable energy future and the process of achieving their clean energy potential. It promotes renewable resources and technologies as a key to a sustainable future. It is the most important platform for international cooperation, a centre of excellence and a repository of policy, technology, resource and financial knowledge on RE. The organization encourages governments to adopt policies that foster RE investments, provides practical tools and policy advice to accelerate RE deployment, as well as assists the progress of knowledge sharing and technology transfer. With its headquarters in Abu Dhabi in the United Arab Emirates, it is the first intergovernmental organization with its headquarters in the Middle East. It has more than 140 members, including the EU (About IRENA, 2016).

The Intergovernmental Panel on Climate Change (hereinafter: IPCC) is a leading international body for assessment of climate change established by the UNEP and the World Meteorological Organization in 1988. It is responsible for reviewing and assessing the most recent scientific, technical and socio-economic information globally that contribute to understanding climate change. It provides decision-makers with rigorous and balanced scientific information. However, it does not conduct any research or monitor climate related data or parameters (Organization, 2016).

1.3 Overview of the International Agreements and Initiatives on Sustainable Development and Renewable Energy

United Nations Framework Convention on Climate Change (hereinafter: UNFCCC) is an international environmental treaty negotiated in 1992 in Rio de Janeiro at the UN Conference on Environment and Development (hereinafter: UNCED), also known as the Earth Summit. It entered into force in 1994. The agreement acts as a framework for international cooperation to combat climate change by limiting average global temperature increases and coping with the impacts of climate change. From 1992 to 2014, the treaty has been signed by 196 countries, known as "Parties". This creates a near universal membership. Parties meet annually at the Conference of Parties (hereinafter: COP), the highest decision-making authority body, to

negotiate multilateral responses to climate change (Background on the UNFCCC: The international response to climate change, 2016).

UNFCCC is the parent treaty of the 1997 Kyoto Protocol, an international agreement ratified by 192 of the UNFCCC parties and which entered into force on 16 February 2005. The ultimate objective of both agreements, as stated in the UN (1992, p. 9), is “to achieve stabilization of greenhouse gas (hereinafter: GHG) concentrations in the atmosphere at a level that will prevent dangerous anthropogenic (human induced) interference with the climate system”. The Kyoto Protocol commits Parties, but does not oblige them, to internationally binding emission reduction targets. The agreement places higher commitments on developed countries under the principle of “common but differentiated responsibilities” since these are primarily responsible for the high levels of GHG emissions as a consequence of more than a century and a half of industrial activity. The agreement sets two commitment periods. During the first commitment period, which started in 2008 and ended 2012, 37 industrialized countries and the European Community committed to GHG emissions reductions to a level of an average of 5% against 1990. The second commitment period, which started January 2013 and will end December 2020, Parties committed to make at least 18% of GHG emissions reduction below the 1990 levels. In the second commitment period the composition of Parties differs from the first one (Kyoto Protocol, 2016).

In December 2015, in Paris at the 21st COP (hereinafter: COP21) under the UNFCCC 195 countries adopted the first ever universal, legally binding global climate agreement also known as the Paris Agreement. The agreement will become legally binding and enter into force when at least 55 countries which together represent 55% of global GHG emissions will deposit their instruments of ratification. The aim of the agreement is to strengthen the global response to the challenges of climate change by (Paris Agreement, 2016):

- keeping the increase in the global average temperature to well below 2°C above pre-industrial levels;
- aiming at limiting the increase of global average temperature to 1.5°C which will contribute to significantly reducing risks and the impacts of climate change;
- the need for global emissions to peak as soon as possible, noticing that this will take longer for developing countries;
- undertaking rapid reductions thereafter in accordance with the best available science.

UN’s initiative SE4All strongly encourages the involvement of all stakeholders in the realisation of the vision for making the sustainable energy for all a reality. The UN (2012) SE4All Framework for Action highlights the importance of the involvement of the private sector stakeholders in achieving initiative’s objectives. The three objectives of the initiative are (UN, 2012):

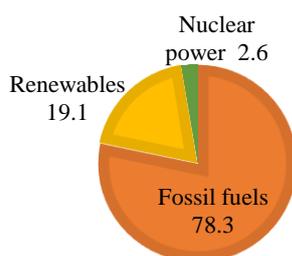
1. providing universal access to modern energy services;
2. doubling the global rate of improvement in energy efficiency; and

- doubling the share of renewable energy in the global energy mix.

1.4 Overview of the First Decade of Renewable Energy Progress 2004-2014

Over the past decade, from 2004 to 2014 RE development has shown an immense progress (REN21, 2015b). Figure 1 shows shares of different energy sources in global energy consumption (in %) in 2013. By 2013, the most recent year for which data is available, an estimated 19.1% of the world's final energy consumption was supplied by renewables.

Figure 1. Final global energy consumption by energy source 2013 (in %)



Source: REN21, *Renewables 2015: Global Status Report*, 2015b, Figure 1, p. 27.

9% of the world's final energy consumption of renewables came from traditional biomass for cooking and heating purposes in remote and rural areas of developing countries. This is followed by 4.1% of biomass/geothermal/solar heat, 3.9% hydropower, 1.3% wind/solar/biomass/geothermal power and 0.8% biofuels (REN21, 2015b). According to REN21 (2015a) over the ten-year period total global renewable power installed capacity marked an almost six-fold increase, rising from 99 GW in 2004 to 560 GW at the end of 2013, excluding large hydro.

1.4.1 Renewable Energy Investments: Global Status and Future Prospects

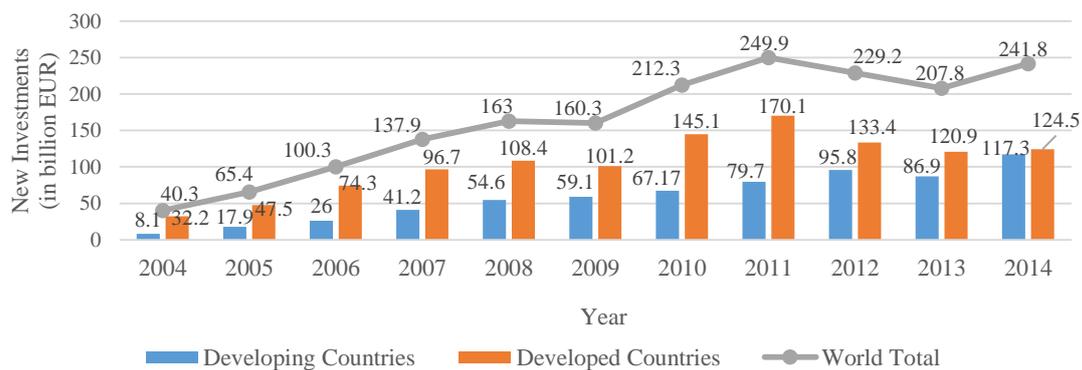
Over the ten-year period, from 2004 to 2014, total new global RE investments marked a fivefold increase. In 2014 global new investments in renewable power and fuels, excluding large hydro (> 50 MW) accounted for an estimated EUR ²241.8 billion, a 500% increase from EUR 40.3 billion in 2004. The increase in 2014 was mostly contributed by the substantial increase in solar power installations in China and Japan in the amount of EUR 67.1 billion between them, as well as a record EUR 16.7 billion of investment decisions for offshore wind projects in Europe (Frankfurt School, UNEP Centre, &BNEF, 2015; REN21, 2015a; REN21, 2015b).

Figure 2 depicts global new investments in billion EUR in renewable power and fuels in developing and developed countries in the ten-year period, from 2004 to 2014. Since 2004 global

² The original amounts of global investments in RE are in dollars and account for 45 billion USD in 2004 and 270 billion USD at the end of 2014. The amount in Euros is calculated according to the Bloomberg Business exchange rate as of 7th of September 2015 where 1 USD = 0.8956 EUR.

investments had been increasing every consecutive year up to 2009 when investments decreased by EUR 3.3 billion mainly due to the global economic and financial crisis and general uncertainty on global financial markets. The situation improved and investments reached its peak in 2011 increasing by 56% to EUR 249.9 billion compared to EUR 160.3 billion in 2009. This was followed by a 2-year downward decrease resulting in a 23% decrease in global RE investments in 2013 compared to 2011. The decline in new investments was due to two main reasons: uncertainty regarding policy support and reductions in technology costs (Frankfurt School, UNEP Centre, & BNEF, 2015). Renewable energy investments recovered in 2014 marking a 17% increase compared to the previous year 2013, however still remaining lower than the 2011 level. The increase in 2014 was partially due to the boom in solar power installations in China and Japan, accounting for 27.7 % of the total investments in RE, as well as investment decisions for offshore wind projects in Europe, making a share of almost 7% of total new investments in RE. 27.2% of the total investments went to small-scale projects, especially small-scale distributed solar PV that increasingly spread in developing countries and are recognized as an immediate and affordable alternative to centralised, grid-based power systems (REN21, 2015b).

Figure 2. Global New Investment (in billion EUR) in Renewable Power and Fuels, 2004 to 2014



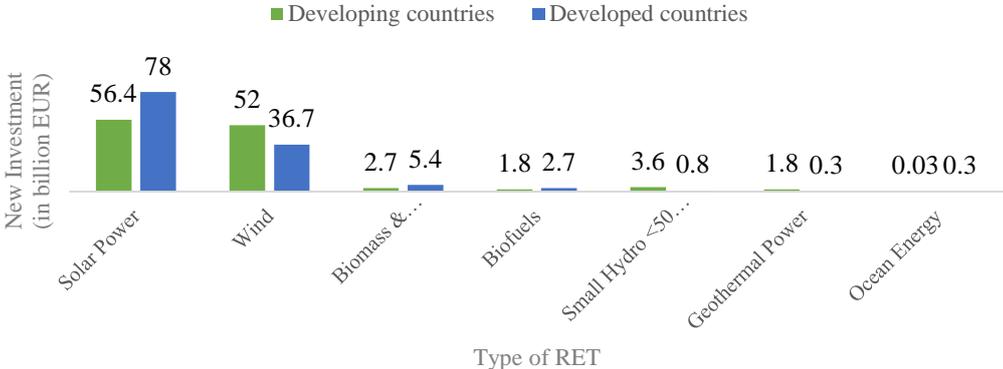
Source: REN21, *Renewables 2015: Global Status Report*, 2015b, Figure 25, p. 79.

As it is visible from Figure 2 total new energy investments in developing countries were rising every consecutive year up to 2012 and increased by almost 12 times compared to 2004. In 2013 total new RE investments in developing countries decreased by 9.3% compared to the previous year. However, this improved in 2014 when total RE investments in developing countries marked an increase of 35% to EUR 117.3 billion compared to EUR 86.9 billion in 2013. Overall, total new energy investments in developing countries marked a fifteen-fold increase over the decade with EUR 117.3 billion in 2014 compared to EUR 8.1 billion in 2004. 2014 is an important year since the gap between new RE investments in developed and developing countries is the smallest ever since 2004. Net investment in additional fossil fuel capacity was considerably lower than the new investment in renewable power capacity. This difference is even higher when large-scale hydropower investment is included (REN21, 2015b).

Europe has the leading place in RE investments since 2004, followed by China. Exception of this trend is 2012 when for the first time China outweighed Europe. Despite China’s notable progress, Europe still has the largest market volume for renewables in the world(Frankfurt School, UNEP Centre, &BNEF, 2014; REN21, 2015a; REN21, 2015b).

Figure 3 shows global RE investments by type of technology for developing and developed countries in 2014. From figure 3 is visible that solar and wind were the two technologies that received the most new investments in 2014. Wind was the leading investment technology in developing countries and solar in the developed ones accounting for EUR 52 billion and EUR 72 billion respectively.

Figure 3. Global New Investment (in billion EUR) in RE by Technology, 2014



Source: REN21, *Renewables 2015: Global Status Report*, 2015b, Figure 27, p.83.

With the start of 2015, renewables faced challenges mostly due to policy uncertainty as well as concerns regarding access to grid for small-scale solar projects. Another concern was the impact of collapsing oil prices on RE investments in the second half of 2014. Falling oil prices may influence investors’ confidence in some parts of the sector, such as solar in oil-exporting countries as well as biofuels, however it should not impact investments in most parts of the world since oil and renewable do not compete for power investment funds. Moreover, future cuttings of costs per MWh of solar and wind should result in increasing investments in these technologies (Frankfurt School, UNEP Centre, & BNEF, 2015).

According to the IEA’s Medium-Term Report (2014c), in 2020 annual investment in new renewable power capacity is anticipated to be at above EUR 204 (or USD 230) billion in real term. This forecasted amount is lower than the 2014 investments due to slowing global capacity growth and expectations of further reducing unit investment costs for some renewable technologies. Renewables are more expensive than conventional electricity-generating technologies; however, the gap is expected to further narrow down over the medium term. IEA’s (2014c) projected growth of the global renewable electricity generation for the medium-term period, up to 2020 is almost 45%, with a projected annual growth of 5.4%. Hydropower is anticipated to contribute 37% to the total growth, while onshore wind is second with a 31% of total growth. 80% of new power generation in the period from 2013 to 2020 is expected to come

from renewables. In the period from 2013-20 non-OECD markets are expected to account for around 70% of new renewable power generation. Even though renewables are expected to be the largest new source of non-OECD generation through 2020, the reality is that they meet only 35% of fast-growing electricity needs. In many countries, especially developing countries, most of the renewable energy projects stay at the inception or early take-off phase of development, mostly due to lack of financing. In most cases deployment usually accelerates to high levels only over the long run (International Energy Agency, 2014c).

According to the IEA's Medium-Term Report (2014c) renewable power capacity is projected to rise from a total 1690 GW on a global level in 2013 to 2 555 GW in 2020, which is a growth of 50%. Two global trends are behind these projections: geographical spreading of deployment as renewable electricity capacity scales up and increasing competitiveness of RETs on a cost basis compared to the existing alternatives.

1.4.2 Barriers to Renewable Energy Development

When developing a RET project in developing countries, project implementers face different challenges, or barriers, that determine the success of their venture. Overcoming these barriers is the "make or break" for the business. However, most of the barriers are not under direct control of the entrepreneurs. Entrepreneurs that are deploying a particular type of RET face a particular market context and they have to adapt and work out innovative tools, processes and products to build a viable business.

Numerous authors (Painuly, 2001; Beck & Martinot, 2004; Mirza, Ahmad, Harijan, & Majeed, 2009) state the same barriers for RE development and deployment. These are technology specific, market context specific, and location (area, land or region) specific. Barriers differ from case to case and new may arise, since they are contextual and dynamically evolving over time. Mirza et al. (2009) argue that lack of successful and replicable business model is a barrier to RETs' adoption. For the purposes of this master thesis, IEA's general classification of barriers to RETs deployment will be used (International Energy Agency, 2011):

1. Economic barriers, which arise when a cost of a given technology, in this case RET, is greater than the cost of its competing technologies, such as fossil fuel technologies, even under optimal market conditions and cost internalisation. According to the OECD Online Glossary of statistical terms (2015), "cost internalisation is the incorporation of negative external effects, notably environmental depletion and degradation, into the budgets of households and enterprises by means of economic instruments, including fiscal measures and other (dis) incentives." Due to direct connection between technological maturity and economic barriers, IEA adopts the name techno-economic barriers. In general, despite decreasing costs of wind and solar PV technologies, RETs are still more costly than its competing conventional alternatives. This is understandable position for renewables, since conventional energy technologies are a result of more than 150 years of systematic research

and learning. Because impacts of climate change and true cost of CO₂ emissions are still unknown, it remains unclear whether higher cost stems from market distortions or true economic barrier. Nevertheless, as a result of learning, cost of RETs has been declining relatively quickly over time (International Energy Agency, 2011).

2. Non-economic barriers- are “...factors that either prevent deployment altogether, no matter how high the willingness to pay, or lead to higher costs than necessary or distorted prices” (International Energy Agency, 2011, p. 34). Non-economic barriers are (International Energy Agency, 2011):
 - a) Regulatory and policy uncertainty includes poor policy design, discontinuity of policies and regulations and/or deficient transparency.
 - b) Institutional and administrative barriers, such as lack of strong and devoted institutions, poorly defined responsibilities, and complicated and complex, time-consuming or non-transparent permitting procedures.
 - c) Market barriers, which include inconsistent pricing structures, market power that makes barriers to entry stronger, wrong price signalling due to not internalizing environmental externalities, asymmetrical information and subsidies for fossil fuels. Fossil fuel subsidies are being justified with the statement that they are in place mostly to help the poor. However, the opposite has been proven and subsidies primarily benefit the upper income groups. A joint report by IEA, OECD, Organization of the Petroleum Exporting Countries (hereinafter: OPEC) and World Bank (2010) reveals that in 2010 only 8% or EUR 31.3 billion (USD 35 billion) of the total EUR 366 (USD 409 billion) fossil fuel consumption subsidies reached the poorest.

Along with the aforementioned barriers, there are additional barriers that considerably impede the deployment of RETs, especially in the developing countries. These are:

- infrastructure barriers: many developing countries lack the needed infrastructure for RE projects’ development. Most of these projects aim at providing access to energy to the poorest, which usually live in the remote rural areas.
- lack of awareness and skilled personnel puts at risk the success of the venture. Failure in operating and maintenance of the systems can affect profitability through delays in project development and additional costs for the project. Moreover, it can affect reputation of RETs in general (Dismantling the Barriers to a Renewables-Based Knowledge Economy, 2015).
- public acceptance and environmental barriers relate to environmental issues that arise from the negative externalities of the RETs. Wind turbines, for instance, have been a target of public rejection in many countries due to increasing bird and marine mammals’ mortality.
- investment and financing barriers are related to the absence of adequate funding opportunities and financing products. Access to finance is one of the biggest impediments for the development of RETs. Many RET businesses fall in the “death valley curve”, term used by venture capitalists, marking the period between the initial funding a new business receives and the beginning of revenue generation (BNEF, 2010). According to the BNEF study (2010,

p. 4) there are two “valleys of death” where shortfall of capital for RETs occurs - technological and commercialization “valley”. The technological valley of death is just after the technology creation stage, which is usually financed with public funding via university or national laboratory funding, and before the venture capital is received. This “valley” includes the research and demonstration/proof of concept stages, where the technology is developed, tested and refined over an extended period, usually 2 to 5 years. The second i.e. the commercialization “valley” appears somewhere in the diffusion/commercialization stage when companies require capital for scaling up for e.g. to finance major manufacturing plant. The commercialization “valley” is “...between late-stage venture capital financing and full scale commercial roll-out” (BNEF, 2010, p. 5). Financing barriers are further explained in Chapter 2 of the master thesis.

Barriers of RETs are closely related. Other categorizations of barriers to RETs are possible and challenges may differ in priority, or new challenges may arise, depending on the technology and its maturity, market context and location.

1.5 Importance of access to energy in developing countries

Energy access in its broader sense is about “providing modern energy services to everyone around the world” (Energy Poverty, 2016). ‘Modern energy services’ are defined as household access to electricity and clean cooking facilities, such as fuels and stoves that do not cause air pollution in living spaces (Energy Poverty, 2016). Karekezi, McDade, Boardman, & Kimani (2012, p. 157) define access to energy more specifically as “...physical proximity to modern energy carriers, such as electricity, natural gas, liquefied petroleum, gas, biogas and ethanol”, as well as the “...availability of affordable improved and more efficient end-use energy devices, such as improved cook stoves, more efficient lights, water pumps, low-cost agro processing equipment as well as energy-efficient housing and transportation options.” Both definitions are equally relevant for the purpose of this master thesis.

1.2 billion people lack access to electricity while more than 2.7 billion people rely on traditional use of biomass (wood and charcoal) for cooking which is health-damaging due to heavy indoor pollution. 95% of these people live in countries in sub-Saharan Africa and developing Asia, located predominantly in rural areas. Sub-Saharan Africa is the world’s most electricity poor region in both, absolute and relative terms. 634 million people or 68% of total population lack access to electricity. In addition to this, 83% of rural population in sub-Saharan Africa lacks access to electricity. Fortunately, the pace of deterioration of this condition has slowed, however efforts and improvements can be camouflaged due to rapid population growth. Developing Asia is the second world’s electricity poorest region with 526 million or 14% of total population, and 22% of rural population, followed by the Middle East with 17 million or 8% total population, and 21% of rural population, and Latin America with 22 million people or 5% of total population, and 15% of rural population. Nearly three quarters of the global population living without clean cooking facilities reside in only ten countries (World Energy Outlook 2015, 2016).

1.5.1 Socio-economic impacts of Sustainable Energy Services in Developing Countries

Access to modern energy services is directly linked to human well-being and prosperity. It is a precondition for the provision of clean water, sanitation and healthcare, as well as for the provision of reliable and efficient lighting, heating, cooking, mechanical power, transport and telecommunications services (World Energy Outlook, 2016). Consequently, countries that have the highest proportion of people in total population without energy access are the ones that face the highest poverty rates.

Lack of access to adequate and affordable energy services puts the poor into a vicious cycle that leads to grater poverty and deterioration of people's livelihoods. People who lack access to cleaner and affordable energy are trapped in a cycle of deprivation, lower incomes and lack of ways to improve their living conditions while at the same time dedicating considerable amounts of their very limited income on expensive and health-damaging forms of energy, such as wood, charcoal, coal, kerosene and fossil fuels, which provide unsafe, unreliable, and poor services (Karekezi et al., 2012). Hence, access to sustainable and affordable energy services is crucial for reducing poverty. Small-scale and community-based RE projects are acknowledged as essential for reaching the energy poor and increase access to energy for individuals and communities that would not have been served by market structures (Terrapon-Pfaff, Dienst, König, & Ortiz, 2014). Socio-economic impacts of small-scale RE projects include: energy access, reducing extreme poverty and hunger, reduced energy costs, provision of public services, such as healthcare and education, increased employment and improved income-levels, improved health, communication, access to information, environmental sustainability and GHG emissions' reduction, and development of sustainable energy policies (Karekezi et al., 2012; Terrapon-Pfaff et al., 2014).

1.5.2 Overview of the Water-Energy-Food Nexus

Water, energy and food sectors are closely interrelated and interdependent. Water requires energy for extraction and distribution, energy i.e. power generation requires water, and food production requires water and energy. These mutual relationships and trade-offs between the three resources are widely recognized and defined as the water-energy-food nexus. The water-energy-food nexus is an approach aiming at understanding and managing complex and dynamic interactions between water, energy and food, also known as the global resource system, by identifying potential trade-offs and synergies, and appropriately designing, assessing and prioritizing response options that are viable across different sectors without compromising sustainability (FAO, 2014; Hoff, 2011; World Economic Forum (hereinafter: WEF), 2011; Zahner, 2014).

Guiding principles of the Water-Energy-Food nexus, according to Hoff (2011, p. 13) are:

- investing to sustain ecosystem services,
- creating more with less, and
- accelerating access and integrating the poorest.

Main drivers of increasing demand for fresh water, energy and food are: economic development, globalization and international trade, population growth and mobility, consumer’s rising incomes and purchasing power, increasing urbanization, diversifying diets and changing consumption patterns, cultural and technological changes, climate change, degradation of the resource base, such as desertification, and land and soil degradation, scarcity of water, land and other natural resources. Due to these factors there is a need for a holistic approach such as the water-energy-food nexus approach (Hoff, 2011).

World population has reached 7.3 billion people as of mid-2015 and is projected to increase to 9.7 billion until 2050, with most of the growth coming from developing countries. More than a half of the population growth till 2050 is expected to occur in Africa (UNDESA, 2015). By 2030, water demand is expected to increase by 30% (FAO, 2014); by 2040, global energy demand is set to increase by 37% (International Energy Agency, 2014b); and by 2050, global demand for food will increase by 60% (FAO, 2014). Agricultural production will have to grow by 70% on global scale and by 100% in developing countries only (Hoff, 2011). Agricultural sector consumes 70% of all water demand, withdrawn from aquifer, streams and lakes, making the sector the largest consumer of water. By 2050, total global water withdrawals for irrigation are projected to increase by 10% (FAO, 2011).

In 2011, WEF (2011) stated Water-Energy-Food nexus as one of the three global risks in focus. Economic growth and population growth are main drivers for all three risks. Table 1 shows the direct and indirect impacts of the risks on governments, societies and businesses related to the nexus.

Table 1. Impacts of risks related to the water-energy-food nexus

Impacts	Direct Impacts	Indirect Impacts
On governments	<ul style="list-style-type: none"> • Stagnation in economic development • Political unrest • Cost of emergency food relief • Significantly reduced agricultural yields • Threats to energy security 	<ul style="list-style-type: none"> • Increased social cost linked to employment and income loss as agriculture is negatively affected • National security risks/conflicts over natural resources
On societies	<ul style="list-style-type: none"> • Increased levels of hunger and poverty • Increased environmental degradation • Severe food and water shortages • Social unrest • Food price spikes 	<ul style="list-style-type: none"> • Migration pressures • Irreparably damaged water sources • Loss of livelihoods
On businesses	<ul style="list-style-type: none"> • Export constraints • Increased resource prices • Commodity price volatilities shortages ripple through global markets • Energy and water restrictions 	<ul style="list-style-type: none"> • Lost investment opportunities

Source: World Economic Forum, *Global Risks 2011*, 2011, p. 28, Table 4.

2 FINANCING OF RETS

Despite the significant improvement in new investments over the past decade, there is still reluctance among financiers and investors in developing RET projects. This is due to difficulties in assessing feasibility, viability and risks of RET projects, as well as the need for long-term financing of usually 15 years. Consequently, RET projects get stuck in a “magical circle” where lack of finances leads to lack in capacity and expertise, which further leads to failure in developing a pipeline of bankable projects; this in turn means that the required expertise and capacity in RET projects will not have the chance to be developed, and ultimately puts the success of the project at risk (WB, Climate Investment Fund (hereinafter: CIF), 2013).

According to the World Bank and CIF’s report (2013, pp. 4-9) financial instruments target two broad categories of barriers and risks:

1. **Financing barriers**, resulting from underdeveloped financial markets that impede access to credit at reasonable terms. All RET projects in low-income, developing countries face these barriers. Financing barriers include:
 - a) lack of long-term financing and project financing due to high up-front capital costs compared to conventional technologies, and inability to assess the risk of the new technology;
 - b) small scale of projects, which are too big for the microfinance institutions but too small for corporate banking;
 - c) high and uncertain project development costs of RET projects because they are located in environmentally and socially sensitive areas, that lack basic infrastructure such as electricity grids, water supply and telecommunications; and
 - d) lack of equity finance due to mismatch between demand for and supply of corporate financing coupled with high country-specific risk associated with low-income, developing countries.
2. **RET-specific risks**, such as:
 - a) high financing cost accounting for 16 – 18% in low-income, developing countries;
 - b) high exposure to regulatory risk due to high dependency on supporting regulatory framework for survival of the project, such as necessary infrastructure investments, commitments to pay premium prices and guarantees of purchases of their outputs, which make RET projects highly vulnerable to changes in regulatory framework;
 - c) uncertainties over carbon financing; and
 - d) uncertainty over resource adequacy due to site-specific nature of resource assessments. Lack of site-specific resource assessments make RET projects very risky, and consequently obtaining of private financing difficult.

Different technologies have different exposure to barriers and risks. Off-grid projects differ from on-grid projects since they rely on sales to individual households or small-scale systems to rural communities. In these projects affordability and financeability become fundamental for viability.

Due to small scale of these projects, which are focusing on individual household level, transaction costs can become a very serious barrier (WB & CIF, 2013). Table 2 presents solar on-grid and off-grid projects and levels of various corresponding financing barriers and project risks.

Table 2. On-grid and Off-grid Solar Projects, Financing Barriers and Project Risks

Type of Solar Project	Financing Barriers						Project Risks			
	Lack of long term financing	Lack of project financing	High and Uncertain Project Development Costs	Lack of equity finance	Small scale of Projects	High Financial Cost	High Exposure to Regulatory Risk	Uncertainties over Carbon Financing	High Costs of Resource Assessment	Uncertainties over Resource Adequacy
On-grid solar	Hi	Med	Lo	Med	Med	Hi	Med	Med	Lo	Med
Off-grid solar	Med	Lo	Med	Hi	Hi	Med	Lo	Lo	Lo	Med

Note:*Lo = Small or no impact (mitigation of risks is desirable); Med = Moderate Impact (mitigation of risks is likely to be required); Hi = Significant impact (mitigation of risks is generally necessary if the project is to proceed).

Source: World Bank, & CIF, *Financing Renewable Energy: Options for Developing Financing Instruments Using Public Funds*, 2013, p. 10, Figure 2.1.

2.1 Financing mechanisms for the development of Renewable Energy

There are three main types of support mechanisms for the development of the RE market. These are (Abolhosseini & Heshmati, 2014):

1. feed-in-tariff (hereinafter: FIT),
2. tax incentives, and
3. tradable green certificates.

FIT is a policy mechanism for encouraging RE deployment. It offers three financial benefits: payment for all electricity produced, additional payments for electricity exported to the grid, and reduction of the standard electricity bill in case of households producing their own electricity from renewable sources, like solar PV. Usually FITs are available for households, businesses and public institutions (World Bank & CIF, 2013; Feed in Tariffs, 2015). Three crucial provisions have to be in place for the success of FIT policy. These are: guaranteed access to grid, stable and long term purchase agreements, and price determination based on unit costs of power generated by RE sources (Abolhosseini & Heshmati, 2014).

Tax incentives, such as tax exemptions or tax credits, are used as a fiscal incentive measure for increasing RE deployment in numerous countries. Tax credits can be applied for investment, production, or consumption of electricity generated by RE sources. Tax credits aimed at supporting RE consumption apply tax credits on the purchase and installation of renewable equipment. Another tax credit is a carbon tax imposed by the government aimed at reducing fossil fuel consumption and creating higher cost burden for burning fossil fuels (Abolhosseini & Heshmati, 2014).

Renewable portfolio standard (hereinafter: RPS) is another policy used with FITs. Main differentiation between the two policies is that FIT is a price-based policy while RPS is quantity-based policy. Under the RPS mechanism, utility companies are obliged to generate a specified share of their electricity by renewable energy. For every unit of power generated companies receive the so-called tradable green certificates. RPS policy includes the market perspective, while FIT policies are preferred for development of renewables where investors are willing to accept only low levels of risk (Abolhosseini & Heshmati, 2014).

2.1.1 Overview of financing instruments for RET projects

Financing instruments can be distinguished by the level of risk assumed by the public entity providing the funding for the instrument, and by the level of leverage- the degree to which public funding mobilizes private finance. The objective is to use those financial instruments that deliver the largest amount of private funding for the smallest amount of public funding, and consequently achieving the greatest leverage (World Bank & CIF, 2013).

Various financial instruments can be used to mobilize private financing, but only under conditions of developed financial markets and low country-specific risk, particularly political risk. When these conditions are not met, as it is the case in many developing and low-income countries, the choice of financial instruments is limited. In line with this, financial instruments that are not effective in low-income countries will not be further explained. These are: venture capital, except for new technologies that are attractive to international investors, asset-backed securities, and aggregation. The following financial instruments are suitable for developing countries (World Bank & CIF, 2013):

1. capital grants address specific risks of RET projects. It is a sum funded by the government to help a company in financing its long-term physical assets, and to improve RET projects' cost-competitiveness. They are relatively simple to implement and do not need ongoing administration, however do not provide control over the project and do not incentivize the project developer to deliver a viable project because does not have future repayments. Moreover, it directly replaces potential private financing.
2. senior debt provides long-term finance and increases cost-competitiveness of RET projects. Credit lines address financing barriers, and project loans address project-specific risks. This

creates incentive for project viability due to the obligation to repay the debt, and repayment of principal can be channelled towards funding future RET projects. However, senior debt involves high transaction costs because of the need for due diligence to verify the ability of the project to repay itself. It has limited ability to attract private finance and may crowd out potential private providers of debt.

3. subordinated debt in this case covers all types of mezzanine debt which is a hybrid of debt and equity funding. If the debt is not repaid fully and in time, the lender has the right to ownership or equity interest in the company. Providers of subordinated debt bear higher risk than providers of senior debt which is compensated by higher returns. Subordinated debt is substantially valuable as a means of financing RET projects because addresses both, financing barriers and project risks. Subordinated debt is intermediate finance between equity and senior debt. This kind of debt has very high level of leverage which is very important for RET projects. However, it incurs high transaction costs because it is usually custom-designed for each project.
4. guarantees and insurance are both risk-transfer mechanisms. Their purpose is to reduce risk for investors by offering them the protection against risks. When investors get protection against risks they are more willing to invest in a particular project. It is not a direct financing; nevertheless, it is important for mobilizing commercial financing.
5. results-based financing (hereinafter: RBF) is a mechanism that pays grants or subsidies after the delivery of predetermined set of output. However, the pre-financing becomes an issue in many situations especially in low-income, developing countries due to the underdeveloped financial markets. Output-based aid (hereinafter: OBA) and Output-based disbursement (hereinafter: OBD) are two groups of RBF. OBA aims to increase access to energy services for the poor by covering the difference between the full cost of supply and the affordable price to low-income consumers. OBA covers either the capital cost of investments or the difference between an affordable user fee and a cost-recovery user fee such as consumption subsidy.
6. there are guarantees that are tailored for the political or regulatory risks in low-income, developing country. There is a political risk insurance (hereinafter: PRI) or a partial risk guarantee (hereinafter: PRG). Such guarantees are provided by multilateral institutions and bilateral credit agencies such as IDA, IBRD, International Finance Corporation (hereinafter: IFC) and Multilateral Investment Guarantee Agency (hereinafter: MIGA) within the WBG (World Bank & CIF, 2013).

2.1.2 Carbon finance

Carbon finance is an instrument for catalyzing finance for low-emissions development (Carbon Finance Unit, 2015). It means generating revenue by using carbon credits on carbon markets (Mitigation of Climate Change in Agriculture Programme (hereinafter: MICCA) & FAO, 2010).

Throughout the years substantial efforts have been made to tackle climate change and reduce carbon emissions. This made carbon a valuable economic commodity. Today, carbon can be

traded on a carbon market that functions in a similar way as financial markets. The currency used for trading carbon emissions is known as **carbon credit**. In order to have a common unit for this commodity all GHGs are converted to CO₂ equivalents (hereinafter: CO₂-eq) where one unit of carbon credit is equivalent to one tone of CO₂ emissions (1 carbon credit = 1t of CO₂ emissions). The CO₂-eqs are traded on carbon markets (MICCA & FAO, 2010).

The carbon trade originated with the Kyoto Protocol in 1997 where 37 industrialized countries and the European Community made their first commitment to reduce GHG emissions to an average of 5% against 1990 levels in the period between 2008 and 2012. Under the Kyoto only developed countries, which contribute the most to pollution, are obliged to meet specific targets of GHG emission reduction. Developing countries are not obliged to do so. Under the Protocol “polluters” i.e. developed countries have agreed for reducing their greenhouse gas emissions below their country-specific target and in a predetermined time frame. They can achieve this by: reducing GHG emissions in their own country, implementing projects to reduce emissions in other countries or trading. In accordance with this, emissions permits that are carbon credits are allocated to polluter countries and these countries further allocate the permits to the most polluting industries. The volume of emission permits these countries receive is equivalent to their 1990 levels of emissions plus/minus their reduction commitment. Carbon trade involves agreement in simple terms between a buyer and a seller of carbon credits. Those that pollute less and therefore are in excess of carbon credits sell them to those who pollute more than the allowed amount. These permits or carbon credits can be traded on two types of carbon markets: regulatory compliance and voluntary markets. Companies and governments by law have to account for their GHG emissions trade on the regulatory compliance market. This market is regulated by mandatory national, regional or international carbon reduction regimes. The voluntary market comprises trade of carbon credits on a voluntary basis (Kyoto Protocol, 2015; MICCA & FAO, 2010; What is the Kyoto Protocol?, 2015).

There are three Kyoto Protocol mechanisms that fall under the regulatory market. These are: the Clean Development Mechanism (hereinafter: CDM) that comprises credit-earning projects developed in countries without emission reduction targets which are mostly developing countries; the second mechanism is the Joint implementation that covers projects developed in countries with emission reduction targets, and the EU Trading System (MICCA & FAO, 2010; What is the Kyoto Protocol?, 2015).

CDM is of biggest interest for developing countries. Under the CDM, developed countries that have to meet the predetermined targets of emission reductions can achieve this by implementing emission reduction project in developing countries. This can be a forestation, an energy efficiency or RE project. The uptake or savings of GHGs from the CDM project generate carbon credits for the developed country implementing the project. Carbon credits from CDM project are known as Certified Emission Reductions (hereinafter: CER). The developed country can then use its CERs to compensate some of the domestic GHG emissions and achieve its emission reduction targets. Developing countries benefit from the CDM projects through new technology

transfer, job creation, positive environmental impact and overall support of sustainable development (MICCA & FAO, 2010). CDM enables projects to access revenue streams from CERs as up-front financing or to refinance other RE projects. However, the number of potential buyers of CERs is very small. Moreover, the project development may experience substantial delay due to the process of realizing carbon revenues, which can be especially complex and costly for first-of-a-kind projects (World Bank & CIF, 2013).

2.1.3 Small-scale project financing

Small-scale project financing comprises financing of small-scale RET projects, specifically household and community-level projects. These are projects developed by small suppliers that provide products and services for low-income communities with limited ability to pay up-front. Due to the customers' low and unreliable purchasing power small-scale RET projects face even greater barriers in raising capital for initial investments. Microfinancing and portfolio guarantees are financing instruments most specific to small scale RET projects, but are not limited to them (World Bank & CIF, 2013).

Microfinance is a development tool for provision of financial services to low-income entrepreneurs and small businesses. As financial intermediaries, microfinance institutions (hereinafter: MFI) offer financial services which generally include savings and credit. Some MFIs provide insurance and payment services too. Microfinance activities involve: small loans typically for working capital, informal appraisal of borrowers and investments, collateral substitutes, such as group guarantees or compulsory savings, access to repeat and larger loans based on repayment performance, streamlined loan disbursement and monitoring and secure saving products. Besides financial services, intermediary MFIs provide social intermediation services, such as training in financial literacy and management capabilities. The majority of MFIs have a relatively narrow geographical, product and sector focus. Loans are typically offered at high interest rates and shorter terms and are expected to be repaid from additional revenues generated from future sales or from the investment. Offering of loans at longer terms, particularly for solar house systems (hereinafter: SHSs), whose repayments rely on household incomes, is a novelty for the microfinance institutions (Ledgerwood, 1998; World Bank & CIF, 2013).

Low-income customers have to take loans in order to buy the services offered by small-scale RET projects. The low-purchasing power of these customers poses high risk of default. One way of managing this risk involves the use of portfolio guarantees. Due to the large number of similar individual loans involved in small-scale RET projects, portfolio guarantees are preferred before individual guarantees which are mostly used for larger RET projects (World Bank & CIF, 2013).

3 WHO IS ENTREPRENEUR AND WHAT ENTREPRENEURSHIP IS?

The questions “what makes a person an entrepreneur” and “what is entrepreneurship” are subjects of debate for many years (Hébert & Link, 1989; Ahmad & Seymour, 2008). The lack of generally agreed, measurable attributes of entrepreneurs and entrepreneurship contributes to the difficulty and complexity of shaping a relevant, widely agreed upon definition (Hébert & Link, 1989; Ahmad & Seymour, 2008; Iversen, Jørgensen, & Møller, 2008).

The word “entrepreneur” comes from the French word “entreprendre” literally meaning “to undertake”. It was first introduced by the French economist Jean-Baptiste Say (Brown & Thornton, 2013). The Irish-French economist Richard Cantillon, considered as “the father of economic theory” (Brown & Thornton, 2013, p. 402), is credited as the first writer to identify the critical role of entrepreneurship and the first relevant author who introduced the modern concept of entrepreneurship (Brown & Thornton, 2013; Murphy, Liao, & Welsch, 2006; Ahmad & Seymour, 2008; Tülüce & Yurtkur, 2015).

In 1730 Richard Cantillon in his “*Essai sur la Nature du Commerce in Général*” defines entrepreneurs as “risk-takers”, since they choose to live on uncertain income instead of a certain one. He described differences between supply and demand as opportunities to buy goods at cheaper price and sell them at higher price, and entrepreneurs are those who spot and are alert to these opportunities. Entrepreneurs were the engine of bringing the market system into equilibrium. Ownership was not a precondition for one to be an entrepreneur. Entrepreneur is someone living in uncertainty and who bears the risk of uncertain, non-fixed income, as opposed to wage earners with fixed incomes (Brown & Thornton, 2013; Murphy et al., 2006; Ahmad & Seymour, 2008; Vasapollo, 1996).

The French economist Jean Baptiste-Say, who was influenced by Cantillon’s work, argued that there are three functions to be found in any process of production: effort, knowledge, and the “applications” of the entrepreneur. Say argued that knowledge of how to produce goods is required; however, application of this knowledge was crucial. Hence, the entrepreneur was needed as a main agent of production who organizes resources to meet market demand (Say, 1832; Koolman, 1971). According to Say (1832, p. 34) and as referenced by Koolman (1971, p. 272), a country can be in deficit of “knowledge” which can be imported from abroad, however “...the art of applying the knowledge”, “...the skill of execution” and ultimately a country rich in “...intelligent merchants, manufacturers, and agriculturalists has more powerful means of attaining prosperity, than one devoted chiefly to the pursuit of the arts and sciences”.

Joseph Alois Schumpeter is known for his academic contributions that substantially increased the significance of entrepreneurship in the economic theory (Jones & Wadhvani, 2006; Kurz, 2012). Schumpeter is mostly associated with the ‘creative destruction’, term which he derived from Karl Marx and promoted as theory of economic innovation and business cycle (Tülüce & Yurtkur, 2015). Creative destruction is the “...process of industrial mutation that incessantly

revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one” (Schumpeter, 1976, p. 83). In this regard, he describes the entrepreneur as an agent of change, economic growth and development (Tülüce & Yurtkur, 2015). The entrepreneur is the innovator who implements change within markets through the carrying of new combinations. These can take several forms (Ahmad & Seymour, 2008):

- introduction of a new good or improved quality,
- introduction of a new method of production,
- opening of a new market,
- conquest of a new source of supply of new materials or parts, and
- rebuilding of an organisation of any industry, including a change of management processes.

Schumpeter (1947) further elaborates on entrepreneurship through the theory of creative response. Creative response is the economy’s, industry’s or firms’ new way of solving a problem, or ‘out of the box’ respond to socioeconomic challenges. As opposed to adaptive response, where the economy, industry, or firms are adapting to newly arisen conditions by using the same knowledge, methods and practices, creative response changes economic and social situations for good by creating solutions that are outside the boundaries of the existing practices. According to Schumpeter (1947, p. 151), the entrepreneur and her/his entrepreneurial function, are defined simply by one characteristic – innovation– “the doing of new things or the doing of things that are already being done in a new way”. Although the definition is broad, Schumpeter claims that the absence of sharp line defining what is and what is not entrepreneurship is actually an advantage. Schumpeter further argues that entrepreneurship must be distinguished from management, although the two interweave each other. Entrepreneurship is about “...setting up a concern embodying a new idea...” and management is “...to head the administration of a going concern...” (1947, p. 151). Another distinction that Schumpeter (1947, p. 152) claims important to make, is the one between the entrepreneur and the inventor. The inventor generates new ideas, and the entrepreneur “...gets things done...”, where the ‘new things’ may or may not be scientifically new. Quite often it is the case when inventors become entrepreneurs, however there does not necessarily need to be a link between the two functions.

Antonicic, & Hisrich (2003, p. 8) consider entrepreneurship as “...individual or organizational level behavioural phenomenon, or a process of emergence” where emergence-related behavioural intentions and behaviours are expressed through innovation or organization formation. These emergence-related intentions and behaviours present the boundary between what entrepreneurship is and what is not. Hisrich, Peters, & Sheperd (2010, p.8) define entrepreneurship as “...a process of creating something new with value by devoting the necessary time and effort, assuming the accompanying financial, psychic, and social risks, and receiving the resulting rewards of monetary and personal satisfaction and independence”.

Drucker (2002) argues that everybody who starts and owns a small business is not an entrepreneur. Entrepreneurs are those “...who create something new, something different; who

change and transmute values” (Drucker, 2002, p. 22). It is not the “risk-taking” that distinguishes entrepreneurs from other individuals performing economic activity, since “...the essence of economic activity is the commitment of present resources to future expectations, and that means to uncertainty and risks” (2002, p.25). Drucker (2002, p.27) sees entrepreneurs as “change agents” by claiming that “...entrepreneurs see change as the norm and as healthy”, even though they do not necessarily bring the change. Drucker (2002, p. 28) concludes, that what defines entrepreneur and entrepreneurship is that “the entrepreneur always searches for change, responds to it, and exploits it as an opportunity”.

Schaper (2005, pp. 4-5) describes entrepreneurs as people who have the ability to spot opportunities and identify new ventures by willing to “look out of the box” and exploring issues in fundamentally different ways. Moreover, entrepreneurs “...incubate ideas and champion their adoption, assemble the resources needed to bring the idea to commercial reality, such as money, people and technologies, and, finally launch and grow the business venture”. The author distinguishes between entrepreneur and manager, by describing the former as a person who puts all energy and enthusiasm into making a new business idea a reality, and directs the venture as it grows and develops. A manager is a person who simply ensures that the firm is run efficiently and effectively on a daily basis.

3.1 Environmental entrepreneurship or 'Ecopreneurship'

Environmental entrepreneurship or ‘ecopreneurship’ is a new field of academic research and study. Some contributions had been made in the 1970s. The subject attracted more interest with Quinn's (1971) Harvard Business Review article claiming that instead of being a drain on economic activity, 'the ecology movement' could be a new profitable market opportunity. The topic started to get more attention in the decades to follow, in particular the late 1980s and 1990s. The authors Bennett (1991), Berle (1991), and Blue (1990) started using the terms: 'environmental entrepreneur', 'green entrepreneur', 'eco-entrepreneur' and its derivation 'ecopreneur'. Accordingly, the terms: 'ecopreneurship', 'eco-entrepreneurship', 'green entrepreneurship' and 'environmental entrepreneurship' have been used interchangeably (Schaper, 2005).

Environmental entrepreneurs, or ecopreneurs are persons who create a new, usually for-profit ventures with the aim to address environmental challenges (Lenox & York, 2011). As entrepreneurs, ecopreneurs identify a new business opportunity, research the market, gather and harness the resources to make the idea stemming from the opportunity a reality, undertake a business ventures and bear the associated risks. What makes them 'ecopreneurs' is the positive net environmental impact their commercial activities have on the natural environment, and their strategic orientation towards sustainable future. The factor of intentionality also contributes to defining the ecopreneurs. Their personal belief system i.e. their set of values and aspirations sees protection of natural environment and sustainable future as important goals in themselves. The factor of intentionality is important because separates 'ecopreneurs' from 'accidental ecopreneurs'

i.e. business ventures that operate in an environmentally friendly manner due to unpredicted byproduct of other business process and not because of intentional focus on the issue. Economic incentives, personal motivations, and institutional context are the three main drivers of environmental entrepreneurship (Schaper, 2005; Lenox & York, 2011).

For the purpose of this master thesis the above stated definition and explanation of ecopreneurs and ecopreneurship are considered: persons or organizations who create a new, usually for-profit ventures with the aim of addressing environmental challenges and adopt set of values and aspirations that see protection of natural environment and sustainable future as important goals in themselves.

4 BUSINESS MODEL – A THEORETHICAL BACKGROUND

The term ‘business model’ has first appeared in Bellman et al.’s article published in 1957. After some period of unspecific use of the term, the term begins to be used as a ‘business modelling’ to denote process models in the context of information technology. In 1975Konczal refers to the use of ‘business models’ as management tools. In the following years ‘business models’ are characterized by functional aspects and business modelling is seen as operative activity. The period up to the mid-1990s is characterized by a ‘lull’ in the academic and practice-based contributions to the use and development of the concept. Since then, the term has become sharply popular and central to the Internet-boom or the beginning of the New Economy, i.e. the transition from manufacturing-based to service-based economy. Some in the academic circles argue that there have been three main drivers behind the emergence and wide usage of the concept since the mid-1990s. These are: the arrival of the Internet, rapid growth in emerging markets and interest in “bottom of the pyramid” issues, and expanding industries and organizations dependent on post-industrial technologies (Zott, Amit, & Massa, 2010; Osterwalder & Pigneur, 2005; Lewis, 2000; DaSaliva & Trkman, 2014; Wirtz, Pistoia, Ullrich & Göttel, 2015).

So what is a business model? There is no single widely accepted definition. Over the years different authors have been contributing with different, yet similar meanings of what a business model is, ranging from simple to more complex ones. Wirtz et al. (2015) note that the field of research is still in a young stage despite the fact that there are numerous contributions. There is also lack of clarity due to literature fragmentation and varying perspectives of the authors. Ovans (2015) notes that definitions are formulated dependent on how business models were used. Despite the fact that there is no consensus regarding the definition, structure and evolution of business models, “a good business model remains essential to every successful organization, whether it is a new venture or an established player” (Magretta, 2002, p. 87).

Magretta (2002, p. 87) uses the analogy of a ‘story’ for a business model. It further explains that business model is a story, which describes how enterprises work. According to the author, good business models give answers to the following questions: “Who is the customer?”, “What does

the customer value?”, “How do we make money in this business?”, and “What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?”. Magretta (2002, p. 88) further explains that “...a successful business model represents a better way than the existing alternatives”, “...may offer more value to a discrete group of customers, or it may replace the old way of doing things and become the standard for the next generation of entrepreneurs to beat”; “...powerful business model creates new, incremental demand”. Well-designed business model can become a competitive advantage for the company if it alters the economics of an industry and is difficult to replicate. Ovans’ (2015) interpretation of Magretta’s distinctions between ‘strategy’ and ‘business model’ clears the fuzziness between the two terms. Ovans (2015) interprets that “...business model is a description of how your business runs, but a competitive strategy explains how you will do better than your rivals”. Ovans (2015) further explains that differentiating the business from the rivals can be done by “...offering a better business model” or “by offering the same business model to a different market”.

DaSilva & Trkman (2015, p. 382) interpret business models through the resource based view and transaction cost perspective, arguing that “...business models represent a specific combination of resources which through transactions generate value for both customers and the organization”.

Morris et al. (2005, pp. 726-727) put business model definitions in three categories. These are: economic, operational and strategic, where each is composed of a special set of decision variables. The order of the categories is hierarchical, meaning the perspectives are becoming more exhaustive as we move from the economic to the strategic category. The economic category comprises the logic of profit generation, or simply put how the firm will make money, and includes decision variables, such as: revenue sources, cost structures, margins, and expected volumes. The operational category comprises the internal processes and design of infrastructure necessary for the firm to create value. Decision variables are: production or service delivery methods, administrative processes, resource flows, knowledge management, and logistical streams. This category is on higher hierarchical level than the economic and presents the business model as an architectural configuration. The most comprehensive of the three is the strategic category, where main concerns are competitive advantage and sustainability. Following the reasoning of economic, operational and, strategic dimensions of a business model, Morris et al. (2005, p. 727) offer the following integrative definition: “A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets.” According to Morris et al. (2005) a business model should answer 6 basic questions: “How do we create value?”, “Who do we create value for?”, “How do we competitively position ourselves?”, “How do we make money?”, and “What are our time, scope and size ambitions?”.

All of the abovementioned definitions are relevant for the purpose of the master thesis.

4.1 Elements of a business model

According to Osterwalder & Pigneur (2009, p. 14) “a business model describes the rationale of how an organization creates, delivers and captures value”. Osterwalder & Pigneur (2009) determine 9 elements or so called “building blocks” of a business model:

1. **Customer segments** are the fundamental building block of a business model. They comprise different groups of people or organizations with common needs, common behaviours, or other attributes, that an enterprise aims to reach and serve. Customer segments give answers to the questions: ‘Who are we creating value for?’ and ‘Who are our most important customers?’. In order to successfully serve different customer segments the enterprise must understand the specific customer needs. “Customer groups represent separate segments if: their needs require and justify a distinct offer, are reached through different distribution channels, require different types of relationships, have substantially different profitability, and are willing to pay for different aspects of the offer” (Osterwalder & Pigneur, 2009, p. 20). There are five different types of customer segments (Osterwalder & Pigneur, 2009, p. 21): mass market, where business models do not differentiate between customer segments and all resources are employed towards one large group of customers with broadly similar needs and problems; niche market, which is opposite to mass market, and is a specific, specialized customer segment where value propositions, distribution channels and customer relationships are all tailored to the specific requirements of this market; segmented market which distinguishes between market segments with slightly different needs; diversified market, where the business model serves two or more unrelated customers segments with considerably different needs and problems; and multi-sided platforms or multi-sided markets which serve two or more interdependent customer segments.
2. **Customer value proposition** is a statement that summarizes key specific benefits of a product or service, or a bundle of both for target customers. It informs a customer with key reasons why the product or service is superior to competing offers. Different value propositions may be provided for different target customers (Tanner & Raymond, 2010). Value propositions may be innovative and represent a new disruptive offer, or it may represent an existing offer, but with added attributes and features. It is quantitative, such as price or speed of service, or qualitative, such as design and customer experience. The following elements can contribute to value creation (Osterwalder & Pigneur, 2009, p. 22): new set of needs which customers previously did not perceive, for e.g. new technology, performance, customization, helping customers with successful realization of a particular job, design, brand, price, cost reduction helping customers to reduce costs, risk reduction i.e. lowering the risks of buying a product or service by for e.g. providing warranties, accessibility -providing access to products and services which previously have not been available usually as a result of a business model innovation, a new technology or the combination of both, and usability - making things more convenient or easier to use. Ultimately, a sound value proposition should provide answers to the following questions (Osterwalder & Pigneur, 2009, p. 23): ‘What value do we deliver for the customer?’, ‘Which

one of our customers' problems are we helping to solve?', 'Which customers' needs are we satisfying?', and 'What bundles of products and services are we offering to each customer segment?'

3. **Channels:** describe how the enterprise communicates and reaches its customer segments to deliver the value proposition" (Osterwalder & Pigneur, 2009, p. 26). This building block comprises communication, distribution and sales channels, which play an important role in the customers' experience. It gives answers to the following questions: "Through which channels do our customer segments want to be reached?', 'How are we reaching them now?', 'How are our channels integrated?', 'Which ones work best?', 'Which ones are most cost-efficient?', 'How are we integrating them with customer routines?'
4. **Customer Relationship** building block presents types of relationship an enterprise establishes with particular customer segments. It gives answers to the following questions: 'What type of relationship does each of our customer segments expect us to establish and maintain with them?', 'Which ones have we established?', 'How costly are they?', 'How are they integrated with the rest of our business model?'
5. **Revenue streams** comprise the cash that the enterprise generates with its activities. The enterprise has to answer the questions: 'For what value is each customer segment truly willing to pay?', 'What they currently pay for?', 'How are they currently paying?', 'How would they prefer to pay?', 'How much does each revenue stream contribute to overall revenues?' A business model can have two types of revenue streams: transactional i.e. one-time customer purchases/payments and relational or recurring that involves ongoing payments for delivering a value proposition to customers or providing post-purchase customer support.
6. **Key Resources** are a company's key assets which are needed to create and offer a value proposition, to reach markets, build and maintain customer relations and earn revenues. They are required to make a business model work. They can be owned or leased by the company or acquired from key partners. Key resources are (Osterwalder & Pigneur, 2009): physical (manufacturing facilities, buildings, vehicles, machines, systems, point-of-sales and distribution networks), financial (cash or credit lines), intellectual (brands, proprietary knowledge, patents and copyrights, partnerships and customer databases), or human.
7. **Key Activities** that the company has to perform in order its business plan to work. These include: production, problem - solving (bringing new solutions to individual customer problems), and platform/network. The enterprise should give answer to the following question: 'What key activities do our value proposition, distribution channels, customer relationships and revenue streams require?'
8. **Key Partnerships** are the network of suppliers and partners. There are three reasons behind the creation of partnerships: optimization of allocation of resources and activities, and economies of scale, risk and uncertainty reduction, and acquisition of particular resources and activities. The enterprise should give answers to the following questions: 'Who are our key partners?', 'Who are our key suppliers?', 'Which key resources are we acquiring from partners?', 'Which key activities do partners perform?'

9. **Cost structure** includes all costs incurred to operate a business model. There are two broad classes of business model cost structures: cost-driven business models whose focus is on minimizing costs, by using low price value propositions, maximum automation, and extensive outsourcing, and value driven that focus on value creation by offering premium value propositions and highly personalized services. Many business models fall in between these two extremes.

4.2 Why is the Business Model Important?

Business model is valuable tool for companies to earn profit and build viable businesses. The business model is the essence, the nucleus of the company. It is simplified representation of how a firm plans to fulfil its purpose of existence i.e. to create the value that customers need, to organize the resources, activities and processes necessary for creating and delivering the value to the consumers, and to capture the value, i.e. to earn profit that ideally will be invested in further sustainable growth of the company, further fulfilment of customers' needs and building a viable business. Osterwalder et al. (2005, p. 11) report five categories of functions for business models:

1. understanding and sharing - "business models help to capture, visualize, understand, communicate and share the business logic" (Osterwalder et al., 2005, p. 11); it is important that the business model is understood by all stakeholders of the company, meaning that the business model should represent a common language.
2. analyzing– business models can be a unit of analysis and a tool for measuring, observing and comparing business logic of a company. Internal and external pressures of the business environment are altering the business logic of the company. A structured approach to business model helps track, monitor and measure these changes.
3. managing – business models help to better align the strategy, business organization and technology.
4. prospect for the future -business model conceptualization can help to accelerate innovation and prepare the firm for the future. According to Amit & Zott (2001, p. 493) the business model is a "...locus of innovation and a crucial source of value creation for the firm and its suppliers, partners, and customers." A business can be better prepared for the future if managers simulate and test business models, by doing low-risk experiments that are harmless for the organization.
5. patenting processes as well as entire aspects of business models, thus becoming intellectual property of the company.

5 CREATING SHARED VALUE

In 2006 Porter and Kramer (2006) introduced the principle of shared value, meaning that both businesses and society must pursue policies that will simultaneously benefit both sides. Under this principle, it is wrong if either side pursues policies and actions at the expense of the other. Doing so can only do harm to the society and consequently to the businesses. The principle is

further developed by Porter (2011) in his publication “Creating Shared Value: Redefining Capitalism and the Role of Corporation in Society”. Here “Shared Value” is defined as “corporate policies and practices that enhance competitiveness of a company while simultaneously advancing social and economic conditions in the communities in which operates.” In a TED speech (2013) and on the site of the Institute for strategy and competitiveness of the Harvard Business School, the concept of creating shared value Porter further defined as “addressing a social issue and challenges with a business model.” It is creating economic prosperity by meeting the needs and tackling the challenges of the society. Creating shared value is creating social value and economic value simultaneously.

There are 3 level of shared value that can be addressed (Porter, 2011, pp.8-14; TED talks; Vaidyanathan & Scott):

1. Reconceiving customer needs, products and markets or meeting social needs through products i.e. meeting social needs through developing innovative products and services, which better serve underserved customers in existing markets or allow access to new customers. It involves creating new markets by serving unmet needs in underserved communities usually by redesigned products or by new, different distribution methods. To spot or find these products and market opportunities businesses must be guided by improving lives and not only meeting consumer needs. They should start with “fresh and new” business mindset, one that will be free of “preconceived constraints” about the product attributes, channel configuration or economic model of the business. Meeting underserved and unmet customers’ needs triggers “self-reinforcing” economic growth.
2. Redefining productivity in the value chain or utilizing resources, energy, suppliers, logistics and employees more productively; and
3. Enabling local cluster development or improving the local business environment: this includes “improving skills, the supplier base, the regulatory environment, and the supporting institutions that affect the business”, as well as “strengthening the cluster on which the company depends” (The Three Levels of CSV, 2015). “A cluster is a geographic concentration of related companies, organizations and institutions in a particular field that can be present in a region, state or nation. Clusters arise because they raise company’s productivity, which is influenced by local assets and presence of like firms, institutions, and infrastructure that surround it.” (What are clusters?, 2015) Clusters increase productivity and operational efficiency, stimulate and enable innovation and facilitate commercialization of new business formation. This level of creating shared value emphasizes the importance of the business environment, known as contexts or ecosystem in which companies operate. Companies do not operate in isolation from their environment. On the contrary, good business environment contributes greatly towards increased company’s productivity. Good general business environment translates into minimal economic, political and financial risks, and good immediate or operational environment includes strong competitive context with reliable local suppliers, functioning infrastructure, access to skilled labour and talent, stable or predictable legal and regulatory framework and well established financing system (Worthington & Britton, 2006; Vaidyanathan & Scott, 2012).

6 ABOUT REEEP – ACCELERATING MARKETS FOR RENEWABLE ENERGY

The Renewable Energy and Energy Efficiency Partnership – REEEP is an international non-profit public – private partnership established in 2002 at the Johannesburg World Summit on Sustainable Development (also known as ONG Earth Summit 2002 and informally “RIO+10”). REEEP invests in clean energy markets in developing countries with the aim of reducing CO2 emissions and building prosperity. Organization’s mission is “...to accelerate markets for clean energy in order to generate prosperity while avoiding and/or reducing CO2 emissions” (Mission, 2015). REEEP’s goal is to “...break business as usual and provide new development scenarios for middle and lower income countries” (REEEP, 2015, p. 10).

The organization is actively searching for specific sectors, subsectors, markets, business models and technologies, named as Pathways, which are low-investment, high return opportunities for developing countries (REEEP, 2015). REEEP’s tools are (What we do-REEEP, 2015): modern clean energy technologies – RE and energy efficiency, market forces, and knowledge management.

The organization’s unique strategy is composed of three core elements: Invest-Learn-Share. The organization invests in high-potential clean energy business models and markets; learns through rigorous monitoring, evaluation and learning system coupled with business and policy analysis, that results in creation of evidence-based intelligence, essential for reducing risk of market engagement for businesses, investors and public sector stakeholders, which is then openly shared to build scale and replication (What we do - REEEP, 2015).

REEEP operates in four interdependent and interconnected pillar activities (What we do-REEEP, 2015; REEEP, 2015):

1. **REEEP Portfolio** - it covers high-potential ventures that serve as a catalyst for clean energy market growth and shift markets. REEEP engages in active searching and recruiting of entrepreneurs and selectively invests donor grant funding into ventures with sound business models that show high potential to spur clean energy market growth. REEEP manages two complementary portfolios: the Enterprise Portfolio and the Enabling Portfolio. The Enterprise Portfolio is about building scale. With a seed-level grant funding of up to EUR 250,000 this portfolio offers committed businesses to launch or expand new clean energy technology and services. Furthermore, it offers entrepreneurs’ access to REEEP’s network of partners. Through the Investment Accelerator pillar activities, in close partnership with the Clean Technology Initiative – Private Finance Advisory Network (hereinafter: CTI PFAN) enterprises get provided with tools in terms of mentorship for business plan development, process improvement and facilitating connections with private investors. With the Enabling Portfolio REEEP focus is on replicating success by improving enabling business environments in specific countries and regions. REEEP encourages exchange of

information based on experience and practices from the business environment with the aim of creating ever better enabling business environment. In accordance with this notion, REEEP receives vital information by its ventures regarding practical experiences in specific markets. These practical experiences are then channelled into knowledge and action, collaborating and working with policy makers to better understand on the ground effect of regulatory measures and policy decisions on the business environment, and ultimately to design policy tools to create better enabling environment. Finally, the practice-based policy insights are then returned into REEEP's work, guiding investments in the enabling portfolio (REEEP Portfolio, 2015).

2. **Policy Lab** - REEEP plays the role of a channel for a practice-based knowledge of specific business environments. By working with policy makers REEEP considerably contributes for the creation of enabling environment for entrepreneurs in places where business as known in the developed world hardly exists. Moreover, lack of reliable data and information essential for doing business in developing middle and low-income countries presents a serious challenge for entrepreneurs, policy-makers and future investors. For this reason the role of the Policy Lab and the information it generates and distributes is crucial for improving business environments in these regions. REEEP achieves this with its Monitoring, evaluation and learning (hereinafter: MEL) framework. The MEL framework is of immense importance since it covers and articulates the entirety of REEEP's strategy for accelerating clean energy markets. It is the engine behind REEEP's work to accelerate clean energy markets and is one of the factors that differentiate REEEP from other organizations working in clean energy markets. At the core of this strategy is the following hypothesis: "...if targeted investments are made into specific subsectors of a marketplace for clean energy; if those investments are closely monitored and evaluated; and if the unique insight gained through the evaluations are reapplied into both the investment strategy and a learning and policy-generation and delivery system; the targeted investments will have disproportionate impacts on the trajectories of two macro trends: CO2 emissions and "composite" prosperity" (REEEP, 2015, p.56).
3. **Investment Accelerator** pillar activities tackle the issue of the "missing middle" i.e. lack of financing possibilities for SMEs, especially in developing countries (IFC, 2010). "REEEP's investment accelerator bridges the gap between early project viability and sustainable market success" (REEEP, 2015, p. 66). Investment accelerator pillar activities are closely related and complementary to the REEEP Portfolio pillar activities described above. Under the Investment Accelerator, REEEP has partnered with CTIPFAN to run the Phased Financing Facility - an innovative combination of public and private financing. Entrepreneurs selected for the REEEP portfolio are included in a multi-year incubator programme. The incubator programme provides seed grant of EUR 250,000, access to REEEP network, business training and mentoring by CTI PFAN coupled with best-practice consulting by REEEP, de-risking of projects through targeted financial injections and due diligence procedure, and finally matching of selected entrepreneurs with private clean energy and impact investors, facilitated by CTI PFAN (REEEP, 2015).
4. The ideas for **Open Knowledge** pillar activities are incorporated into REEEP's organizational culture. As a learning-oriented organization, REEEP believes that sharing

insight and best-practices is greatly assisting in building scale and replication across sustainable markets. For this reason, REEEP develops and provides tools and support for all types of organizations with the aim of improved sharing and connecting information and knowledge, and development of an environment where information is open and accessible to all (REEEP, 2015). In 2005, REEEP launched the first climate and information portal to apply Linked Open Data. Since then REEEP has been the leader in global efforts to promote and publish climate and development data as Open Data, and supports organizations that look for opening their own data sets.

REEEP operates in 3 focal areas through 6 Pathways:

1. **Cross-Sector Systems:**
 - a) Pathway: Water - Energy -Food Nexus in Agrifood value chains, and
 - b) Pathway: Connecting climate knowledge.
2. **Smart Cities:**
 - a) Pathway: Urban Water Works,
 - b) Pathway: Sustainable Urban Transport, and
 - c) Pathway: Efficient, Affordable Housing.
3. **Energy Access:**
 - a) Pathway: Off-grid rural electrification.

Through the Water-Energy-Food Nexus in Agrifood Pathway REEEP tackles two aspects. The first one is on the ground support of innovative business ventures with the aim of accelerating markets for viable and profitable RETs and solutions that include a nexus approach into SMEs value chains. The second aspect, which is occurring simultaneously with the first one, is careful monitoring and evaluation of the ventures' experiences (REEEP, 2015). Governments can use these lessons "...to improve evidence-based policy making and boost the resiliency and prosperity-generating potential of their economies" (REEEP, 2015, p. 19). The analyzed cases for this master thesis are two projects of the REEEP's Project Portfolio as part of the Cross-Sector Systems Focal area, particularly from the Water-Energy-Food Nexus in Agrifood Pathway.

7 ANALYSIS OF THE EXTERNAL ENVIRONMENT

7.1 Nicaragua

The Republic of Nicaragua is the largest country in the Central American isthmus with population of around 6 million as of 2014 and a declining annual population growth rate of 1.1% (World Bank, 2016). 50.7% of the total population is female (World Bank, 2016). Located in Central America, it borders with Honduras to the North and Costa Rica to the South, the Pacific Ocean to the West and the Caribbean Sea to the East. The capital of Nicaragua is Managua with

population of 1.4 million as of 2012 (INIDE, 2012). The predominant ethnicity, accounting for 69% of total population, is the Mestizo ethnicity, people of combined European and Amerindian decent. Spanish is the official language spoken by 95.3% of the population (The World Factbook, 2016). As of 2005, predominant religion is Roman Catholic accounting for 58.5% of total population, followed by Protestants with 23.2%. In 2014, 65% of total population was a working age population between 15 and 64 years, 31% of total population was aged between 0 and 14 years and 5% of total population was above 65 years old (World Bank, 2016).

Nicaragua is the second poorest country after Haiti in the Western Hemisphere of the Central American and the Caribbean region with 29.6% of total population in 2014 living below the national poverty lines. 42% of total population is living in rural areas, out of which more than 80% are poor (World Bank, 2016). According to the World Bank (2016), Nicaragua is a lower middle-income country. The minimum wage set in 2014 accounts for a monthly average of EUR 165 (Danish Trade Union Council for International Development Cooperation, 2014). Nicaragua has the lowest income inequality compared to all countries in the Central American and Caribbean Region with a Gini coefficient 40.5 in 2013 (Income Gini Coefficient, 2016).

7.1.1 Economic and Financial Environment

Nicaragua managed to cope well with the global economic crises, rising food and oil prices due to disciplined macroeconomic policies coupled with an increase in exports and foreign direct investments (hereinafter: FDI). As a result, the country maintained growth levels above the average for Latin America and the Caribbean (hereinafter: LAC) (World Bank Overview - Nicaragua, 2016).

In 2014, Nicaragua had a GDP of EUR 10,353,101,190.00 (World Bank, 2016). Top three economic activities that had greatest contributions to GDP were agriculture, forestry and fishery with 15.14%, trade, hotels and restaurants with 14.52% and manufacturing with 13.13% (Central Bank of Republic of Nicaragua (hereinafter: BCN), 2014). Average real GDP growth rate over the five-year period from 2010 to 2014 was 4.74%. In 2015 annual real GDP growth rate declined by 0.8 percentage points compared to the 2014 level to 3.9%, mostly due to the effects of drought and fall in commodity prices (World Bank Overview - Nicaragua, 2016; IMF, 2016). Real GDP growth rates for years 2016, 2017 and 2018 are forecasted at 4.2%, 4.1% and 4% respectively, which is higher than most of the LAC countries' GDP growth rates forecasts, except for Panama, and Costa Rica and Peru for years 2017 and 2018 (World Bank Group, 2016a).

According to the World Bank (2016), in 2014 imports contributed more to GDP than exports, accounting for 59.3% of GDP while exports accounted for 42.3% of GDP. In 2014, exports reached the highest level since 2006 accounting for EUR 4,5 million. The top 5 export products in 2014 were: textile and apparel (26.7%), automotive harnesses (11%), bovine meat (8.7%),

coffee (7.7%) and gold (7.6%). The top exporting partners are: USA, Central America, Venezuela, Europe and Asia (BCN, 2014).

As the second poorest country in the LAC region, Nicaragua has the lowest GDP per capita after Haiti. Table 3 shows GDP per capita based on purchasing power parity (hereinafter: PPP) in Nicaragua over the five-year period, from 2010 to 2014. GDP per capita (PPP) has been increasing every consecutive year, resulting in 24.7% increase in 2014 compared to 2010.

Table 3. Nicaragua's GDP per capita (PPP), 2010 to 2014

Year	2010	2011	2012	2013	2014
GDP per capita (PPP) (EUR)	3457,7	3703,8	3917,0	4106,8	4313,2

Source: World Bank, <http://databank.worldbank.org/data/home.aspx>, 2016.

According to the World Bank Global Prospects report (2016), Nicaragua's inflation rate decreased from 6% in 2014 to 4% in 2015 due to a cut in electricity prices. Even though inflation is higher than 2-3% annually, it is still one-digit and manageable. Unemployment as a percentage of total labour force in Nicaragua has been decreasing since 2010 accounting for 5.1% in 2014 (World Bank, 2016). However, it is assumed that large portion of people in Nicaragua work in the informal sector of the economy. According to the ILO's Key Indicators of the Labour Market 2015 (2015), in 2010, the last year for which data is available, 75% of people in total non-agricultural employment were informally employed. According to the same source in 2010, the last year for which data is available, 32.2% of total employment is in the agricultural sector, 16.5% in industry and 51.3% of total employment is in services sector.

In 2014, FDI accounted for EUR 1.3 million marking a 4% increase compared to 2013 level. The top five sectors with highest FDI inflows were: industry (40%), telecommunications (13%), financial (11%), energy (10%) and mines (9%). The top five investing countries were USA (20%), Panama (14%), Mexico (13%), Venezuela (13%) and Spain (6%) (Economy, 2016).

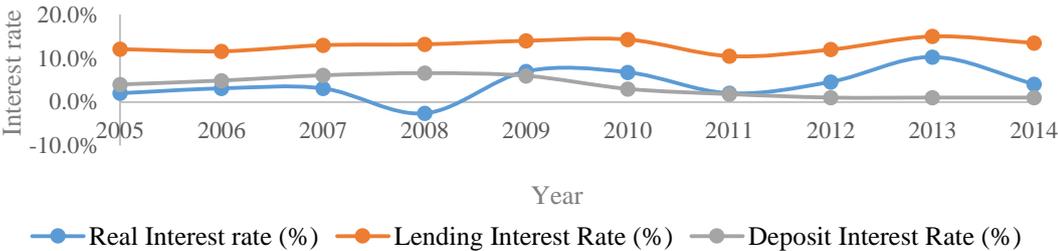
Current account deficit decreased from 11.1% of GDP in 2013 to 7.1% of GDP in 2014, mostly due to smaller oil bill, as well as increased exports (World Bank, 2016; International Monetary Fund (hereinafter: IMF), 2016a). Nicaragua's external public debt is lower than 50% of GDP and has been declining over the five-year period accounting for 40.6% of GDP in 2014. According to the IMF's Debt Sustainability Analysis (hereinafter: DSA) (2013), Nicaragua's risk of external public debt distress remains moderate. Nicaragua's public debt in 2014 decreased by 10.7% to EUR 87.5 million compared to the 2012 level (BCN, 2014). Public sector deficit increased from 1.3% of GDP in 2013 to 2% of GDP in 2014, mostly because of a decline in grants coming from the oil collaboration with Venezuela (IMF, 2016a).

General poverty declined by 12.9 percentage points in the five-year period from 42.5% in 2009 to 29.6% in 2014, while extreme poverty declined from 14.6% in 2009 to 8.3% in 2014.

Nevertheless, Nicaragua is still one of the least developed countries in Latin America, and the access to basic services is still a major issue (IMF, 2016a).

Figure 4 presents real, lending and deposit interest rates for Nicaragua for a period of 10 years, from 2005 to 2014. In 2014, real interest rate was 4.1%, which is by 6.2 percentage points lower than 2013 level; lending interest rate was 13.5%, which is by 1.5 percentage points lower than 2013 level, and deposit interest rate was 1%, same as year 2013 (World Bank, 2016).

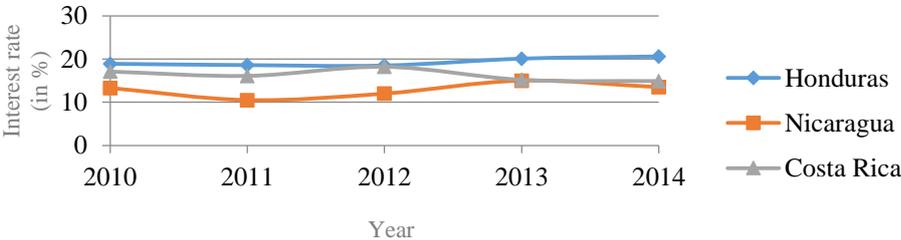
Figure 4. Real, Lending and Deposit interest rate for Nicaragua, 2005 to 2014



Source: World Bank, <http://databank.worldbank.org/data/home.aspx>, 2016.

Figure 5 shows lending interest rates for Nicaragua and its neighbouring countries Honduras and Costa Rica from 2010 to 2014. From the table it is visible that Nicaragua has the lowest lending interest rate among the three countries for every consecutive year.

Figure 5. Lending interest rate for Honduras, Nicaragua and Costa Rica, 2010 to 2014



Source: World Bank, <http://databank.worldbank.org/data/home.aspx>, 2016.

According to the World Bank’s Global Findex (2016) database, in 2014 in Nicaragua 18.85% of people aged above 15 had account at a financial institution as opposed to the regional average (developing countries only) of 51.14% which depicts Nicaragua’s relatively low financial inclusion. In 2011, 10.26% of rural population had account in a financial institution compared to 34.99% in the LAC (developing countries only) region. 6.44% of rural population in Nicaragua borrowed from financial institution compared to the average of 9.18% in LAC (developing countries only) region.

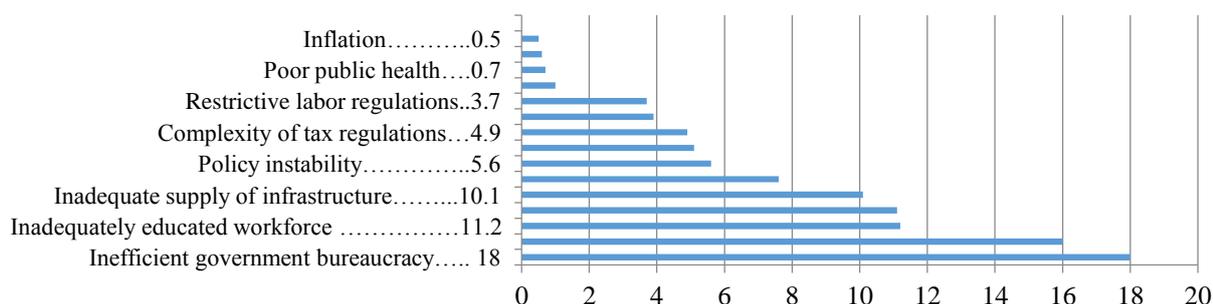
Domestic credit to private sector accounted for 34.10% of GDP in 2014, an increase of 7.8 percentage points compared to 2011. 8.9% of population aged above 15, and 4.18% of poorest 40% aged above 15 borrowed to start, operate, or expand a business, which is better than the LAC average of 6.14% and 3.9% respectively. In 2011, only 0.9% of population aged above 15

and 0.62% of rural population aged above 15 used an account at a financial institution for business purposes. This is lower than the LAC average of 5.34% and 5.21% respectively.

7.1.2 Competitiveness and Business Environment

In the latest WEF’s World Competitiveness Report 2015-2016 (2015) Nicaragua is ranked 108 out of 140 economies, scoring 3.75 on the Global Competitiveness Index (hereinafter: GCI). This is a drop of 9 places from the previous year report. According to the WEF’s report (2015), Nicaragua is in the first stage of development i.e. a factor driven economy meaning that competes on the basis of factor endowments, which is mainly unskilled labour and natural resources. According to the World Bank Group’s Ease of doing business (2016b) ranking in 2016, Nicaragua is ranked 125 out of 189 economies - a drop of two places from year 2015 ranking. Nicaragua’s ranking is worse than the regional average of 104 for LAC, and is ranked below most of the LAC countries except for upper middle countries: Grenada (135) and Suriname (156), and lower middle-income countries, such as Guyana (137) and Bolivia (157). Figure 6 shows the most problematic sectors for doing business in Nicaragua in 2015 according to the GCI 2015-2016. The top three most problematic factors for doing business in Nicaragua are: inefficient government bureaucracy, corruption and inadequately educated workforce.

Figure 6. The most problematic factors for doing business in Nicaragua in 2015



Source: World Economic Forum, *World Competitiveness Index Report 2015-2016*, 2015, p. 280.

7.1.3 Political environment

Nicaragua is a presidential representative democratic republic consisted of four political branches: the executive branch, the legislative branch, the electoral branch and the judicial branch. The President is appointed for the role of both head of state and head of government. The political system is a multi-party system. The Sandinista National Liberation Front (span: *Frente Sandinista de Liberación Nacional* – hereinafter: FSLN), a democratic socialist party, is the current ruling party and one of the two largest political parties in Nicaragua, together with the Constitutionalist Liberal Party. Daniel Ortega is the president of the FSLN, and since 2007 the president of Nicaragua. From 1990 to 2006 the country managed to conduct mainly free and competitive elections. However, after the present ruling party FSLN took over the government, the elections have become unfair and not transparent, characterized by institutional bias in favour of the incumbent FSLN. Moreover, 2014 constitutional amendments that abolished presidential

term limits, allowing President Ortega to run for the 2016 and the following presidential elections, coupled with the newly introduced rule of plurality for presidential election, which eliminates second round of elections, presents a great concern. (Bertelsmann Stiftung, 2014; Bertelsmann Stiftung, 2016a)

The rule of law is not a strong side in Nicaragua. The country has a score of 28 on the corruption perception index (hereinafter: CPI) which places Nicaragua among highly corrupted countries (Corruption by country/territory, 2016). The judiciary lacks independence and is a subject of strong political influence and corruption. Corruption is firmly seated in Nicaragua's political culture and is considered as a political weapon rather than a matter of law. Consequently, budget management is not a transparent process, public entities lack monitoring, there is a selective application of legal safeguards as well as lack of transparency in the management of public sources, especially sources coming from the Venezuelan government through ALBANISA, a private company assisting in managing investment funds from Bolivarian Alliance for the Peoples of Our America (hereinafter: ALBA), which are controlled by the government party FSLN and president's close family. The current Nicaraguan government was greatly financially dependent on financial resources from Venezuela through the ALBA. However, the influence diminished as a result of substantial reduction of aid after Hugo Chavez's death and decline of oil prices. Instead, the role of China and Russia has become more important. International donors and financial institutions, particularly the IMF, have a strong influence in some political areas, particularly the fiscal policy. Specific groups of businessman have great power over legislation on issues related to banking, international trade or particular investments. Highly corrupt judiciary has considerable influence on the business environment, making it unfavourable for doing business and pushing small businesses into the informal sector. (Bertelsmann Stiftung, 2014; Bertelsmann Stiftung, 2016a)

According to the Bertelsmann Stiftung's Transformation Index (hereinafter: BTI) (2016a) despite state's provision of education and health care throughout the country, the access of such goods and services is limited in the remote rural and jungle regions. Moreover, marginal urban neighbourhoods are deficient of clean water and sanitation and almost non-existent in the rural remote areas. There is transportation infrastructure in place for the Pacific region, however access to regions in the country's interior and especially in the Caribbean region is more difficult, especially in the rainy seasons when access can be cut off entirely.

According to UNDP's Human Development Report (2015a) Nicaragua is ranked 95 out of 155 countries on the Gender Inequality Index (hereinafter: GII) in 2014, scoring 0.449. The index reflects gender-based inequalities based on three areas: reproductive health, empowerment, and economic activity. 39.1% of parliamentary seats in Nicaragua in 2014 were held by women, and 39.4% of adult women have reached at least secondary level of education, compared to 38.3% of men. Nicaragua's Human Development Index (hereinafter: HDI) value for 2014 is 0.631 placing the county in the medium human development category with a rank of 125 out of 188 countries

and territories. Nicaragua's HDI of 0.631 is above the result of the medium human development category, however lower than the average of 0.748 for countries in LAC.

Nicaragua is a member of the World Trade Organization (hereinafter: WTO). It is also a member of the Central American Integration System (span: *Sistema de la Integración Centro Americana, or SICA*), a custom union, and a member of free trade agreements (hereinafter: FTA): Association Agreement between Central American region and EU; Central America and Mexico; Taiwan and Nicaragua; Dominican Republic-Central America Free Trade Agreement, Central America and Panama FTA; Central America and Chile; Central America and Dominican Republic. Nicaragua has also preferential trade agreements with Venezuela and Colombia. In the beginning of August 2015 Nicaragua ratified the Trade Facilitation Agreement, aiming at considerably simplifying and modernizing customs procedures around the world.

7.1.4 Legal Environment

The Ministry of Environment and Natural Resources (span. *Ministerio del Ambiente y los Recursos Naturales* (hereinafter: MARENA) is responsible for conservation, protection and sustainable use of the natural resources and the environment, and is the leader in the national dialogue on climate change. The Ministry for energy and mines of the Republic of Nicaragua (hereinafter: MEM) is the institution responsible for formulating, proposing, coordinating and implementing strategic plans and public policies for the energy sector. MARENA, MEM and the Nicaraguan Energy Institute (span. *Instituto Nicaragüense de Energía*) (hereinafter: INE) play an important role in the promotion of sustainable energies and environmental protection (IRENA, 2015a; Energy profile Nicaragua, 2016).

In 1998, the Law of the Electrical Industry was issued, also known as Law 272 of the Electrical Industry which provided the basis for the participation of the private sector in the Nicaraguan electrical industry in both, generation and distribution (Latin American Energy Organisation (hereinafter: OLADE) & United Nations Industrial Development Organisation (hereinafter: UNIDO), 2011). In 2005, the government adopted Law No. 532, "The Law on Promotion of Electricity Generation with Renewable Resources" which expired 2015. The government is conducting a review of the Law, which involves feedback from local policy makers, regulatory and market stakeholders with the aim of developing a joint plan to support the national strategy of energy diversification and matrix transformation towards more renewables (IRENA, 2015a).

The Government has developed an investment program in RE development with the target of producing 94% of electricity from RE sources by 2017 and meeting domestic demand as well as exporting energy to neighbouring countries (IRENA, 2015b). In 2014, 76.1% of total electricity produced in Nicaragua was contributed by renewable sources (Generación por Tipo de Fuente, 2016). The government has also set a non-binding goal of generating 91% of its electricity from renewables by 2027 in its 2013 national plan for electricity expansion (IRENA, 2015a). Nicaragua has national RE laws and programmes for every RE except for solar and wind. The

government offers fiscal incentives such as: value added taxes (VAT) exemptions, income tax exemption (IR), importing and exporting fiscal benefits such as import custom duties (DAI) and national exemption of local taxes (IRENA, 2015b). Among regulatory instruments for incentivising the adoption of RE sources in the energy mix are: auctions, limited application feed-in-tariffs, quotas and hybrid instruments that combine auctions with design elements from other regulation. There are financial policies facilitating RE investments, such as: currency hedging, dedicated funds, guarantees, pre-investment support and direct funding. There are also policies in support of renewables such as: Renewable Energy in Rural Access Programmes, Renewable Energy Cookstove Programme and special environmental regulations (IRENA, 2015b).

The government of Nicaragua is a State Party to the UNFCCC and ratified the Kyoto Protocol in 1998, making the country eligible to take part in the GHG reductions through the CDM (OLADE & UNIDO, 2011). Nicaragua is part of the SE4All initiative, however it did not support the Paris Agreement and was one of the ten countries that did not submit emission reduction plans as opposed to the 186 countries that submitted their commitments to reduce emissions.

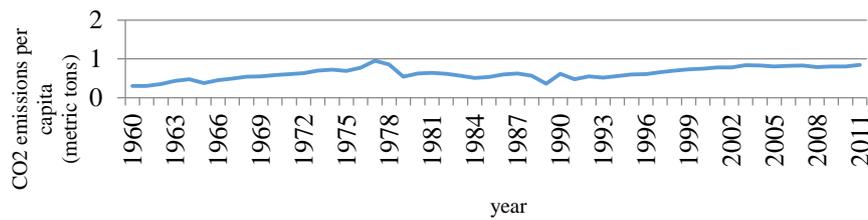
7.1.5 Environmental and Climate change overview for Nicaragua

According to the Climate Risk Index 2016, Nicaragua is ranked 4th out of 10 countries on the list that are affected the most by climate change in the world in the period from 1994 to 2014. Over this time period Nicaragua has suffered a climate-related damage in the amount of total EUR 271.5 million (based on PPP). The country is highly vulnerable to natural threats due to its mountainous geography and 21 watersheds it has, which is additionally magnified by the increasing deforestation.

Figure 7 shows historic CO₂ emissions per capita in metric tons in Nicaragua for a period of 18 years. Nicaragua emitted 0.8 metric tonnes of CO₂ emissions per capita in 2011 which is lower than the amount emitted by the Latin American and the Caribbean Region amounting for 2.8 tonnes of CO₂ emissions per capita in 2011 and lower than the 2.5 metric tons of CO₂ emissions per capita discharged by the Latin American and Caribbean region including only the developing countries.³ Nicaragua is listed 61 out of 149 countries regarding CO₂ emissions per capita, proving that, as most of the low and middle income developing countries, it is not one of the heavy CO₂ emitters (Kreft et al., 2015).

³Latin America and the Caribbean – only developing countries: Belize, Bolivia, Brazil, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Lucia, St. Vincent and the Grenadines, Suriname

Figure 7. Historic CO2 emissions per capita (metric tons) in Nicaragua from 1960 to 2011

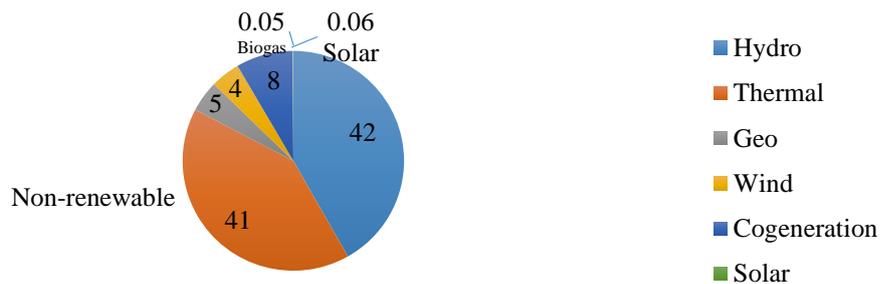


Source: World Bank, <http://databank.worldbank.org/data/home.aspx>, 2016.

7.1.6 Overview of Nicaragua’s Energy sector

In 2014, Nicaragua had a total of 1311.7 MW of installed capacity. According to the UN Economic Commission for Latin America and the Caribbean (hereinafter: ECLAC) (2015) and as presented in figure 8, 55% of the total installed capacity is thermal, 14% wind, 12% geothermal, 10% cogeneration and 9% hydro.

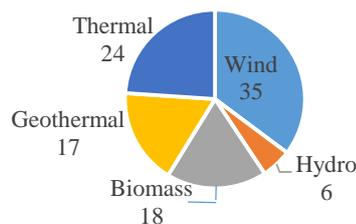
Figure 8. Total installed capacity by energy type (in %), 2014



Source: ECLAC, *Centroamérica: Estadísticas de producción del subsector electric*, 2014, 2015, Table3, p. 15.

According to the MEM (*Generación por Tipo de Fuente*, 2016) and as presented in Figure 9 which shows electricity generation by type of energy source in 2014, 35% of total electricity produced was generated by wind power, followed by 24% of thermal, 18% biomass, 17% geothermal and 6% hydro. In 2014, 91% of total electricity generation was produced by private entities and 9% by public enterprises (ECLAC, 2015).

Figure 9. Total electricity generation by type of energy source (in %) in Nicaragua, 2014

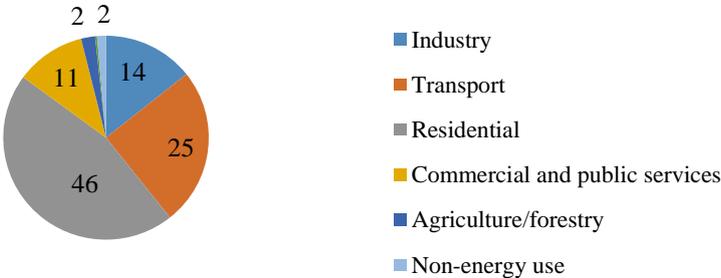


Source: *Generación por Tipo de Fuente*, 2016.

According to IEA (Nicaragua: Balances for 2013, 2016), the total primary energy supply (hereinafter: TPES) in 2013 accounted for 3530 ktoe as opposed to total final consumption of 2230 ktoe. 60.3% of TPES is produced in Nicaragua and comprises biofuels and waste (1457 ktoe), geothermal and wind (632 ktoe) and hydro (39 ktoe). 40.3% of TPES is imported and consists primarily of oil products (764 ktoe) and crude oil (656 ktoe) imported from Venezuela, and electricity (4 ktoe). 46.4% of total final consumption comprises biofuels and waste, 41.3% oil products and 12.3% electricity.

Figure 10 shows total energy consumption by sector in 2013. From figure 10 it is visible that the residential sector represents 46% of total energy consumption, of which 888 ktoe biofuels and waste and 44 ktoe oil products, followed by 25% of total energy consumption consumed by the transportation sector (oil products) and 14% by the industry (predominantly consuming oil products).

Figure 10. Total energy consumption by sector (in %) in Nicaragua in 2013



Source: Nicaragua: Balances for 2013, 2016.

Nicaragua’s electricity tariffs are the highest in Central America and superior to the Latin American average, especially electricity tariffs for industries. Despite the drop of electricity generation costs in 2015 due to falling crude oil prices, the government reduced electricity tariffs only by 10% in 2015 and an additional 4.5% in 2016 (Maebara, 2016).

7.1.6.1 Renewable Energy in Nicaragua

As mentioned above, Nicaragua has historically been dependent on high oil imports for electricity generation and transport. Fortunately, this situation is changing and renewables play even more important role in the energy sector. In 2014, renewables have contributed 75% to the gross domestic primary energy supply and around 50% to the total electricity supply (IRENA, 2015a). 42% of total installed electricity capacity comes from renewables (ECLAC, 2015). It is estimated that RE could add 4 500 MW to the country’s current capacity which is more than three times the current installed capacity, excluding PV potential (IRENA, 2015a).

In the period from 2006 to 2012 the country attracted EUR 1.3 billion of total clean energy investment which is the largest investment of that kind in Latin America. In 2012, total investments in renewables accounted for EUR 260 million, out of which 94% were allocated to wind projects and the rest 6% to small hydro projects (BNEF, 2013). Due to the extensive

geothermic resources from the large volcanic chain and seismic activity, the excellent exposure to wind and sun and the variety of water source Nicaragua is known as the ‘paradise of renewable energies’ (Mora, 2013).

7.1.7 Access to electricity

According to the World Bank (2016), 22% of the population in Nicaragua in 2012 did not have access to electricity. The country is among the countries with the lowest electrification rate in Central America, higher only than Haiti’s rate. Remote and dispersed nature of the rural inhabitants as well as mountainous geography of the country pose serious challenges for rural electrification, making grid extension solutions economically and financially unviable. Consequently, 40% of the rural population still lacks access to electricity. Historically, diesel powered microgrids, which represent connection of various demand points to one generation point, have been the preferred solution for medium and large populated areas. However, diesel powered microgrids come with many disadvantages due to high fluctuating fuel cost, additional high fuel transportation costs to bring the fuel to the community, which is also time-consuming, and inherent pollution. These circumstances make stand-alone, renewable energy systems the best sustainable and reliable alternative for the remote communities (Ranaboldo et al., 2015).

7.2 Kenya

The Republic of Kenya is an East African country with a population estimated at 45.5 million, out of which 50% are female (The World Bank Overview - Kenya, 2016). Kenya is located on the equator, bordering Ethiopia to the north, Somalia to the northeast, South Sudan to the northwest, Uganda to the west and Tanzania to the south and Indian Ocean to the southeast. The capital of Kenya is Nairobi. The largest ethnic group in Kenya is Kikuyu comprising 22% of Kenya’s population, followed by Luhya with 14%, Luo 13%, Kalenjin 12%, Kamba 11%, Kisii 6%, Meru 6%, other African 15% and 1% of non-African ethnicity (Asian, European, and Arab). English and Kiswahili are the two official languages. Christianity is the predominant religion with 82% being Christian. Second largest religious group is Muslim with 11.1% of total population (The World Factbook, 2016).

In 2014, Kenya’s population annual growth rate was 2.6%. According to the UN projections, Kenya population will grow by 3000 people per day and around 1 million people per year over the next 40 years. It is expected to reach 85 million by 2050 (Fengler, 2010). In 2014, 55% of the population was working population aged between 15 and 64. 42% of total population was aged between 0 and 14 years and only 3% of total population was aged 65 and above. 75% of Kenya’s total population is rural. According to Turner, Cillers, & Hughes (2014), Kenya is the fifth among ten African countries with the largest populations of severely poor, and sixth in absolute numbers living in extreme poverty. This translates in more than 10 million people, or around 43% of total population in Kenya, living in extreme poverty with less than EUR 1.20 (USD 1,

25) per day. Extreme poverty is forecasted to decrease to 38, 6% in 2030, or to 25.1 million people in absolute terms.

Kenya is a lower-middle-income country (World Bank, 2016). As of May 2015, Kenyan government has decided to increase the statutory minimum wage by 12%. This means that domestic workers in Nairobi receive a minimum salary of KES 10,954 or EUR 98.02 (Kenya Gazette Supplement No. 91, 2015). Gini coefficient for Kenya is 47.7, indicating high inequality in income distribution (Income Gini Coefficient, 2016).

7.2.1 Economic and Financial Environment

Kenya receives a relatively modest amount of FDI, which represents 0.6% of GDP, while foreign development assistance is 5.1% of Gross National Income (hereinafter: GNI). Kenya has made important structural and economic reforms with the support of the WBG and IMF, which have resulted in a sustained economic growth over the past decade. The solid economic growth over the past ten years had been supported by sustained public investment, rising farm output and continued mining investments, which has lifted the country to middle-income status (World Bank, 2016).

In 2014, Kenya’s GDP was EUR 53,439,015,854.00 (World Bank, 2016). The top three economic activities contributing to Kenya’s growth were agriculture, forestry and fishing with 15.4% of GDP, construction with 11.1%, and wholesale and retail trade with 9.8% of GDP (Kenyan National Bureau of Statistics (hereinafter: KNBS), 2015). Average annual GDP growth rate over the five-year period, from 2010 to 2014 was 6.02%. Annual GDP growth for 2015 is estimated at 5.4% and forecasted to 5.7% in 2016, and 6.1% in years 2017 and 2018. Increase in annual growth rate is forecasted due to infrastructure investments (World Bank, 2016).

Table 3 shows GDP per capita (PPP) in Kenya over the five-year period, from 2010 to 2014. It shows that GDP per capita (PPP) in current international dollars had been increasing every consecutive year, resulting in 36.9% increase in year 2014 compared to year 2010.

Table 4. Kenya’s GDP per capita (PPP) in current international dollars, 2010 to 2014

Year	2010	2011	2012	2013	2014
GDP per capita (PPP) (current international US\$)	870	888.3	1039.1	1102.5	1191.2

Source: World Bank, <http://databank.worldbank.org/data/home.aspx>, 2016.

In 2014, inflation rate increased by 1.2 percentage points compared to 2013 to 6.9%. Stability in currency markets have been restored due to sound monetary policy, which have positively affected inflation in 2015, decreasing by 0.3 percentage points to 6.6%. Even though inflation is higher than 2-3% annually, it is still one-digit and manageable (World Bank Overview, 2016). Unemployment was 9.2% in 2014, an increase of 0.1 percentage point compared to the 2013

level. However, it is assumed that large portion of people in Kenya work in the informal sector of the economy. According to the ILO's Key Indicators of the Labour Market 2015 (2015), 79.1% of people in total non-agricultural employment were informally employed in 2007, the last year for which data is available.

According to the World Bank (2016), in Kenya in 2014 imports accounted for 33.9% of GDP while exports accounted for 16.4% of GDP. The top five exporting products as of December 2014 were: tea with 11.4% of total exports, horticulture with 8.2%, chemicals with 4%, coffee with 1.6% and petroleum products with 1.2%. The top five exporting partners in 2014 were: Uganda providing 10.4% of total exports, Tanzania with 8%, Netherlands with 7.5%, USA with 7% and UK with 6.7%. The top five importing products in 2014 were: machinery and transport equipment comprising 33.3% of total imports, mineral fuels, lubricants and related materials with 21.9%, manufactured goods classified chiefly by materials comprised 14.5% of total imports, chemicals 13% and food and live animals 6.6%. The top five importing partners were India with 16.3% of total imports, USA with 10.4%, United Arab Emirates with 6.4%, Japan with 5.3% and South Africa with 3.9% (Central Bank of Kenya, 2015).

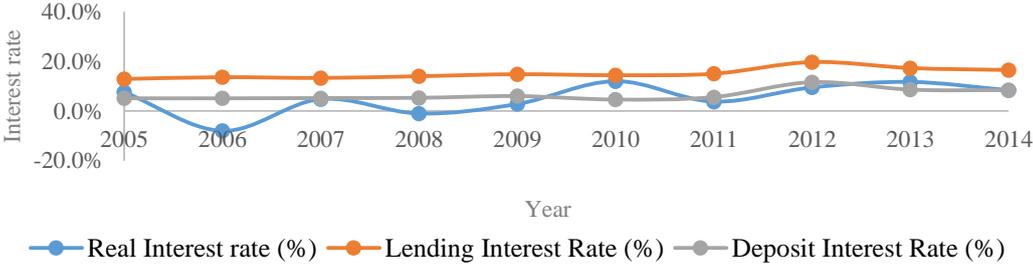
FDI in Kenya in 2014 accounted for EUR 828,139,354.00, an increase of 54% compared to the 2013 level (World Bank, 2016). Main sectors attracting the most FDI are energy, real estate, agriculture and manufacturing (Kenya FDI inflows rise 95pc to Sh97.8bn in 2014, 2016)

Although data for budget balance for recent years 2013 and 2014 is not available, Kenya has a budget deficit higher than 3%. This is due to large infrastructure projects that the country is undertaking in the transport such as Nairobi-Mombasa Standard Gauge Railway, irrigation and alternative sources of energy (IMF, 2015). Current account deficit increased from 8.9% in 2013 to 10.4% of GDP in 2014. The current account deficit is expected to increase in the following years due to infrastructure-related imports and is projected to narrow down after 2017 with the decline in infrastructure-related imports and closure of infrastructure projects (IMF, 2015). Kenya's external public debt is lower than 50% of GDP, however in a steady increase, accounting for 42% of GDP. This rapid rise of public debt accumulation is mostly due to financing infrastructure that should tackle bottlenecks and boost sustainable growth. However, appropriate efforts are required for containment of the fiscal deficit and eventually reverse the rise in the medium term period. Nevertheless, according to the IMF's Debt Sustainability Analysis (2015) Kenya's risk of external public debt distress remains low. Coordination failure rather than inability to pay is the reason behind temporary delays in external debt service payments.

Kenya's currency is Kenyan shilling (KES). The country has floating exchange rate regime and a liberalized capital account (Central Bank of Kenya's Exchange Rate Policy, 2016). Remittances are Kenya's single largest source of foreign exchange, marking a 10% increase in year 2015 compared to year 2014 (UHY, 2015).

Figure 11 presents real, lending and deposit interest rates for Kenya for a period of 10 years, from 2005 to 2014. In 2014, real interest rate was 8.4%, by 3.3 percentage points lower than the 2013 level and by 0.8 percentage points higher than the 2005 level; lending interest rate was 16.5%, by 0.8 percentage points lower than the 2013 level, and by 3.6 percentage points higher than the 2005 level, and deposit interest rate was 8.6%, by 0.2 percentage points lower than the 2013 level and by 3.5 percentage points higher than the 2005 level. In 2014, Kenya’s lending interest rate was higher than most of the developing countries in the Sub-Saharan African (hereinafter: SSA) region except for Madagascar, Malawi and Uganda (World Bank, 2016).

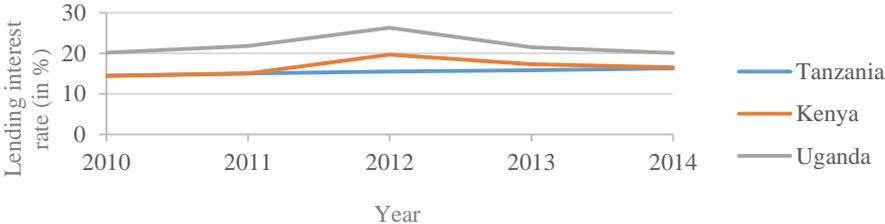
Figure 11. Real, Lending and Deposit interest rate for Kenya, 2005 to 2014



Source: World Bank, <http://databank.worldbank.org/data/home.aspx>, 2016.

Figure 12 shows lending interest rates for Kenya and its neighbouring countries Tanzania and Uganda from 2010 to 2014. Data about lending interest rates for Ethiopia, Somalia and South Sudan is not available. From Figure 12 is visible that Kenya has higher lending interest rate than Tanzania, and lower than Uganda’s lending interest rate. In 2014, Kenya’s lending interest was 16.5%, Tanzania’s lending interest rate was 16.3% and Uganda’s interest rate was 20.1%.

Figure 12. Lending interest rate for Tanzania, Kenya and Uganda, 2010 to 2014



Source: World Bank, <http://databank.worldbank.org/data/home.aspx>, 2016.

According to the World Bank’s Global Findex (2016) database, in 2014 in Kenya 55.21% of people aged above 15 had account at a financial institution as opposed to the regional average (developing countries only) of 28.09% which depicts Kenya’s relatively high financial inclusion. Almost 52% of female population aged above 15 has account at a financial institution, compared to the regional average of 25.1%. 53.06% of rural population aged above 15 had an account at a financial institution compared to 23.6% in the SSA (developing countries only) region. Compared to the 2011 level, the percentage of rural population with an account at a financial institution has increased by 14.32 percentage points in Kenya, which is three times more than the

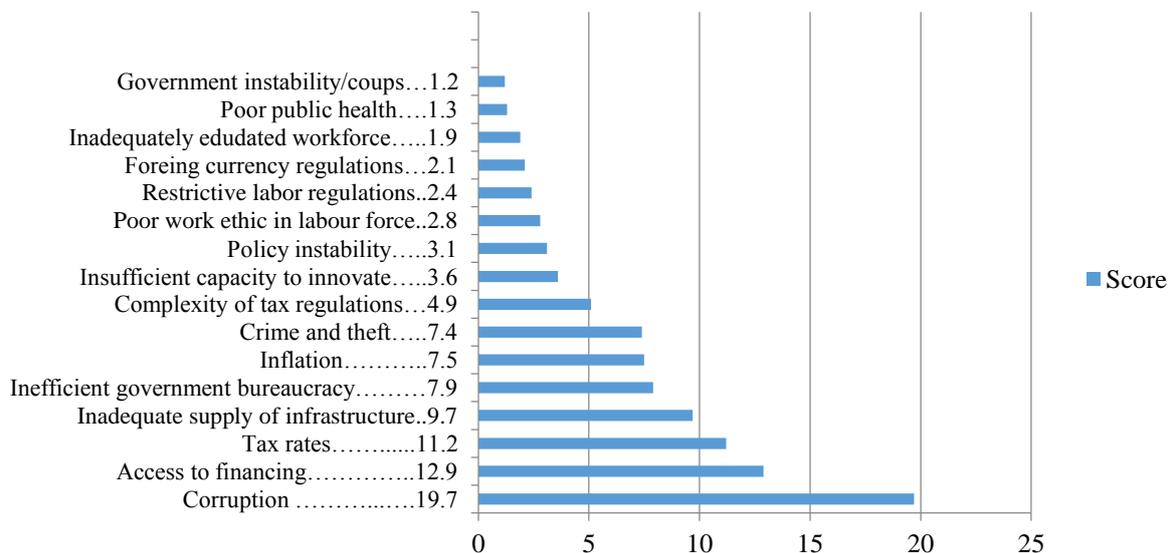
increase of the regional average of 4.9 percentage points. 15.64 % of rural population in Kenya borrowed from a financial institution compared to 6% in the SSA (developing countries only) region.

7.2.2 Competitiveness and Business Environment

In the latest WEF’s Global Competitiveness Report 2015-2016 (2015) Kenya is ranked 99 out of 140 economies, scoring 3.85 on the GCI. This is a drop of 1 place from the previous year report. Kenya is in the first stage of development that is a factor driven economy.

Figure 13 shows the most problematic sectors for doing business in Kenya in 2015 according to the World Competitiveness Index 2015-2016. Inefficient government bureaucracy, corruption and inadequately educated workforce are the three top most problematic factors.

Figure 13. The most problematic factors for doing business in Kenya in 2015



Source: World Economic Forum, *World Competitiveness Index Report 2015-2016*, 2015, p. 220.

According to the ease of doing business ranking, which compares economies to one another, in 2016 Kenyais ranked 108 out of 189 economies. Kenya is ranked higher than most of the SSA developing countries⁴. Exceptions are: Mauritius (32), Rwanda (62), Botswana (72), South Africa (73), and Zambia (97) (World Bank, 2016).

24.3% of the total population aged above 15, 21.10% of female population aged above 15, 20.8% of the 40% poorest aged 15, and 23.4% of rural population aged above 15 borrowed to start, operate or expand farm or a business in 2014. The most noticeable difference between SSA

⁴ Angola, Benin, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Cote d’Ivoire, Eritrea, Ethiopia, Gabon, Gambia, Guinea, Guinea Bissau, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, South Sudan, Sudan, Swaziland, Tanzania, Togo, Uganda, Zimbabwe.

region and Kenya in 2014 was the percentage of people aged 15 and above that saved with the aim to start, operate or expand a farm or business where Kenya surpasses the SSA region by 13.53 percentage points. The second most noticeable difference is the percentage of rural people aged 15 and above that saved to start, operate or expand a farm or business in 2014. Again, Kenya surpasses the SSA region by 13.52 percentage points. Third most noticeable difference is the percentage of females aged 15 and above that saved to start, operate or expand a farm or business in 2014 where Kenya surpasses the SSA region by 12.22 percentage points. In 2014, domestic credit to private sector accounted for 34.4% of GDP, an increase of 3.83 percentage points compared to 2011 (World Bank, 2016).

7.2.3 Political environment

Kenya is a presidential representative democratic republic. The President is appointed for the role of both head of state and head of government. The country has a multi-party system. Uhuru Kenyatta is the president since the elections in 2013. He is from The National Alliance (hereinafter: TNA) party and is the son of the first president of Kenya – Jommo Kenyatta, who was in the office for 14 years. Since the independence from the British colonial rule, Kenya has been ruled by the political party Kenya African National Union (hereinafter: KANU) for 40 years, from 1963 till 2002. The 2002 elections were the first peaceful and democratic elections and the coalition of political parties National Rainbow Coalition (hereinafter: NARC) won the elections. However, this was reversed with the 2007 elections, which triggered a big violence resulting in a death of around 1,300 people and displacement of almost 700,000. The crisis was ended with international intervention led by U.N.'s secretary general Kofi Annan (Bertelsmann Stiftung, 2016b). The multiparty system introduced in 1991 has led to an unstable party system due to a creation of many new parties, splitting the existing ones, merging and forming once more. Party members aiming for leadership positions establish new parties instead of contesting for leadership position within the existing parties.

In 2010, Kenya got its new constitution. This resulted in total restructuring of the political and administrative framework of the country. The new constitution provides rights as free education, safe housing and access to clean water; however, no example of these can be seen in reality. Primary education is corrupted and urban areas are undersupplied with clean drinking water. The new constitution has increased the trust in democracy; nevertheless, parties still serve the interest of individuals rather than the interest of the people, based on ethnic loyalties and patronage rather than platforms of principles (Bertelsmann Stiftung, 2016b). Kenya has high levels of political risk and regulatory uncertainty which is expected to be improved with the new constitution. It faces high political violence and high risk of attacks on foreigners due to sporadic terrorist attacks by militant groups from Somalia. State crises in neighbouring countries affect Kenya, which provides shelter for thousands of refugees from Somalia. Business activity is limited by poor infrastructure, especially poor electricity supply, as well as by corruption (Kenya, 2016).

Kenya scores pretty high on the CPI 2015 with a score of 25 out of 100 and ranked 139 out of 168 countries – equal to Uganda’s score and a rank, lower than South Sudan’s and Somalia’s, and higher than Ethiopia’s and Tanzania’s scores and ranks (Corruption by country/territory, 2016). In 2013, 61% of respondents say that corruption is a serious problem in the public sector in Kenya; 95% of respondents feel that police is corrupt or extremely corrupt; 68% of respondents state that the parliament and judiciary is corrupt or extremely corrupt, 53% of respondents think that the political parties are corrupt or extremely corrupt, and 29% of respondents think that business is corrupt or extremely corrupt. 77% of the respondents in 2013 reported paying a bribe to the police, 58% to the Judiciary and 54% to the registry and permit services (Transparency International – Kenya, 2016). Kenya score is below the global average of 43 and below SSA mean of 33, where Botswana performs best with a score of 63 and Somalia the worst with a score of 8 (Transparency International, 2016).

Kenya’s HDI value for 2014 is 0.548, placing the country in the low human development category with a rank of 145 out of 188 countries and territories. Kenya’s HDI in 2014 is above the average of countries in the low human development group accounting for 0.505, and above the SSA average of 0.518. Kenya is ranked 126 out of 155 countries in the 2014GII index, scoring a value of 0.552. Kenya performs better in the GII than the SSA average of 0.575. 20.8% of parliamentary seats in Kenya in 2014 were held by women, and 25.3% of adult women have reached at least secondary level of education, compared to 31.4% of men. Female participation rate in the labour market accounts for 62.2% compared to 72.4% for men. 400 women die from pregnancy related causes for every 100,000 live births, while adolescent birth rate is 93.6 births per 1000 women of ages 15-19 (UNDP, 2015b, p. 5).

Kenya is a member of the WTO. Numerous of Kenya’s manufactured products are entitled to preferential duty treatment in the EU, US, Japan, Canada, New Zealand, Australia and Switzerland under the Generalized System of Preferences. Kenya is part of the Common Market for Eastern and Southern Africa (hereinafter: COMESA) – a free trade area with 20 member states. The country has bilateral trade agreements with the following countries: Argentina, Bangladesh, Bulgaria, China, Comoros, Congo (DRC), Djibouti, Egypt, Hungary, India, Iraq, Lesotho, Liberia, Netherlands, Nigeria, Pakistan, Poland, Romania, Russia, Rwanda, Somalia, South Korea, Swaziland, Tanzania, Thailand, Zambia and Zimbabwe (Good reasons to invest in Kenya, 2016).

7.2.4 Legal Environment

The Ministry of Environment, Natural Resources and Regional Development Authorities is responsible for protecting, conserving and managing the environment and natural resources for socio-economic development (About the Ministry, 2016). Article 42 of the newly adopted Kenyan Constitution (2010) recognizes the right to clean and healthy environment and Article 60 (c) covers sustainable and productive management of land resources. The Government of Kenya in 2010 developed a National Climate Change Response Strategy (hereinafter: NCCRS),

followed by a National Climate Change Action Plan (hereinafter: NCCAP) in 2013 that outlines how the NCCRS will be implemented. Both focus on mitigating negative impacts of climate change (Government of Kenya, 2010; Climate change action plan, 2016).

The Ministry of Agriculture, Livestock and Fisheries has a mandate for formulation, implementation and monitoring of agricultural legislations, regulations and policies (About Us, 2016a). As of 2015, Kenya adopted the National irrigation policy. Under the section “Enhancing sustainability in irrigated agriculture” the policy considers solar energy and other RE in pumping as part of improving irrigation technology (Ministry of Agriculture, Livestock and Fisheries, 2015, p. 23).

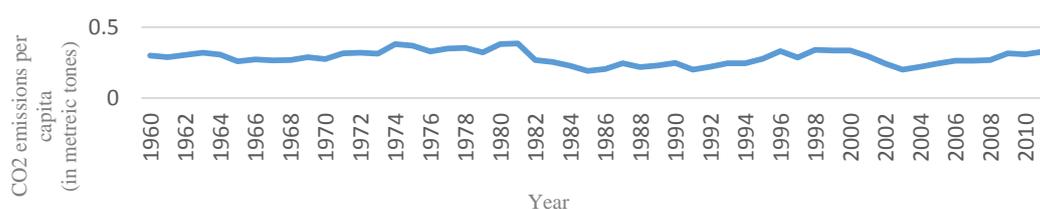
In 2008, Kenya has adopted Vision 2030 aiming to be a middle-income rapidly industrializing country by 2030 where all citizens have a high quality of life. The Vision 2030 is scheduled to be implemented through Medium Term Plans. The first was implemented between 2008 and 2012 and the second Medium Term Plan should be implemented in the period from 2013 to 2017. Expanding Kenya’s area under irrigation with the aim of increasing agricultural productivity and food security and reducing dependability of the country on rain-fed agriculture is a key priority for the government. In this manner priority will be given to increasing investment in irrigation. Under the Second Medium Term Plan in the period from 2013 to 2017, a total of 404,800 hectares will be put under irrigation. Under the First Medium Term Plan 2008-2012 irrigation area expanded from 119,000 to 159,000 hectares in small holders as well as large schemes (Ministry of Devolution and Planning, 2013).

7.2.5 Environment and Climate change data for Kenya

According to the Climate Risk Index 2015 (2014) for the period from 1995 to 2014 Kenya is ranked 85th. Over this period, Kenya has suffered a climate-related damage in the amount of total EUR 77,422.00 million (PPP). Kenya emitted 0.3 metric tonnes of CO₂ emissions per capita in 2011, which is lower than the average amount emitted by the SSA region accounting for 0.8 tonnes of CO₂ emissions per capita in 2011.

Figure 14 shows historic CO₂ emissions in metric tons per capita in Kenya from 1960 to 2011. From Figure 14 is visible that CO₂ emissions in metric tons per capita in Kenya have been varying over the years with the highest levels of CO₂ emissions being in year 1980 and accounting for 0.38 metric tons per capita. CO₂ emissions per capita mark an increasing trend since 2003 when CO₂ emissions per capita accounted for 0.2 metric tons and increased to 0.33 metric tons in year 2011, the most recent year for which data is available.

Figure 14. Historic CO2 emissions per capita (metric tons) in Kenya from 1960 to 2011



Source: World Bank, <http://databank.worldbank.org/data/home.aspx>, 2016.

From an environmental perspective, Kenya has a low ecological footprint due mainly to its relatively low levels of consumption and economic activities (UNEP, 2015). However, the country has rapidly moved into a state of “ecological overshooting” i.e. a faster depletion rate than the replacement rate of its natural resources (UNEP, 2014). In 2007, Kenya’s ecological footprint was 1.11 ha/person which is below the global average biocapacity. The increasing deficit in the national ecological account is attributable to overexploitation, industrial pollution, deforestation and soil erosion and natural disasters including prolonged droughts and floods. These conditions affect food security and agricultural production and have contributed to land degradation, desertification, and water scarcity and degraded water quality. The pressure on ecosystems is the most noticeable in the Arid and Semi-Arid Lands (hereinafter: ASALs), which are the bloodstream of the country. The ASALs represent more than 80% of Kenya’s total territory, are home to over 10 million people, or about a quarter of Kenya’s total population. Over 70% of the national livestock population and 90% of the wild game which supports the tourism sector and Kenya’s potential and exploited commercial mineral wealth are all located in the ASALs. ASALs have the highest poverty rate and the lowest development indicators in the country which makes them even more vulnerable to environmental degradation, insecurity, climatic shocks and diseases. Nevertheless, these territories are perceived to have the potential to accelerate development and to contribute to economic transformation of the country. Weather fluctuations, particularly droughts pose serious threat to the key agricultural sector which may cause supply chain disruptions (UNEP, 2014).

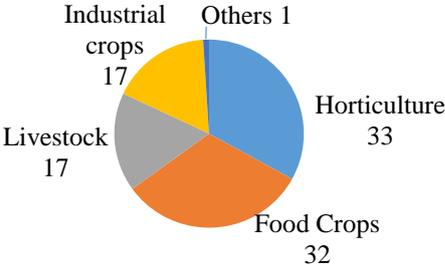
7.2.6 Overview of Agricultural sector in Kenya

Agriculture is the bloodstream of the Kenyan economy and a source of livelihood for the majority of Kenyan people. The sector is the main driver of economic growth directly contributing 24% of GDP, and indirectly additional 27% of GDP. It provides income to more than 80% of total population, employment to 40% of total population and informal employment to more than 70% of rural population. The majority of the population in Kenya depends on the agricultural sector in terms of food security, off-farm employment, and foreign exchange earnings. The sector accounts for 65% of export earnings. Historic data since the independence of Kenya until today show that economic growth in the country is highly correlated with the development of agriculture (UNEP, 2015).

97.8% of Kenya’s area of 582.646 km² is land and 2.2% is water surface. However, only 20% of the land area is medium to high potential agricultural land and 80% of the land area is predominantly ASAL (Ministry of Agriculture, Livestock and Fisheries, 2015).

Kenya’s agricultural sector is consisted of six major sub-sectors: industrial crops, food crops, horticulture, livestock, fisheries and forestry. From Figure 15, which shows the contribution of agricultural sub-sectors to agricultural gross domestic product (hereinafter: AGDP) in 2009, is visible that horticulture contributes the most to AGDP with 33% of AGDP, followed by food crops with 32% of AGDP, and followed by livestock and industrial crops which each contribute 17% of AGDP. Industrial crops contribute the most to exports with 55% of total exports, followed by horticulture with 38% of total exports, livestock with 6% of total exports and food crops with 1% of total exports.

Figure 15. Contribution of agricultural sub-sectors to AGDP (in %) in Kenya in 2009



Source: UNEP, *Green Economy Sector Study on Agriculture in Kenya*, 2015, Figure 1, p. 10

Development of the agricultural sector is the key priority to the government. In 2009, the Government of Kenya published the Agricultural Sector Development Strategy 2009-2020 with the ultimate goal “...to achieve a progressive reduction in unemployment and poverty...” (Government of Kenya, 2009, p. 10). The sector is crucial for the realization of the Vision 2030 for poverty reduction, wealth and employment creation. Due to dependability of cropping and livestock production systems on annual rainfall patterns, which are highly variable and unreliable, the government recognizes irrigation development as the key to achieving increasing agricultural production and food security, as well as remaining competitive in the regional and global markets (Ministry of Agriculture, Livestock and Fisheries, 2015). Kenyan Vision 2030 sets the target of 10% annual economic growth rate delivered by the agricultural sector. The precondition for the target to be achieved “...is the transformation of smallholder subsistence agriculture into an innovative, commercially-oriented modern agricultural sector” (UNEP, 2015, p. 4).

About 75% of total agricultural output and 70% of marketed agricultural production comes from rain-fed farms with an average of 0.3 to 3 hectares in size proving that farming in Kenya is mostly on a small scale (UNEP, 2014).

However, the sector is facing considerable challenges such as: stagnant or declining productivity levels, under-exploitation of land, inefficiencies in the supply chain because of limited storage capacity, lack of post-harvest services, poor access to input markets and low value addition of most agricultural exports. Moreover, population increase and extreme weather changes pose further pressure to the sector. Population growth and relative scarcity of productive agricultural land cause sub-division of land resulting in small uneconomic farm sizes that are difficult to be managed sustainably. This issue is expected to become even more serious since available land per capita in Kenya is expected to diminish in size from 1.5 hectares to 0.3 hectares by 2050. Climate change is translated in more frequent and prolonged droughts and major floods which result in intensified soil erosion, deforestation and loss of soil fertility and reduced productivity (UNEP, 2015; UNEP, 2014).

Important private sector actors are Kenya Private Sector Alliance (hereinafter: KEPSA), Kenya National Federation of Agricultural Producer (hereinafter: KENFAP) and Kenyan National Federation of Co-operatives (hereinafter: KNFC). KEPSA organizes private sector players to facilitate issue-based engagements. KENFAP develops and promotes commercial activities of the KENFAP for its sustainability purposes and offers various services to farmers and institutions, including: input supply to farmers, trainings, (agri)-business advisory, research and consultancy services, information and communication technology services to cooperatives and organization of agri-events and study tours. KNFC is responsible for the commercial arm of agriculture and acts through the cooperative movement. There are other private institutions present in the sector including processors, marketing agencies and farm input dealers. However, they are neither strong nor organized players (Government of Kenya, 2009).

8 DATA AND METHODOLOGY

The **purpose** of the master thesis is to understand REBMs in middle and low-income developing countries. The **main objectives** of the master thesis are:

1. to research and analyse the field of entrepreneurial business models as factor of success for achieving economic viability of renewable energy projects/businesses in developing countries;
2. to enrich the research in the REBM field by analysing real cases in developing countries and determining their peculiarities; and
3. to determine REBMs and characterize the effective REBM(s).

8.1 Data

Primary qualitative data was collected with semi-structured interviews based on the framework for characterization of business models developed by Morris et al. (2005, p. 729-732) due to its applicability to enterprises and projects in general while at the same time serving the needs of the individual entrepreneur. The decision to use this framework came after reading the article “In

search of Viable Business Models for Development: Sustainable Energy in Developing Countries” by Ans Kolk and Daniel van den Buuse, where the same framework is used for the purpose of their research. Secondary data was collected with desk research from publicly available sources.

In the initial stage of the research four innovative RE projects, one in Nicaragua, one in Uganda, and two in Kenya, were supposed to be analysed. Due to cancellation of one of the projects and other technical reasons, these were reduced to two projects. Two RE enterprises that have developed innovative REBMs and serve customers in remote, rural areas that lack access to energy were analysed. The first company, Tecnosol based in Nicaragua, was chosen because is a successful and, at the time of writing the thesis, a profitable regional entrepreneurial company with a track record of 17 years. The local enterprise X, based in Kenya, was chosen as an example of a high potential, start-up entrepreneurial company. One of the respondents is the marketing and development manager and the other respondent is the financing director of the company.

Since respondents are geographically dispersed, the semi-structured interviews were facilitated by the use of the Internet, in particular by conducting e-mail interviews. After making contact and obtaining an agreement to participate the respondents received the framework in its electronic form. They filled it in and returned it back via e-mail. As the research progressed there was a need for additional shorter questions to be answered which were again facilitated by the use of the e-mail.

The research would not be possible without the support from REEEP. REEEP gave me the precious opportunity to be part of the Implementers’ meeting where I got the opportunity to meet the respondents, exchange contacts and briefly discuss topics related to the research. Respondents were very responsive and showed great interest in the research.

8.2 Methodology

The interest in gaining rich understanding of the context of this research, as well as the processes being enacted led to the decision to choose case study as a method of analytical approach. By using the case method, the following **research questions** are explored and explained:

1. How can renewable energy business models be characterized?
2. What are the characteristics of viable renewable energy business models?

The cases are based on the findings from the semi-structured, e-mail interviews which are in turn based on the above mentioned framework for characterization of business models. In its original form, the framework is composed of three levels of decision-making: the foundation level, proprietary level and rules level. For the purpose of this master thesis only foundation and proprietary levels were included. The foundation level covers fundamental decisions that all

entrepreneurs have to make and allows comparison across ventures while the proprietary level offers insights into how value can be created in each of the six decision areas included in the framework (Morris et al., 2005).

8.3 Research limitation and future research

The empirical qualitative research through the case study method brought valuable contributions in terms of characterizing the REBMs of the two enterprises. However, there are several limitations to this research that could be improved in future research.

Even though there are consistencies in the findings, a larger sample of enterprises is needed in order some generalization on REBM to be done. Larger sample is also needed in order to determine relevant patterns in the REBMs. In addition to this, the research on the characteristics and viability of REBMs would be more consistent if financial indicators on business performance were included. One of the reasons why financial indicators were not included in this research is the fact that one of the companies is relatively new. The other reason is the time constraints of the interviews, thus requesting financial performance data would represent an additional time burden on respondents, which may result in not participating in the research.

The framework for characterizing a business model by Morris et al. (2005) upon which the interviews were formulated provides excellent applicability for any type of enterprise and serves the needs of the individual entrepreneur. However, for companies operating in low and middle-income developing countries, serving customers in rural, remote areas, it is of great importance to present the business ecosystem and external business environment in which they operate. This way a better picture would be presented about the business and wider environment in which they operate and the many challenges they have to face and overcome, ranging from lack of basic infrastructure, to lack of skilled labour, to lack of access to finance and underdeveloped financial markets, to high administrative burdens, unstable macroeconomic environments and high political risk, all of which play an important role for the viability of the business. Moreover, in this way the strong entrepreneurial spirit required and the substantial effort entrepreneurs invest in making these ventures a success would be captured. This research aimed at expanding the framework with elements that would present the respective business ecosystem, however this was not realized due to confidentiality reasons.

9 CASES

9.1 About Tecnosol S. A.

Tecnosol S.A (further referred to as Tecnosol) is an enterprise that designs, distributes, and installs photovoltaic systems in both rural and urban areas in Central America. The main activity of the company is the supply and installation of solar PV systems, mostly SHSs in rural areas

(Ashden Awards, 2010). It is formally registered as a corporation or a public limited company (span. *Sociedad Anónima, S.A*).

Tecnosol was established in 1998 by its current chairman and CEO Vladimir Delagneau as a company selling solar PV systems. Founder Vladimir Delagneau was driven by the will to improve the living conditions of many people living without access to electricity since he himself experienced the sad life without electricity during his military service in warring remote areas (Testimonio, 2016).

Tecnosol is a pioneer and a leader in the Central American region for decentralized RE systems: solar, wind, hydro and biogas. As mentioned above, the main activity of the company is supply and installation of solar PV systems, mostly SHSs in rural areas. Tecnosol has 70 to 80% market share of the SHSs market in Nicaragua (Tecnosol, 2016). SHSs are composed from a PV module that generates electricity from sunlight, a rechargeable battery for storing electricity making it usable during both day and night, a charge controller to prevent the battery from overcharging or discharging, lights, wiring and fixtures. Both, compact fluorescent and LED lights are used. SHSs have a universal outlet where people can charge their cell phones and other appliances. Tecnosol also supplies phone chargers, TVs, DVD systems, sound systems and radios depending on customers' will, requirements and purchasing power (Ashden Awards, 2010). Beside SHSs, the company offers solar water pumps, solar thermal, wind and pico-hydro systems, as well as solar-powered electric fences for livestock and households.

Tecnosol's products are used by wide variety of customers with different income levels. SHSs are used for lighting households, schools, businesses and health clinics. They can be used for powering refrigerators and freezers for health clinics, shops, entertainment bars, and farmers who need to prevent their agricultural products from rotting. Solar water pumps are used in agriculture and for supplying portable water to villages.

Besides targeting the supply side for clean energy technologies, Tecnosol's business model is based on targeting the demand side for clean energy technologies, too. Through partnerships with microfinance institutions and non-profit micro lenders Tehnosol helps customers, especially poor customers without access to electricity, to get a loan under favorable terms for investing in solar PV systems, or other products. By owning the solar PV systems, customers that live in energy poverty can drastically improve their living conditions. Tecnosol is currently partnering with KIVA, a non-profit micro-lending organization, with the aim of meeting the demand for financing for Tecnosol's products that cannot be met by local banks (Tecnosol, 2016).

Today Tecnosol has a head office in Managua, the capital of Nicaragua and additional 17 regional strategically positioned branches that cover whole Nicaragua, and most importantly allow reaching the most remote rural areas. Tecnosol has 4 more offices responsible for the regional operations of the company, two in Honduras, one in Panama and one in El Salvador. The company has more than 90 permanent employees. In its 17 years of operations Tecnosol has

had sold more than 40.000,00 renewable energy systems of various kinds, mainly in Nicaragua, benefiting more than 240.000,00 people (Quiénes Somos, 2016).

Tecnosol has received many awards. In 2010, the company received the award for “Excellence in Business Development for Innovative Solutions for Micro and Small producers in rural areas” by Foromic - the most important annual event in LAC on microfinance and entrepreneurship, organized by the Inter-American Development Bank (hereinafter: IDB) and the Multilateral Investment Fund (hereinafter: MIF) - member of IDB. That same year Tecnosol was the winner of the international Ashden Awards for sustainable energy, for outstanding achievement in using sustainable energy to improve quality of life and protect the environment. In 2010, Mr. Vladimir Delagneu received the award by the WEF for “Outstanding Social Entrepreneur in Latin America”, in recognition of visionary, pragmatic and courageous contributions that significantly improve the state of the world (Quiénes Somos, 2016). The organization I³ LATAM – “Driving innovation impact” listed Tecnosol’s founder, Mr. Vladimir Delagneu, as one of the ten social entrepreneurs with most innovative business models in Latin America for the years 2015-2016 (Noticias, 2016).

9.2 Case study 1.: Tecnosol, S. A., Nicaragua

9.2.1 Factors related to the offering: How do we create value?

Tecnosol creates value for customers by offering a heavy mix of highly customized products and services. Its main offering is supply and installation of solar PV systems, in particular SHS. It provides supplies, design, training, installation, technical support, consulting and implementation of RE projects. By providing clean energy solutions Tecnosol helps people to meet their basic needs and improve their lives. With the SHSs people get access to electricity in their homes and access to basic services such as lighting, cooking, watching TV, listening to the radio, charging mobile phones etc. Access to electricity translates into improved well-being. Children have light at home so they can dedicate longer hours to studying and families can create their own small businesses that will generate more income for the future.

Besides SHSs, Tecnosol also provides biogas for cooking. It has a product line specifically targeting farmers by offering solar water pumps and solar powered electric fencing. The company works on creating strong relationships with farmers in order to meet their needs and by offering suitable products to assist in boosting their productivity.

Tecnosol tailors the design of the technology to match the needs of customers as well as their purchasing power. Moreover, by partnering with microfinance institutions that provide loans at affordable terms Tecnosol makes its products available to those mostly in needs - people living in energy poverty.

Tecnosol is offering a broad line of products and services. The width of the offering consists of four product lines: back up power, pumping water, outdoor lighting and cooling systems. The offering is comprised of deep lines, each including numerous products. Tecnosol offering is usually comprised of products bundled with other firm's products such as solar systems of 100W bundled with pico lights, or solar systems of 150W bundled with a LCD 16" TV. Tecnosol does not manufacture its products, but imports them and then does reselling or a value added reselling either through direct distribution through sales from their own regional stores, or indirect distribution through intermediaries.

9.2.2 Market factors: Who do we create value for?

Tecnosol is a regional company with operations in Nicaragua, Honduras, Panama and El Salvador. Its commerce includes business-to-business (B2B) and business-to-consumers (B2C) transactions. Final customers are predominantly transactional customers in multiple segments: households in rural areas, households in urban areas, businesses and farmers.

Tecnosol targets two broad markets: clean energy solutions for people living in rural areas, and clean energy solutions for people living in urban areas. Within the rural market, which is at its maturity stage, Tecnosol targets different groups of customers who do not have access to electricity. These are: households, farmers and businesses. In order to meet the needs of these groups of customers Tehnosol has a very well developed sales channel consisting of various retail locations across the country and the region deployed in order to reach customers in most remote areas. Within the urban segment of the market, Tecnosol serves households and businesses that want to have electricity savings and promote clean energy. Tecnosol is in the initial stage serving this market.

9.2.3 Internal capability factors: What is our source of competence?

Selling and marketing is what Tecnosol counts as its source of competence. Tecnosol states branding as one of its most important sources of competence and states strong brand recognition as a competitive advantage. High quality products coupled with knowledge and experience gained over the 17 years of experience in the clean energy markets are the main factors contributing to the strong brand recognition.

In order to serve customers in remote rural areas, as well as customers living in urban areas, Tecnosol has a well-developed sales channel with branches throughout the country which makes Tecnosol flexible in meeting the needs of its customers. However, maintenance of such sales channel is capital intensive and requires substantial financial resources. In times of scarce financial resources, maintaining of the sales channel becomes very challenging and presents an obstacle in doing business due to lower flexibility in responding to customers' needs.

9.2.4 Competitive strategy factors: How do we competitively position ourselves?

How do we differentiate ourselves?

Innovation leadership, intimate customer relationship and experience accumulated in the 17 years of experience are the elements that differentiate Tecnosol from its competitors. Tecnosol aims to position itself as a leader in clean energy services, innovation and products delivery. It aims to create alliances with organizations, such as microfinance institutions, banks and cooperatives to promote the technology and its services.

9.2.5 Economic factors: How do we make money?

Tecnosol's pricing and revenue sources are flexible and the company has medium operating leverage. It is selling high volumes at medium margins. Tecnosol financing structure is consisted of 80% debt and 20% private equity. Tecnosol states the following factors as crucial for the profitability of the business: very good understanding of different segments in the market, excellent inventory management, cost control, and sales techniques aiming at offering a good quality, customer-friendly service.

9.2.6 Personal/Investor factors: What are our time, scope and size ambitions?

Tecnosol aims at investing and reinvesting in the future growth of the value of the firm that would provide capital gain for the initial investors. The company's expected rate of return on investment is 14%. However, Tecnosol is facing cash flow pressure due to investments done in previous year in Honduras, Panama, and El Salvador. In order to keep managing its sales channel consisted of 17 branches in the region Tecnosol requires further capital investment, or otherwise will have to close down some branches or to get involved in the franchising business and convert the branches into independent stores run by a franchisee.

9.3 About Enterprise X

Due to confidentiality reasons the enterprise preferred to be named as Enterprise X. Enterprise X is a young company based in Kisumu, a former capital city of Nyanza province in Kenya, with a main activity of manufacturing and distributing low - cost solar irrigation pump. Target customers are one-acre farmers with access to shallow water in developing countries and the rest of the world.

The enterprise fights poverty, specifically by providing solutions for smallholder farmers' issues. The ability for regular irrigation leads to more reliable harvests and gives farmers the opportunity to grow and sell crops out of season and leads to additional incomes.

In 2015 the company was one of the 13 winners of Agriculture Innovation Competition and received funding from the US Agency for International Development – USAID's Powering

Agriculture: An Energy Grand Challenge for Development fund. In 2014 the company won the “Innovations and Agriculture” award, voted for one of the top-ranked start-ups.

9.4 Case study 2.: Enterprise X, Kenya

9.4.1 Factors related to the offering: How do we create value?

Enterprise X’s offering is consisted primarily of products, particularly solar irrigation pump for 1-acre farmers (referred to as ‘the pump’ in the following text). The irrigation pump is a portable, robust solar irrigation pump aimed to be used by farmers that grow seasonal vegetables and live in areas with accessible shallow water. The pump can pump up to 12,000 litres/day of irrigation water, 900 litres/hr at 6 meters, or 2,000 litres/hr at 1 meter. It comes with a detachable 80 Wp solar panel. It has manual back up and its parts can be put together by the farmers themselves. It is complementary with storage tanks and drip systems. It has robust hardware design with no circuit boards or small electronics that could go wrong. The panel has a switch that allows the pump to run on cloudy days too, as water can be pumped manually when there is no sun. Besides irrigation activities the pump can be used for charging various DC accessories from the panel, which presents an additional benefit for farmers living in remote areas with no access to electricity.

The pump is highly customized to farmers’ needs. The enterprise offers one particular product line comprising this particular product. It manufactures the pump and provides direct as well as indirect, multichannel distribution. The pump is offered with payment plans to facilitate the purchases by farmers with very low incomes. The solar irrigation pump offered with innovative payment plans solves a great issue for smallholder farmers who could not afford the high cost irrigation pumps and as a result had to deal with very time-consuming, less effective and consequently more costly irrigation techniques.

9.4.2 Market factors: Who do we create value for?

The enterprise is a local company based in Nyanza, Western Kenya. Its commerce includes B2B as well as B2C transactions. It offers its products to downstream suppliers, retailers, as well as final customers, who are mostly transactional customers in this niche market. Company’s end-users are smallholder one-acre farmers in Kenya, predominantly located in Nyanza, Western Kenya. Locations where the company is selling its product must have high density of suitable potential customers i.e. one-acre farmers with accessible shallow water in order to make the set-up of after sales support structure commercially viable.

9.4.3 Internal capability factors: What is our source of competence?

The company states production, technology, R&D, creative or innovative capability, supply chain management and networking as main sources of competence. The key competences of the

company derive from the initial product development stage with significant relevant expertise and experience. The company, although relatively young, is a result of a partnership that has invested a decade in developing and perfecting the pump. These competences are complemented with high quality, low cost manufacturing capacity. Commercial business acumen and experience enable the company to identify scalable strategies to access targeted markets and achieve profitability.

9.4.4 Competitive strategy factors: How do we competitively position ourselves?

How do we differentiate ourselves?

Dependability, product or service quality, innovation leadership, low-cost, efficiency, intimate customer relationship and experience are the factors that differentiate the firm from other competitors on the market. The company's product competes with petrol/diesel pumps, thus the technology and energy source used are the first factors that differentiate their product from its competitors. This implies that the product does not incur an ongoing cost as petrol/diesel pumps do. The product features such as performance, which is getting a highly efficient product for low cost, is another factor that differentiates the products from the competition on the market. Another factor is the user-friendly design where a robust product is easy to maintain and repair as opposed to competitors' products which have to be replaced when they brake.

9.4.5 Economic factors: How do we make money?

Company X's prices and revenue sources are fixed. The solar pump retails at EUR 578.5 (or USD 650 or KES 65,000). The product is offered with innovative payment plans.

The company has low operating leverage. It produces low volumes with the aim of increasing volumes in the future in order to be profitable. High volumes of sales will be achieved by utilizing existing distribution networks to maintain minimal cost base, coupled with a tailored finance offering to make the product far more accessible for low income customers/farmers. The business will become profitable by reaching high volumes of sales, and consequently achieving economies of scale. Profit margins will be necessarily low in order to accommodate the strategy of utilizing existing distribution networks and achieving sales to low-income farmers. The company's financing structure is 50% debt financing for 3 years and 50% donor finance for 3 years. Private equity is expected in the future.

9.4.6 Personal/Investor factors: What are our time, scope and size ambitions?

Enterprise X aims at investing and reinvesting in the future growth of the value of the firm that would provide capital gain for the initial investors. The company aims at achieving high volumes of sale through selected distributors to demonstrate the commercial viability of the product. Moreover, the company will look to expand sales in other geographical regions whilst scaling up production capacity. For this phase, the company would require additional investment in the

form of private capital. Time scales are hard to estimate, however requirement for further investment is likely to occur within the next 1 to 2 years.

9.5 Summary of key findings– Characterizing business models of Tecnosol and enterprise X

The cases present two different RE enterprises, Tecnosol, based in Nicaragua, and enterprise X, based in Kenya. Tecnosol is a regional RE enterprise with a tradition of 17 years on RE markets, mainly solar PV markets, in Nicaragua and in the Central American region (Honduras, El Salvador and Panama), while enterprise X, even though it represents the commercial arm of a partnership that has dedicated a decade on developing and perfecting the solar irrigation pump, is still a young enterprise with a record of less than 5 years.

Years of experience and existence of a company naturally influences the offering and consequently the characteristics of the business model. The longer period of existence of a company gives space to expand its product portfolio, and to expand its business to new geographical markets. Tecnosol business model is based on highly diversified product portfolio. Company's offering is consisted of heavy mix of highly customized products and services. The offering is characterized by a broad line of products, consisted of 12 product lines: solar electricity –SHSs, wind electricity, hydroelectricity, solar energy – thermal generation of biogas, water pumping, indoor and outdoor lighting, backup power, refrigeration, rural telecommunication, water heating, control of livestock and pasture and biogas through digesters systems. Product lines are consisted of deep lines that consist in most cases of a number of different products in each product line that are bundled with other firm's products. The offering is primarily service delivery, reselling and value added reselling, distributed via both, direct and indirect channels. The main activity of the company is the supply and installation of solar PV systems, mostly SHSs in rural areas. The expected time of commercial viability of the product is 2 years.

On the other hand, enterprise X's offering is consisted of the product itself - the solar irrigation pump for 1 acre farmers. Respondents stated 2 years of expected time to commercial viability, which is the same period as for the SHSs provided by Tecnosol. As opposed to Tecnosol offering, enterprise X's offering is characterized by narrow line consisted of shallow lines, which may be a result of the relatively short time of existence of the company, as well as the fact that the company manufactures the product and provides service delivery itself, while Tecnosol does not manufacture its products, but rather provides service delivery, reselling and value added reselling. Enterprise X, as Tecnosol, uses direct and indirect distribution channels.

Both companies create value for both, businesses and consumers. However, Tecnosol is a regional company operating in Nicaragua, Panama, El Salvador and Honduras, while enterprise X is a local company operating in Nyanza, Western Kenya that aims at expanding to other geographical markets in the medium term. Both companies target, among others, customers in

rural areas and solve crucial customers' needs such as access to electricity and access to affordable irrigation, which is a major limit to farm productivity. By this, they help eradicate poverty and build prosperity for those mostly in need. While both companies deal predominantly with transactional customers, Tecnosol's customers are final consumers in multiple segments, whilst enterprise X's customers are, besides final consumers, also downstream suppliers and retailers in niche market.

Tecnosol states selling and marketing as main sources of competence, which is expected since the company offering is consisted of service delivery, reselling and value added reselling. Enterprise X on the other hand as a company doing internal manufacturing, states production, distinct technology, R&D, creative or innovative capability, supply chain management and networking as their sources of competence. Both companies state innovation leadership, intimate customer relationship and experience as main characteristics that differentiate them from their competitors. Enterprise X added also product or service quality, low cost and efficiency.

Tecnosol has flexible pricing and revenue sources while enterprise X has fixed. Tecnosol has medium operating leverage, sells high volumes with medium margins. Its financing structure is consisted of 20% private equity for 8 years and 80% debt financing. Enterprise X has low operating leverage, sells low volumes, still it has to considerably increase its sales volume in order to reach profitability. It sells at low margins. Its financing structure is consisted of 50% debt for 3 years and 50% of donor funding. Tehnosol has access to private capital primarily because of its longer tradition and history of financial performance, as well as strong brand which acts as a guarantor that its products are proven on the market.

Both companies aim for the growth model, where they not only acquire initial investment, but also substantial reinvestment in an attempt to grow the value of the firm to the point that it eventually generates a major capital gain for the initial investors. Both companies have emphasized the importance of sales and after sales channels for the growth of the business. This is so because their customers are located in remote, rural areas that lack access to basic social services. Hence, it is necessary to have well-developed sales and after sales channel in order to provide timely services, such as assistance with maintenance of the products.

Overall, as crucial building blocks of the companies' REBMs in developing countries are:

- **CVP** where products and services are **highly customized** to customers' or customer segments' specific needs. The **design, usability and convenience** of the product is a distinctive factor through which the new technology is made more approachable and more acceptable for users, which is of crucial importance when dealing with customers who are often not accustomed to using technology in general because they live in remote areas where basic living conditions are not met. In this case the design is portable, farmer-friendly, and farmer-fixable. Another important element is the **price**, where similar value is offered at lower price with the aim of satisfying the needs of price sensitive customers. Low-price value

proposition usually requires designing a business model that specifically supports the low-price value proposition. In that manner, in order to reach high volumes of sales to low income farmers, enterprise X will utilize existing distribution networks in order to maintain minimal cost base. Another key factor of the CVP of these RE business models is the **cost reduction** where companies help customers to reduce their costs. This is primarily done with the products themselves, which are clean energy and energy efficient solutions that provide savings on the opportunity costs of purchasing unsustainable fossil fuel run engine pumps, or fuels and kerosene for cooking, heating and lighting. Besides the high financial cost to which are added also transportation costs to get to the sales points, obtaining fossil fuel engines or kerosene are very time consuming and impose high irreversible costs in terms of poor health of people and polluting the environment. The CVP has the element of **accessibility** because companies provide access to products and services that previously have not been available, such as provision of sustainable, clean energy sources and access to reliable electricity. This is a result of combination of both, a new technology and a business model innovation, where the innovative consumer financing or payment plans raise the very low purchasing power of customers and make the product or service available to them, while reducing barriers to entry for the enterprises. Finally, the existence of **consumer financing i.e. payment plans** for consumers is a characteristic element of the CVP of REBMs developing countries, especially when it comes to buyers who have very low and unstable incomes and live in rural remote areas. Payment plans for customers are innovative in themselves and contribute to the overall innovation of the business model. Payment plans increase customers' very low purchasing power and contribute to market creation, which contributes to larger sales for the companies, and products that are of essential importance for the well-being and prosperity of the customers.

- **Channels**, in particular **distribution, sales and after-sales channels**, play very important role in the customers' experience. Distribution and sales channels are very important element of the overall cost structure of companies that deserve a special attention. If not managed properly they may present a substantial financial burden for the company, as in the case of the sales channels of Tecnosol, or may be the main factor in sustaining minimal cost base as in the case of enterprise X's distribution channels. Distribution, sales and after-sales channels play an important role in the particular RE business models because they serve customers who live in remote, rural areas that are difficult to access and contribute substantially to the customers' experience and satisfaction. They have to be strategically located in order to reach a sufficient number of customers that will in turn make the existence of these channels viable. Moreover, distribution, sales and after sales channels are crucial for the future growth and viability of the businesses.
- **Customer relationship** is very important for reaching and understanding the specific needs of customers. Both companies stated intimate customer relationships as crucial factors that differentiate them from their competitors in the market. Personal assistance, dedicated personal assistance and communities are the three main types of customer relationships. User communities, such as farmer communities are used by enterprises to become more involved

with customers, to facilitate the connection between the community members and to better understand customers.

- **Revenue streams** are the next crucial building block of every business model. These RE business models have **transactional** type of revenue streams, meaning they deal with one-time customer purchases who always seek the lowest price.
- **Key resources** are an essential building block of RE business models. In these cases, business models are characterized by a great need for financing through bank loans under favourable terms and private equity. Companies face a shortage of financing due to the new technology that is still to be proven on the market, as well as the fact that one of the companies is relatively new and lacks sufficient history of financial performance. Banks are reluctant to approve loans to such new companies and new, unproven technologies, while investors require high returns to compensate for the high risk they bear. Additional obstacle in obtaining financial resources is the fact that these enterprises are located in countries with high political risk, which is the main factor deterring private investment, coupled with underdeveloped financial systems.
- **Key partnerships** are very important part of companies' business model since they help to optimize the allocation of resources and activities, and achieve economies of scale.
- The above-described business models demonstrate **cost structures** that fail between cost-driven and value-driven structures. They focus on minimizing costs by using low-price value proposition but offer high quality products with personalized services.

RECOMMENDATION FOR BUSINESSES

There are three main set of questions that entrepreneurs who develop a business model for a business in the solar industry and serve customers in remote, rural areas in developing countries should pay special attention to. This does not suggest that entrepreneurs should focus only on these set of questions, but rather to consider the distinctive importance of these elements for the success of their business. The three set of questions that entrepreneurs should ask themselves when developing a REBM are:

1. What is our CVP? Is our product or service specifically tailored to and meeting our customers' needs? What is our consumer financing model?
2. Are we going to utilize existing distribution, sales and/or after-sales channels or should we develop new ones? How will this decision affect the viability of our business?
3. Where do our key resources i.e. financing come from? What is our financial strategy? How are we going to reduce the risk of our business so that we become more attractive for private investors to invest in our business?

The first set of questions focuses on the CVP. Businesses should consider whether they have tailored their product(s) or service(s) to the customers' specific needs, bearing in mind that these customers are located in remote, rural areas, and that majority of them are poor. When developing their product or service businesses should consider high customization to customer

needs including a design of a product that is convenient for use by customers living in rural and remote areas. Businesses should develop a consumer financing model that will provide the necessary purchasing power to customers so that customers can afford to buy the product or the service. Businesses should allow themselves to be innovative in creating these consumer-financing models and consider partnering with MFIs that would provide loans to consumers at favourable terms. Businesses should increase customers' awareness of the direct and indirect benefits of the product or service, such as cost reduction, improved wellbeing through higher income, eliminated indoor pollution that causes considerable health problems, especially to women responsible for cooking and care giving in the households, and children. Access to electricity through SHSs translates, among others, into additional hours for educational pursuits, or additional income-generating activities. Customers' should be made aware of all the benefits they would have with these products. Finally, even though not covered within this master thesis, business should consider demographic and cultural factors that influence consumers' behaviour and purchasing decision.

Second set of questions focuses on distribution, sales and after-sales channels. Businesses should have a clear strategy supported with the corresponding financials, on how they would reach out to customers in remote, rural areas i.e. through what channels would they serve their customers? Are they going to utilize existing channels, or are they going to, and are appropriately financially backed-up to pursue the development of new ones? It is recommended that businesses should use existing distribution, sales and after-sales channels in order to minimize their costs. On the other hand, if they decide to pursue the development of new channels they should position their channels strategically to be able to serve its customers, but also to ensure that channels do not become a financial burden for the business, i.e. channels generate more revenues than costs to the business.

The third set of questions refers to the key resources of the business. Companies in the RE business face a shortage of financing due to the new technology that albeit substantial progress in deployment of renewables, is still to be proven on the market. Moreover, these are usually relatively new companies with high growth potential but lack of sufficient history of financial performance, have initial losses and intangible balance sheet. In addition to this, businesses operating in low-income developing countries face challenging business environments, dealing with problematic factors ranging from underdeveloped basic infrastructure to underdeveloped financial systems. These factors add to the overall risk of the business, making it more challenging for business to attract private investors. Nevertheless, there are international organisations and partnerships that provide grants or concessional loans to early-stage businesses; or financially supporting the transition of businesses from early to later, commercial growth stage. Entrepreneurs should be aware of these and other innovative types of financing opportunities and exploit them appropriately.

CONCLUSION

The purpose of the master thesis was to understand and characterize REBMs in low and middle - income developing countries by using case study as a method of analytical approach. Characterization of REBMs was done using the framework for characterization of business models developed by Morris et al. (2005) which is also the foundation for the semi-structured interviews and for the cases. The cases present two different RE enterprises, Tecnosol, based in Nicaragua, and enterprise X, based in Kenya. Tecnosol is a regional RE enterprise with a tradition of 17 years in RE markets, mainly solar PV markets. It is based in Nicaragua with operations in the Central American region, in particular Honduras, El Salvador and Panama. Enterprise X is a young enterprise manufacturing and distributing low - cost solar irrigation pumps with a record of less than 5 years.

The results show that there are several elements of the business model in the first case that occur in the other case too. These are of crucial importance for the success and viability of the business and hence characterize the REBM. The main three elements are the CVP, channels, and key resources.

The CVP is a fundamental part of any business model and naturally, REBMs are not an exemption from this. Particular subelements of the CVP are crucial for and characterize the REBM. These are:

- high customization of products to customers' or customer segments' specific needs;
- design, usability and convenience of the product, which makes the product more approachable and acceptable for customers who live in rural, remote areas and who are not familiar with the use of technology in general;
- price of the product, because enterprises are dealing with very price-sensitive customers who have very low purchasing power;
- cost reduction for the customers as a result of the use of the particular clean energy and energy efficient solutions that provide savings on the opportunity costs of purchasing unsustainable fossil fuel run engine pumps, or fuels and kerosene for cooking, heating and lighting. These products also reduce indirect costs such as eliminating the time-consuming process of getting to the sales points for fossil fuels and kerosene, eliminating the high irreversible costs in terms of poor health of people from inhaling the harmful smoke and environment pollution;
- accessibility, meaning that companies provide access to products and services that previously have not been available, such as provision of sustainable, clean energy sources and access to reliable electricity. This is a result of combination of both, a new technology and a business model innovation, where the innovative consumer financing raises the very low purchasing power of customers and make the product or service available for customers.
- consumer financing i.e. payment plans for customers, as a complementary service to the product, is the key innovation in the REBMs and a key element for market creation reducing

barriers to entry. Even though for people who live in the remote, rural areas these products are essential in order to meet their basic needs, it is the low purchasing power and instable or non-existent incomes that prevent them from buying these products. Moreover, with their low income they do not qualify for a bank loan. Hence, payment plans increase customers' purchasing power that results in sales of the products, and ultimately building prosperity for the people.

Channels, in particular distribution, sales and after-sales channels play a very important role for the viability of the business. The companies serve customers who live in remote, rural areas that are difficult to access. They have to be strategically located in order to reach a sufficient number of customers that will in turn make the existence of these channels viable. Hence, distribution, sales and after-sales channels are very important element of the overall cost structure of companies. If not managed properly they may present a substantial financial burden for the company, as in the case of the sales channels of Tecnosol, or may be the main factor in sustaining minimal cost base as in the case of enterprise X's distribution channels.

Key resources are the third main element that characterizes the REBM. The companies face a shortage of financing due to the new technology that is still to be proven on the market, as well as the fact that these are relatively new companies that lack sufficient history of financial performance. Banks are reluctant to approve loans to new companies and new, unproven technologies, while investors require high returns to compensate for the high risk they bear. Additional obstacle in obtaining financial resources is the fact that these enterprises are located in countries with high political risk, which is one of the main factors deterring private investment, coupled with underdeveloped financial systems.

In addition to these three main elements, there are more elements of the business model that characterize the REBM. Companies stated intimate customer relationships and innovation leadership as important factors that differentiate them from the competitors on the market. Both companies deal with transactional customers who usually make one-time purchases and always seek the lowest price. Both business models demonstrate cost structure that fails between cost-driven and value-driven structure. Moreover, partnerships are essential for optimal allocation of resources and activities. Naturally, in the medium to long run both companies aim for the growth model where substantial reinvestment is available with the aim of growing the value of the company and generating returns for initial investors.

The results offer valuable insights into the REBMs of companies operating in developing countries, however in order some generalization and determination of patterns to be made a larger sample of enterprises is needed. Moreover, if hard data and financial performance indicators were available there would be clearer picture about the viability of the business models.

The fields of RE and business model research are relatively new and in the process of constant development. The fact that there is no consensus on definition, nature, structure and evolution of business models says that business models are constantly shaping, in response to internal influences stemming from the enterprise itself and external influences coming from the business environment. In this sense, business models in general are characterized by the freedom for innovation and continuous progress.

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APPENDIXES

LIST OF APPENDIXES

List of Abbreviations1
Appendix A: Foundation for the semi-structured interviews.....3
Appendix B: Characterizing business models.....5

LIST OF ABBREVIATIONS

AGDP	Agricultural Gross Domestic Product
ALBA	Bolivarian Alliance for the Peoples of Our America
ASALS	Arid and Semi-Arid Lands
BNEP	Bloomberg New Energy Finance
B2B	Business to Business
B2C	Business to Customers
BoP	Base of the Pyramid
BTI	Bertelsmann Stiftung's Transformation Index
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CPI	Corruption Perception Index
CSV	Creating Shared Value
CVP	Customer Value Proposition
COMESA	Common Market for Eastern and Southern Africa
DSA	Debt Sustainability Analysis
ECLAC	United Nations Economic Commission for Latin America and Caribbean
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FDI	Foreign Direct Investments
FSLN	Frente Sandinista de Liberación Nacional (angl. The Sandinista National Liberation Front)
GCI	Global Competitiveness Index
GII	Gender Inequality Index
GHG	Greenhouse gas
HDI	Human Development Index
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IEA	International Energy Agency
IFC	International Finance Corporation
ILO	International Labour Organization
IMF	International Monetary Fund
INE	Nicaraguan Energy Institute
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
KANY	Kenya African National Union
KES	Kenyan Shilling
LAC	Latin America and the Caribbean
MARENA	Ministry of Environment and Natural Resources
MEM	Ministry of Energy and Mines of the Republic of Nicaragua
MFI	Microfinance institution

MICCA	Mitigation of Climate Change in Agriculture Programme
MIGA	Multilateral Investment Guarantee Agency
NARU	National Rainbow Coalition
NCCAP	National Climate Change Action Plan
NCCRS	National Climate Change Response Strategy
RE	Renewable Energy
REBM	Renewable Energy Business Model
REEEP	Renewable Energy and Energy Efficiency Partnership
REN21	Renewable Energy Policy Network for the 21 st Century
RET	Renewable Energy Technology
OBA	Output-based aid
OBD	Output-based disbursement
OECD	Organization for Economic Cooperation and Development
PRG	Partial risk guarantee
PRI	Political risk insurance
PV	Photovoltaic
RBF	Results-based financing
RPS	Renewable Portfolio Standard
SSA	Sub-Saharan Africa
SE4All	Sustainable Energy for All
SHS	Solar House System
TPES	Total primary energy supply
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change – UNFCCC
USAID	United States Agency for International Development
VAT	Value added tax
WB	World Bank
WEF	World Economic Forum
WTO	World Trade Organization

Appendix A: Foundation for the semi-structured interviews

Table 1. Framework for characterizing business models

Component 1 (factors related to the offering): How do we create value? (select from each set)	Component 2 (market factors): Who do we create value for? (select from each set)		Component 3 (internal capability factors): What is our source of competence? (select one or more)	Component 4 (competitive strategy factors): How do we competitively position ourselves? (select one or more)	Component 5 (economic factors): How we make money? (select from each set)	Component 6 (personal/investor factors): What are our time, scope, and size ambitions? (select one)
. offering: primarily products/primarily services/heavy mix	. type of organization:		. production/operating systems	. image of operational excellence/consistency/dependability/speed	. pricing and revenue sources:	. subsistence model
	b-to-b/ b-to-c/ both	local/regional/ national/ international			fixed/mixed/flexible	
. offering: standardized/some customization/high customization	. where customer is in value chain:		. selling/marketing	. product or service quality/selection/features/availability	. operating leverage:	. income model
	upstream supplier/ downstream supplier/ government/ institutional/ wholesaler/ retailer/ service provider/final consumer				high/medium/low	
. offering: broad line/medium breadth/narrow line . offering: deep lines/medium depth/shallow lines	. broad or general market/ multiple segment/ niche market		. information management/mining/packaging	. innovation leadership	. volumes:	. growth model
					high/medium/low	

table continues

Table 1. Framework for characterizing business models (continued)

. offering: access to product/ product itself/ product bundled with other firm's product	. transactional/relational	. technology/R&D/creative or innovative capability/intellectual	. low cost/efficiency	. margins: high/medium/low	. speculative model
. offering: internal manufacturing or service delivery/ outsourcing/ licensing/ reselling/ value added reselling		. financial transactions/arbitrage	. intimate customer relationship/experience		
. offering: direct distribution/indirect distribution (if indirect: single or multichannel)		. supply chain management			
		. networking/resource leveraging			

Source: M. Morris et al., *The entrepreneur's business model: Toward a unified perspective*, 2005, p. 730, Table 1.

Appendix B: Characterizing business models

Table 1. Characterizing business models – Tecnosol (Nicaragua) & enterprise X (Kenya)

	Tecnosol		Enterprise X	
	Foundation level	Proprietary level	Foundation level	Proprietary level
Component 1: Factors related to offering How do we create value?	Sell heavy mix Highly customized offering Broad line Deep lines Product bundled with other firm's products Internal service delivery, reselling and value added reselling Direct and indirect distribution	Provides basic energy sources for lighting, watching TV, listening to the radio, mobile communication Provides electricity to pump water, farm fencing Provides biogas to cook and biofertilizers to farmers Special design to match the technology to the need and the economic capability of the consumer Farm-friendly relationships Provision of financial solutions for customers to make investments that will bring benefits to their families	Sell primarily products Highly customized offering Narrow breadth Shallow lines Product itself Internal manufacturing and service delivery Direct and Indirect distribution	Portable, robust solar irrigation pump aimed at seasonal vegetable farmers. Pumps up to 12,000 liters per day of irrigation water Performance: 900 liters/hr at 6m, or, 2,000 liters/hr at 1m Portable design Manual backup Detachable 80 Wp solar panel for security Works great with storage tanks and drip systems Robust hardware design No circuit boards or small electronics to go wrong Farmer-fixable Payment plans

table continues

Table 1. Characterizing business models – Tecnosol (Nicaragua) & enterprise X (Kenya) (continued)

<p>Component 2: Market factors Who do we create value for?</p>	<p>B2B and B2C Regional (Nicaragua, Honduras, Panama and El Salvador) Final consumer Multiple segment Transactional</p>	<p>There are two markets: Rural market, that is at its maturity stage. It serves people who do not have access to grid electricity. Requires well developed sales channels and sales locations throughout the country. Urban market, which is in its initial stage. Serves businesses and households that want to have savings in electricity bill and promote clean energy.</p>	<p>B2B and B2C Local (Western Kenya – Nyanza) Retailer and final consumer Niche market Transactional</p>	<p>End users are smallholder one acre farmers in Kenya, currently predominantly in Nyanza, Western Kenya. Locales where the company will sell must have high density of suitable potential customers i.e. one acre farmers with accessible shallow water. High density of potential customers is required to make it commercially viable to set up after sales support structure.</p>
<p>Component 3: Internal capability factors What is our source of competence?</p>	<p>Selling/marketing</p>	<p>Branding: strong brand recognition Good quality products (the best brand for PV products) 17 years of experience Branches located throughout the country are particularly important and necessary to reach and serve customers in remote, rural areas. However, it is a capital intensive, which in times of lack of capital presents a big obstacle since low budget translates into low flexibility.</p>	<p>Production/technology/R&D/creative or innovative capability/supply chain management/networking</p>	<p>Key competences stem from initial product development, with significant expertise and experience. High quality, low cost manufacturing capacity Commercial business acumen and experience enable the company to identify scalable strategies to access the markets required to achieve profitability.</p>

table continues

Table 1. Characterizing business models – Tecnosol (Nicaragua) & enterprise X (Kenya) (continued)

<p>Component 4: Competitive strategy factors How do we competitivelypos ition ourselves? (How we differentiate ourselves?)</p>	<p>Innovation leadership/intimate customer relationship/experience</p>	<p>The company tries to position itself as a leader in services, innovation and products delivery. It tries to create alliances with organizations such as microfinance institutions, banks and cooperatives to promote the technology and services connected with it.</p>	<p>Dependability/product or service quality/innovation leadership/low cost/efficiency/intimate customer relationship/experience</p>	<p>The product is low cost relative to competitor’s solar irrigation products, and highly efficient resulting in a good performance for the cost. No ongoing cost for solar pump as opposed to competing petrol/diesel pumps User centric design leads to robust product that is easy to maintain and repair, whereas competitor products need to be replaced when they break.</p>
<p>Component 5: Economic factors How do we make money?</p>	<p>Flexible revenue source Medium operating leverage High volumes Medium margins Financing structure: 80% debt for 8 years + 20% private equity</p>	<p>What makes our business profitable? Understanding of segments of the markets, imports of large quantities of products with high rotation directly from the factories, cost control, and sales techniques tailored to offer a good quality, friendly customer service.</p>	<p>Fixed revenue source Low operating leverage Low volumes (low at the present, high required for profitability) Low margins Financing structure: 50% debt for 3 years + 50% donor funding for 3 years (private equity expected in future)</p>	<p>The business will become profitable by achieving high volumes of sales. This will give access to economies of scale. Profit margins will be necessarily low to accommodate the strategy of utilizing existing distribution networks, that will require competitive profit margin, and to make sales to low income farmers. Therefore, to reach profitability the company will need to reach high volumes of sales. This will be achieved by utilizing existing distribution networks, to maintain a minimal cost base, coupled with a tailored finance offering that will make the product far more accessible for customers with low incomes.</p>

table continues

Table 1. Characterizing business models – Tecnosol (Nicaragua) & enterprise X (Kenya) (continued)

<p>Component 6: Growth/exit factors What are our time, scope and size ambitions?</p>	<p>Growth model</p>	<p>The company is facing cash flow pressure due to investments done in the last years in Honduras, Panama and El Salvador. It requires further capital investments if the company wants to keep managing the numerous sales branches in the region. Otherwise, it will need to close down some sales branches and sell them as franchises.</p>	<p>Growth model</p>	<p>Achieve volumes of sales through few, selected distributors to demonstrate commercial viability. Expanding to geographically new markets whilst scaling up production capacity. For this phase the company will require additional investment, most likely in the form of private capital. Requirement for new investment is likely to be within 1 to 2 years.</p>
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