A DESK ASSESSMENT OF CURRENT PRODUCTS AND PLAYERS INVOLVED IN THE DEVELOPMENT AND SALE OF DOMESTIC ENERGY EFFICIENT PRODUCTS IN KENYA

A review conducted for

"The next generation of low-cost energy-efficient appliances and devices to benefit the bottom of the pyramid" (LCT) Project

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EXECUTIVE SUMMARY

In recent years, there has been a significant increase in activities to provide energy to low-income households and communities in developing countries, through rural electrification schemes, the promotion of micro-grids and other methods. Increasingly there is recognition of the need for this energy to be sustainable. As a result a significant effort is being made to increase the percentage of power generated by renewable sources, notably wind and solar. Kenya has identified energy as one of the key infrastructure enablers for the country's economic and social development and has one of the highest penetrations of solar products in Africa.

This paper focuses on Kenya and assesses the current state of the market for domestic low cost, energy efficient appliances. It focuses on the national policy environment, the players involved in the market and the current status of product availability. The paper informs efforts in the LCT project to determine the top priority low cost, energy efficient technologies for Kenya.

Kenya's strategic plan has been driven by its national development strategy known as 'Vision 2030', the national energy access scale up programme and international goals (initially the Millennium Development Goals and more recently the Sustainable Energy for All programme (SE4ALL) and the Sustainable Development Goals).

Kenya has a vibrant industrial, manufacturing and retail sector and is moving forward in its efforts to reduce poverty in the country. It is for this reason that Kenya has one of the highest penetration rates for solar products in Africa. The market for domestic renewable energy products is dominated by the private sector (for profit and not-for profit) as well as public sector actors (donors and the government). This has been assisted by international finance opportunities, vibrant market competition in Kenya with a variety of products available on the market.

This project has focused attention on the current state of the market in relation to the following domestic appliances which are the focus of this project: **s**olar pumps for irrigation, solar household refrigeration and solar cookers. We find that solar pumps are available through numerous suppliers; solar refrigeration options are available but are extremely expensive and solar cookers have not really caught on due to the dominance of improved cookstoves.

INTRODUCTION

Kenya could be considered somewhat of a leader in Africa in the renewable energy sector in recent years. Investments in the field have gone from very small investments to over US$1.3 billion by 2010 (UNEP, 2011). Kenya is has the highest number of solar power systems installed per capita in the world and is the largest producer of geothermal power in Africa. The Government of Kenya in its 'Vision 2030', a program to transform Kenya into a newly industrializing, middle-income country, places a significant emphasis on the role of energy as an infrastructure enabler for economic and social development. However, connectivity to the national grid in Kenya currently stands at only 28% (Oxford Business Group, 2016), while those that have power often have erratic and unreliable supply. This makes low cost energy efficient products, not simply alternative (renewable) power generation sources, extremely important.

This project is focused on understanding the top- priority low-energy technologies that have the potential to improve lives at the Bottom of the pyramid (BoP). It will do this through a focus on the context and culture-specific design and operational parameters of these technologies and how the technologies will be constructed and commercialized at those levels. It will investigate the current innovation system created to develop a continuous pipeline of pro-poor energy-related technologies. It will also investigate the types of new partnerships and business models that will lead to the uptake of innovative low cost energy efficient technologies in Kenya.

As an initial step in this project, this paper outlines the findings of a desk review of the current state of the market for a selection of domestic energy appliances available in Kenya and which the LCT project is likely to focus on. The review outlines the policy environment currently effecting energy technology development and diffusion, the current actors involved and the products currently available.

REVIEW OF KENYA'S DEVELOPMENT AGENDA AND POLICY FRAMEWORK IN ENERGY

A variety of policy initiatives have shaped Kenya's energy sector and technology development in this area in recent years. The major initiatives are outlined below.

KENYA VISION 2030

Kenya's Vision 2030 is the country's development programme covering the period 2008 to 2030. Its objective is to "help transform Kenya into a newly industrializing, middle-income country providing a high quality of life to all citizens by 2030 in a clean and secure environment" (GoK, 2013) and links itself to meeting the Millennium Development Goals (MDGs) for Kenyans. The vision is anchored on 3 key pillars which each have a series of flagship projects associated to them in key sectors:

> **The economic pillar** – This focuses on achieving an economic growth rate of 10% per annum which can be sustained until 2030. Key sectors promoted under this pillar include tourism, agriculture, manufacturing and the oil and gas sector to name a few.
>
> **The social pillar** – this seeks to create just, cohesive and equitable social development and focuses on the key sectors of health, education, water and sanitation, population and housing, gender, youth and culture.
>
> **The political pillar** – this pillar is focused on creating a democratic society with transparent and accountable governance structures to reduce conflict in society.

Vision 2030 acknowledges the fact that these pillars will only be strengthened if a set of enabling forces and factors are addressed. One of these is energy. The document says of energy:

> "Development projects recommended under *Vision 2030* will increase demand on Kenya's energy supply. Currently, Kenya's energy costs are higher than those of her competitors. Kenya must, therefore, generate more energy at a lower cost and increase efficiency in energy consumption. The Government is committed to continued institutional reforms in the energy sector, including a strong regulatory framework, encouraging more private generators of power, and separating generation from distribution. New sources of energy will be found through exploitation of geothermal power, coal, renewable energy sources, and connecting Kenya to energy-surplus countries in the region." (GoK, 2007b)

RURAL ELECTRIFICATION

It is estimated that only 5% of rural households are connected to the grid despite grid connection expanding by around 10% per year in recent years (Oxford Business Group, 2016). The Rural Electrification Authority (REA) has been charged, since 2007, with the mandate of implementing the Rural Electrification Programme. REA is expected to increase the speed of implementation of projects lined up for implementation throughout the country that will see power reach the most remote areas. Currently, the Authority is developing a rural electrification master plan to provide a framework for the selection of projects that are supported.

THE MDGS, SE4ALL AND SDGS

Supply of adequate and affordable types of energy for growth and development is the central theme of the Kenyan government's energy policy. Vision 2030 was grounded in a need to meet the Millennium Development Goals (MDGs) by 2015. Since Vision 2030 was published two additional international policy initiatives have been launched which impact Kenyan policy activities in the energy sector. The Sustainable Energy for All (SE4ALL) initiative launched in 2011 by the UN and the more recent introduction of the global Sustainable Development Goals (SDGs), notably SDG7 focusing on access to affordable, reliable, sustainable and modern energy for all. Kenya is currently developing its SE4ALL Action Agenda and Investment Prospectus (http://se4allkenya.com/) while SDG7 is seen as instrumental to the Vision 2030 goals (see http://se4allforum.org/content/kenya)

OTHER POLICIES AND GOVERNMENT INCENTIVES FOR THE INDUSTRY AND MARKET

There are also a number of additional policy instruments that have been developed in Kenya which are influencing the energy market in Kenya and the development and deployment of domestic energy appliances. A list of some of the key instruments are outlined below in a non-exhaustive, non-ranked manner:

Feed-in tariff policy – This was launched in 2008 but has not been widely taken up. In 2015 the first four feed-in agreements were signed to enable the four companies to sell their excess energy produced through their own power generation operations using biomass, solar, wind and hydro back to the national power company for use in the national grid.

Zero rated import duty and value added tax exemption – these were granted in 2011 on all renewable energy equipment and accessories.

ENERGY SECTOR ACTORS

There are a number of different actors performing different roles in Kenya, these includes; the government, financial institutions, private sector, research institutions, development partners and civil society organizations.

THE GOVERNMENT

The Government is one of the main actors in implementation of laws, policies and regulations and funding through public private partnerships in Kenya's energy sector.

The following are the key governmental actors in the Kenya energy sector:

Ministry of Energy (MoE)

Energy Regulatory commission (ERC)

Energy Tribunal

The Kenya Power and Lighting Company Limited (KPLC),

Kenya Electricity Generating Company Limited (KenGen),

Rural Electrification Authority (REA),

Kenya Electricity Transmission Company Limited (KETRACO) and;

Centre for Energy Efficient and Conservation (CEEC).

Other government key players that have influence in the energy sector include The National Environmental Management Authority (NEMA), The National Commission for Science, Technology and Innovation (NACOSTI) and the Presidency.

FINANCIAL INSTITUTIONS

Financial institutions have played a big role in renewable energy. Key financial players in Kenya's energy sector are:

Banks – CfC Stanbic, a Kenyan bank within the Standard Bank group, provides investment support to two of the largest energy projects in Kenya. The Cooperative Bank of Kenya is an investor of Strathmore Business School's solar park in Nairobi.

Government and international finance mechanisms – A range of national governments, beyond the Government of Kenya are supporting large scale power development projects in Kenya including the Chinese, Spanish, Finnish, Danish, Norwegian and US governments while the World Bank through the International Finance Corporation provides support to large scale projects. National governments outside Kenya together with regional institutions such as the European Union also support smaller solar power projects. In addition, international support from governments has supported the

development of the Kenya Climate Innovation Centre (KCIC) which provides an innovation hub for entrepreneurs and small businesses working in the renewables sector.

Other donors and international aid organisations – Google publically committed its support to the Lake Turkana wind project in 2015 (http://googlegreenblog.blogspot.co.ke/2015/10/investing-in-africas-largest-wind.html), however, donors and international aid organisations have been involved in smaller scale projects, particularly in the renewables area for many years. For example, the solar home system field is dominated by firms that are supported by donor funding to a greater or lesser degree (for example, the German Development Agency, GIZ or GVEP International).

Private individuals and firms – Behind most projects a key individuals or firms that have staked their money and reputations on energy projects or the introduction of a new domestic energy appliance. From large international firms such as Vestas (the Danish wind turbine manufacturer) to local solar appliance firms such as Sollatek, firms are central to the financial viability of the market.

Research Institutions and universities – Research institutions have an important role in renewable energy. They develop new knowledge and advise government sometimes influencing policy making. There are several research institutions that are important in this field. These include: The Kenya Forestry Research Institute (KEFRI), the International Centre for Insect Physiology and Ecology (ICIPE) and the Kenya Industrial Research and Development Institute (KIRDI). Key universities include: University of Nairobi, Jomo Kenyatta University of Agriculture and Technology (JKUAT) and Strathmore University.

DOMESTIC ENERGY APPLIANCES IN KENYA

This section provides an overview of the current situation with regards three sets of domestic energy appliances which are a major focus of this project's activities: solar water pumps; solar and energy efficient refrigeration and; solar cookers. Because these products are predominately solar powered, a brief overview of the solar energy landscape is provided. This is followed by detailed listings of the current products available in Kenya in the different product categories.

AN OVERVIEW OF THE SOLAR ENERGY LANDSCAPE

Solar is one of the emerging renewable energy technologies in Kenya that has the potential to transform the country's energy sector. Kenya is endowed with enormous solar potential at a daily rate of 4-6 KWh/m^2 (ERC, n.d.). A study by M-KOPA Solar and InterMedia (2014) has stated that 'Kenya has emerged as a hot spot for off-grid solar, with 14% of the population [out of 300 households] surveyed using solar as their primary lighting and charging source.' The local solar PV industry in Kenya is mainly emerging from the production of solar PV components such as batteries, controllers, inverters and specialised installation and services. There are four main solar PV market segments:

Small Pico systems – very small units comprising a lantern and sometimes a phone charging function. It is estimated that 700,000 lanterns are in use in Kenya. There are currently 29 quality-verified solar lighting products, from 17 manufacturers on sale.

Solar Home Systems – larger units providing lighting, phone charging, power for a radio and can, in some instances, provide sufficient power to run a TV. In 2013, the solar homes system market constituted over 80% of the total solar PV market volume.

Stand-alone institutional PV systems – these are larger units still which provide power for schools, health centre or homes.

Stand alone or hybrid (PV-diesel) mini-grids – these provide power to a number of homes and are therefore found at the community level. The Government of Kenya has been promoting these as a means of bringing electricity to remote areas of the country where grid connectivity would be extremely costly.

Large scale, grid-connected PV systems – These solar PV systems are usually large-scale and owned and operated by national power generation utilities and private operators.

DOMESTIC ENERGY APPLIANCES IN KENYA

As the above discussion of the solar sector in Kenya highlights, the majority of the discussion in Kenya has been focused on energy generation rather than appliances themselves. Our project's underlying argument is that it isn't energy that changes people's lives; rather, it is what people use the energy for that changes lives. As such, this project focuses on energy technologies, specifically devices or appliances that have a function in the domestic or healthcare arena. A separate report will focus on the current status of appliances in the healthcare sector. This report is interested in the current state of the market in Kenya of energy appliances in the areas of water pumping, refrigeration and cooking.

SOLAR WATER PUMPS

The following solar water pumps were found to be on the market in Kenya that are produced by organisations or companies in Kenya. There are also a number of firms that sell imported solar water pumps which are not included in this list.

Technology	Details
Future pump Limited	Futurepump Ltd have developed a low cost, solar-powered irrigation pump in Kenya, called the Sunflower. The idea is founded on the fact that 500 million smallholder farmers around the world rely on unpredictable rainfall for their crops. The Sunflower offers an alternative to manual water pumping and a cheaper form of irrigation than petrol or diesel pumps. It uses a solar collector that generates steam to drive a simple engine pump. It can lift 12,000 litres/ day from a 7.5m well (more at shallower depths) which can irrigate around ½ an acre. The manufacturer argues that the initial investment of around $400 can be recouped in 1-2 years. http://www.futurepump.com/
Sunculture	Sunculture sells AgroSolar Kits, an entirely solar-powered drip irrigation system that makes it easier and cheaper for farmers to grow a wide variety of crops. The kit combines solar water pumping technology with high efficiency drip irrigation and includes everything a farmer needs to grow. The technology producer argues that the kit has the potential of increasing crop yields up to 300%. http://sunculture.com/
Solar World EA ltd	Solar World EA Ltd, offer design information and plans for solar and renewable energy water pumping. They argue that their solar water pumps can pump more water from as deep as 200 meters with less solar panels using a solar tracker than any other pump in the market. http://www.solarworld.co.ke/
Greenlink Kenya (formerly RIWIK Solar Solutions)	RIWIK was a solar company located in Kenya with holding operations in the Netherlands founded in 2011. In 2015 it was acquired by a Dutch solar company, Greenlink. The company have a license for Lorenz solar water pumps from Germany and provide these under tailor made solutions for individual requirements. They argue that anyone who purchases their solar water pump can return their investment in two years. http://riwikeastafrica.com/about-us/
Kickstart International	Kickstart International started in Kenya but now distributes its water pumps to multiple countries around the world. While originally developing a foot

Ltd	operated water pump, Kickstart has recently invented a solar photovoltaic (PV) pump for irrigation. http://www.kickstart.org/ and http://kenyacic.org/?q=content/kickstart-international

SOLAR COOKERS

These cookers are rare in Kenya due to the prominence and promotion of improved cookstoves. We have only found one major solar cooker provider in Kenya which is supported by an international not for profit, Solar Cookers International. The solar cooker 'cook kit' is produced outside of Kenya.

The principles of a solar cooker are that they trap heat from the sun through the use of insulated materials and/or encourage the capture of more heat from the sun through the use of reflective materials.

Technology	**Details**
Sunny Solutions	Sunny Solutions is an initiative focused on promoting the use of solar cookers. In partnership with the Nyakach Community Development Association (NYACODA), Solar Cookers International (SCI) is focusing on the provision of a solar cooker in Kenya. http://www.solarcookers.org/programs/multkenya.html

SOLAR REFRIGERATORS

Solar refrigerators are not produced in Kenya but are imported. There are an increasing number of distributors selling these products in Kenya. Below we provide details of two major products imported into Kenya and sold in the country.

Technology	**Details**
Minus 40	This fridge is sold as an up-right or a top loading fridge. The upright version includes an icebox option. The cold saver range is designed to work using generator or erratic mains power as it requires only three or four hours of electricity a day to function. www.minus40.co.za
Sundanzer	Argued to be the world's number one selling solar fridge. Product sold in Kenya the 115 and 225 litre capacity top loading design. Specifically, SunDanzer is developing a small-scale portable cooling system tailored for use in the Kenyan dairy market.

	SunDanzer is also evaluating freezing phase-change material into “milk packs” www.sundanzer.com

CONCLUSION

The main objective of this review was to gain a better understanding of the market for certain domestic energy appliances in Kenya. Despite a strong history of solar technology promotion and a high diffusion of pico and solar home systems, the use of solar powered domestic energy appliances (that are the focus of this project) appears low, with the exception of solar powered water pumps.

REFERENCES

ERC (n.d.) *Renewable energy sources: Solar energy*. Website article available at: http://www.erc.go.ke/index.php?option=com_fsf&view=faq&catid=2&Itemid=649

Government of the Republic of Kenya (2007) *Kenya Vision 2030: A Globally Competitive and Prosperous Kenya*. Nairobi: GoK

Government of the Republic of Kenya (2007b) *Kenya Vision 2030 (Popular Version)*. Nairobi: GoK http://www.konzacity.go.ke/wp-content/uploads/2014/12/Popular_Version.pdf

Government of the Republic of Kenya (2013) *Second Medium Term Plan, 2013 – 2017* Nairobi: GoK. Available at: http://faolex.fao.org/docs/pdf/ken145264.pdf

Oxford Business Group (2016) *Expanding Capacity and access across the nation*. Webpage available at http://www.oxfordbusinessgroup.com/overview/expanding-capacity-and-access-across-nation

UNEP (2011) *On the Road to Rio+20, Countries Accelerate Plans for Green Economy Transition* UNEP News Centre. Available at: http://www.unep.org/newscentre/Default.aspx?DocumentID=2659&ArticleID=8943#sthash.6YDYwDtZ.dpuf