SUSTAINABLE
ENERGY FOR ALL

Ministry of Energy

REPUBLIC OF KENYA

UNITED NATIONS INITIATIVE ON SUSTAINABLE ENERGY FOR ALL

STOCK-TAKING AND GAP ANALYSIS REPORT ON SUSTAINABLE ENERGY FOR ALL

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

List of abbreviations

ABPP	Africa Biogas Partnership Programme
ACFC	Agro-Chemical and Food Company
ACON	African Christians Organization Network
AFD	French Development Agency
AfDB	African Development Bank
AGO	Automotive Gas Oil
ASAL	Arid and Semi-arid Lands
AU	African Union
CAFOD	Catholic Agency for Overseas Development
CBK	Central Bank of Kenya
CBO	Community Based organisation
CDC	Commonwealth Development Corporation
CDM	Clean Development Mechanism
CEEC	Centre for Energy Efficiency and Conservation
CFL	Compact Fluorescent Lamp
CIDA	Canadian International Development Authority
CPI	Consumer Price Index
CSO	Civil Society Organisation
DEEP	Developing Energy Enterprises Program
DGIS	Directorate General for International Cooperation
DSM	Demand Side Management
EAPP	East African Power Pool
EDF	Electricity de France
EIB	European Investment Bank
EMA	Energy Management Awards
EMP	Energy Management Plans
EPC	Engineering, Procurement and Construction
ERC	Energy Regulatory Commission
ESCOs	Energy Service Companies
EU	European Union
FiT	Feed-in-Tariff
FKE	Federation of Kenya Employers
FY	Fiscal Year
GDC	Geothermal Development Company
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Green House Gas
GoK	Government of Kenya
GRA	Geothermal Resource Assessment
GT	Gas Turbine
GWh	Gigawatt hours
HFO	Heavy Fuel Oil
HSD	High Speed Diesel
HVDC	High Voltage Direct Current
IBRD	International Bank for Reconstruction and Development
IFC	International Finance Corporation
IPP	Independent Power Producer
ISAK	Improved Cook-stoves Association of Kenya
IUNPDP	Interim Update of the National Power Development Plan
JICA	Japan International Cooperation Agency

KAM	Kenya Association of Manufacturers
KBS	Kenya Bureau of Statistics
KEBS	Kenya Bureau of Standards
KEFRI	Kenya Forestry Research Institute
KENDBIP	Kenya National Domestic Biogas Programme
KenGen	Kenya Electricity Generating Company Limited
KEREA	Kenya Renewable Energy Association
KES	Kenya Shillings
KETRACO	Kenya Electricity Transmission Company Limited
KfW	Kredintsatalt fur Weidraufbau (of Germany)
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KIRDI	Kenya Industrial Research and Development Institute
KIRDI	Kenya Industrial Research and Development Institute
KMC	Kenya Meat Commission
KNBS	Kenya National Bureau of Statistics
KPC	Kenya Pipeline Company Limited
KPC	Kenya Power Company
KPLC	Kenya Power & Lighting Company Limited
KPRL	Kenya Petroleum Refinery Limited
KTDA	Kenya Tea Development Authority
KW	Kilowatt
KWh	Kilowatt hours
LED	Light Emitting Diodes
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
MEMR	Ministry of Environment and Mineral Resources
MEPS	Minimum Energy Performance Standards
MFIs	Micro Finance Institutions
MoE	Ministry of Energy
MSD	Medium Speed Diesel
MVA	Megavolt Amperes
MW	Megawatt
MWe	Megawatt electric
NEMA	National Environment Management Authority
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental organisation
NOCK	National Oil Corporation of Kenya
OMC	Oil Marketing Companies
PSDA	Private Sector for Development in Agriculture Programme
PV	Photo Voltaic
REA	Rural Electrification Authority
REEEP	Renewable Energy and Energy Efficiency Partnership
REF	Rural Electrification Fund
REP	Rural Electrification Programme
RES	Renewable Energy Sources
RTAP	Regional Technical Assistance Programme
SA	Statistical Abstract
SAPP	Southern African Power Pool
SE4ALL	Sustainable Energy for All
SHS	Solar Home Systems
SIDA	Swedish International Development Authority
SMEs	Small and Medium Enterprises
SREP	Scaling –up Renewable Energy Programmes

SWH	Solar Water Heaters
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
USD	US dollars

EXECUTIVE SUMMARY

Sustainable Energy for All (SE4ALL) initiative was launched by UN Secretary General at the General Assembly in September 2011, with the aim of catalysing action around three objectives to be achieved by 2030, namely (i) ensuring universal access to modern energy services, (ii) doubling the global rate of improvement in energy efficiency, and (iii) doubling the share of renewable energy in the global energy mix. In connection with this initiative, the year 2012 was declared the International Year of SE4ALL. Kenya is among the countries that have joined the SE4ALL initiative.

There are four stages of country process in the implementation of SE4ALL initiative. These stages are: Country opt-in; Stock taking and gap analysis; national action plans and programmes; and monitoring and implementation. This report covers the country process of stock-taking and gap analysis. The key objective of the exercise is to identify the gaps and barriers to energy use and access with a view to developing an appropriate national action plan to address them.

This report provides information on the available energy resources and their potential; energy supply and demand; levels of development of renewable energy resources/ technologies; access to modern energy services; energy efficiency; national policies and regulatory framework in the energy sector; and gaps and barriers in the development of the energy sector.

Kenya is endowed with vast renewable energy resources. The potential of these resources includes geothermal (7,000-10,000 MW), solar (4-6kWh/m^2), wind (346W/m^2), and hydropower (6,000MW). Biomass fuels, mainly in traditional forms, are by far the largest source of primary energy in Kenya. In addition there have been recent discoveries of commercially viable deposits of fossil fuels. Currently the total installed generation capacity is 1753.4MW which includes hydropower (812MW), geothermal (248MW), cogeneration (26MW), wind (5.85MW) and temporary power (120MW). According to the country's Least Cost Power Development Plan, the projected power demand is 15,000MW by 2030.

The country is highly dependent on biomass energy which provides 68% of the total energy supply. Fossil fuels and electricity provide 22% and 9% respectively while other sources provide 1% of the overall energy requirements. Access to electricity is currently about 30% of the population. The average growth in electricity consumption in the last 6 years is 5.4%. However, the country continues to experience significant constraints in the supply of electricity owing to challenges of hydro power generation, affected by the vagaries of weather.

The national energy policy (2004) and the Energy Act (2006) recognize the need to promote development and use of renewable energy resources. This is complemented by the Renewable Energy Feed-in-Tariffs (FiT) policy which was developed in 2008. A number of Regulations are in place, including the Energy (Energy Management) Regulations, 2012; the Energy (Solar Water Heating) Regulations, 2012; Solar PV Regulations*;* and Energy (Improved Biomass Cook-stoves) Regulations (in draft).

The government and development partners are currently implementing programmes to enhance the generation, transmission, distribution and supply of electricity. There are also programmes to increase the contribution of renewable energy to the national energy supply mix, improve energy efficiency and increase energy access. These are complemented by private sector and civil society initiatives. All these initiatives are relevant to the goals of Sustainable Energy for All (SE4ALL)

The gaps and barriers to investment in energy access, energy efficiency and renewable energy relate to perceived high political risks; inadequate commitment and weak implementation of policies; inadequate standards and, more importantly, lack of enforcement of the standards; insufficient capacity to collect process and disseminate energy; insufficient capacity to provide professional technical

services. There is also lack of up-to-date renewable energy data base to inform renewable energy policy, upon which potential investors would rely when making important decisions. Furthermore, there is a gap between availability and access to renewable energy technologies occasioned by high up-front payments, making them unaffordable, especially in rural areas; these limit the market and discourage investment.

Gaps to achievement of national goals with respect to financing, policies, institutions and capacities include unequal accessibility to all sectors of the population and the fact that existing skills do not match the requirements. The barriers comprise: lack of awareness on the benefits of accessing modern energy options; high cost of modern thermal technologies; inadequate capacity for enforcement, monitoring, review and promotion and enforcement of standards and codes; inadequate resource data on renewable energy; lack of access to renewable energy sites; etc.

Opportunities exist for scaling up stakeholder engagement and investment: there is significant market potential since 68% of the population uses traditional biomass; and for investment in the power sector, energy efficiency, and renewable energy. Specific opportunities exist in enhancing off-grid and mini-grid power supply; developing efficient distribution and storage infrastructure for LPG; providing credit facilities to consumers through MFIs; enforcing and implementing policies and regulations; switching from imported fossil fuel based power generation to local alternatives such as geothermal, wind and coal; facilitating local manufacture and assembly through financing and policy; collecting of data on RE resources and conducting feasibility studies and supporting research; creating a fund for RE investment; developing the capacity of relevant institutions and provide an enabling environment for the private sector; and enhancing funding of energy audits.

1.0 BACKGROUND

1.1 Sustainable Energy for All

Energy is crucial to sustainable development. In spite, of this, there has, over the years, been growing concern at the national, regional and international levels about the enormous and increasing number of people - estimated at 1.5 billion worldwide, without access to modern energy. The bulk of these still rely on traditional forms of energy mainly biomass. Affordability is still a major constraint while reliability of service is extremely poor and the quality of service and delivery is inadequate or non-existent. All these have implications to health, economic development, environmental sustainability, and poverty eradication among other issues. Most of those affected are to be found in rural areas of developing countries, including Kenya.

In the wake of growing concern, the United Nations Secretary General launched the Sustainable Energy for All (SE4ALL) initiative at the General Assembly in September 2011 aimed at catalysing action around three objectives to be achieved by 2030, namely (i) ensuring universal access to modern energy services, (ii) doubling the global rate of improvement in energy efficiency, and (iii) doubling the share of renewable energy in the global energy mix. In connection with this initiative, the year 2012 was declared the International Year of SE4ALL.

All stakeholders, composed of the public sector, the private sector and civil society organizations (CSOs), are urged to take concrete action toward the three objectives, which are necessary for long term sustainable development. Support for the new initiative is currently being mobilised. A Global Action Agenda led by the UNIDO Executive Director is in place to accelerate global momentum toward SE4ALL. The expectation is that the initiative will catalyse major new investments to speed the transformation of the world's energy systems, pursue the elimination of energy poverty, and enhance prosperity.

Achievement of the objectives of the SE4ALL Initiative will require a crucial shift from "business as usual". More action will be needed to address regulatory frameworks and infrastructure in the energy and other sectors, establish enabling conditions for private investment, and formulate policies that encourage sustainable energy technologies.

The Initiative embraces a set of guiding principles that steer its operations. These comprise full inclusion of all parties, collaboration to catalyse action at all levels, transparency by all stakeholders on commitments made, dissemination of lessons and best practices and acceptance of diversity of approaches.

1.2 Action Areas

1.2.1 Background

Action shall be taken at the global, regional, country and local levels. At each level leadership is needed from all stakeholder groups in order to realise a future with Sustainable Energy for All. Progress will depend on recognizing the interconnectedness of the stakeholders. Leadership in the public sector is critical, and national governments must design and implement a set of integrated country actions to drive transformative change of the world's energy systems. Equally important is leadership in the private sector, bearing in mind the role of businesses as solution and technology providers as well as primary drivers of investment.

Civil society continues to play a pivotal role through demonstration of working models for delivery of energy services, and in particular, ensuring that the poorest and most marginalised communities are included. It also highlights a wide range of issues that ensure that energy is sustainable from social, environmental, and economic perspectives with due regard to gender and participation. In addition,

Civil society organizations are able to focus on decentralized household, community, and enterprise systems as well as mini and micro grids, which private sector and government models may not find viable. Civil society also performs the vital function of identifying, advocating and monitoring public policy implementation and delivery, in addition to mobilising social innovation, building awareness and training of communities to promote uptake of new technologies and services.

1.2.2 Global Action Agenda

The three core objectives have been disaggregated into eleven action areas in order to make the vision of SE4ALL actionable. For each action area, high-impact opportunities for change have been identified. The action areas have been grouped into two categories, namely Sectoral and Enabling. There are seven Sectoral Action Areas namely: (a) modern cooking appliances and fuels; (b) distributed electricity solutions; (c) grid infrastructure and supply efficiency; (d) large scale renewable energy power; (e) industrial and agricultural processes; (f) transportation; and (g) building and appliances. Each of the seven Sectoral Action Areas supports one or more of the three main objectives.

The four Enabling Action Areas include cross-cutting mechanisms that support the Sectoral Action Areas at the country, regional and local levels. They include: (i) energy planning and policies; (ii) business model and technology innovation; (iii) finance and risk management and; (iv) capacity building as well as knowledge sharing.

Success in each Action Area will require the participation and collaboration of multiple stakeholders across all sectors of the economy: governments (developing, developed. regional and local), the private sector, donors and multilateral organizations and civil society organizations. Collaboration among these stakeholders will take many different forms and will cut across all sectors.

1.2.3 African Continental Level

There have been SE4ALL activities at the continental level in Africa. New Partnership for Africa's Development (NEPAD) and the United Nations Development Programme (UNDP) through the African Union (AU) have been coordinating the implementation of the initiative within the African region. Africa's response to SE4ALL was developed at a meeting in Nairobi (19^{th} – 21^{st} Sept 2012). Recommendations of this meeting were endorsed during the Conference of Ministers in Africa- Addis Ababa which was held on 16^{th} November, 2012. Guidelines for undertaking gap analyses and formulation of country action plans have been developed under the guidance of the AU, NEPAD and UNDP.

1.2.4 The Kenya SE4ALL Country Process

The country action process involves country opt-in; stock taking and gap analysis; national action plans and programmes; and implementation and monitoring. A guiding timeframe for the last three processes has been suggested (section 1.3). Kenya is a pilot country for the SE4ALL initiative in recognition of the country's record in and commitment to improving access to energy, and strategies in place for energy efficiency as well as development and use of renewable sources of energy. A High Level United Nations Mission to Kenya in March, 2012 concluded that there was a very strong base for launching an ambitious energy scale up programmes in the country.

The United Nations Resident Coordinator in Kenya established a task force to assist the country in spearheading the SE4ALL initiative, coordinate the main development partners and serve as a connecting link to different sectors of the society. Subsequently, a draft stocktaking and gap analysis report prepared and shared with Energy Sector stakeholders in June, 2012. The draft report was subsequently refined to give rise to this report.

Civil society organisations have been participating in the Kenya country process. Practical Action, a CSO, has been coordinating the inputs of civil society. In this regard, a workshop for representatives of CSO in the East African region was held and so was a national workshop for CSO representatives in

Kenya. The latter meeting came up with the Kenya Civil Society Declaration on SE4ALL, whose content was used in refining this report.

1.3 Implementation Roadmap

Since access to energy is critical in supporting societal progress, energy transformation must be coordinated with social, economic and environmental development. The implementation roadmap has three stages namely: stock-taking and gap analysis (2-3 months); national action plan and programmes (6-18 months); and implementation and monitoring (10-20 years).

Metrics of progress should cover both action areas and supporting activities. Indicators of progress could include accelerating country action, driving sectoral action and developing enabling action while supporting activities could include promoting accountability and transparency, based on regular monitoring of progress and mobilizing global public engagement.

1.4 Mobilizing Action

The success of the initiative depends on how well it can secure commitment to action and mobilise action from all stakeholders. The convening power of the Secretary General to mobilise action by stakeholders will be useful. Meanwhile, members of the High-Level Group led by the UNIDO Executive Director, and their partners are reaching out to their respective networks at global level to catalyse and accelerate collaborative action to bring scale to the process. Effective coordination at the global and national levels as well as of specific actions will be essential for scaled –up effort to achieve SE4ALL objectives. This is certainly within reach if all stakeholders come together and act to achieve broad based transformation of the world's energy over the next two decades.

Many actions have been taken in Kenya to increase access to energy, promote energy efficiency and support widespread development and use of renewable sources of energy (Appendix 1-7). The actions that have so far been taken are in line with the objectives of SE4ALL. This report provides an overview of the energy situation in Kenya with regard to SE4ALL and identifies critical gaps and barriers investment as well as to the achievement of national goals in such areas as financing, policies, institutions and capacities.

2.0 COUNTRY OVERVIEW

2.1 Country Situation

Kenya lies across the equator on the East of the African continent stretching from latitudes 4^o north to 4^o South and longitudes 34^o to 41^o east. With a population of approximately 40 million (2009 Population Census), the country covers an area of approximately 582,646 square kilometres. The rural population is estimated at 67.7% and the urban population at 32.3%. In 2010, Kenya's per capita GDP at market prices was estimated at Kenya Shillings 63,182 (USD 743) with the key economic sectors being agriculture, wholesale and retail trade and transport and communications. Together, their joint contribution accounts for about 52% of the country are GDP.

Household monthly income levels are classified into those whose income is up to KES 23,671 (low income level); those earning KES 23,671 to 120,000 (middle income level); and those earning above KES 120,000 (upper income level) per month (KNBS, 2011).

Kenya promulgated a new constitution in 2010. The new constitution, in recognition of the need for the citizenry to access services, under article 6 (3) and 46(1) (a)), compels national state organs to ensure reasonable access to services in all parts of the republic in so far as it is appropriate and having regard to the nature of the service. Access to adequate energy services is essential in both rural and urban areas to spur income-generating activities that alleviate poverty. Kenya therefore recognizes the need for her citizenry to access modern energy as a way of improving livelihood.

The Bill of Rights in the constitution also elevates the profile of human and fundamental rights, including the right to a clean and healthy environment under article 42. Furthermore, article 69 obligates the state to ensure sustainable exploitation, utilization, management and conservation of the environment and natural resources, and ensure the equitable sharing of accruing benefits. To comply with the requirements of these articles, technologies used in energy generation and utilization must, therefore, be sustainable and thus in line with increased development and use of renewable energy sources and improved energy efficiency.

The current development blue print in Kenya is the Vision 2030, which covers a period from 2008 to 2030. In this Vision, Kenya aspires to become a globally competitive middle-income country, providing a high quality life to its citizens by the year 2030. The Vision is based on three pillars - economic, social and political. Vision 2030 recognizes the fact that development projects recommended within it and the overall economic growth will lead to increased demand for energy. It therefore stipulates production of more energy accompanied with improved energy efficiency. The energy infrastructure and particularly electricity also need to be expanded and diversified in order to scale-up power supply to all parts of the country. A combination of energy sources – fossil fuels, renewable energy, nuclear energy and regional grid power interconnection - will be deployed to meet demand requirements.

An issue that demands attention in connection with broader national development objectives is gender equality. According to the Gender Audit Report of the Kenya Energy policy, 2007, the current lack of energy services creates barriers to overall socio-economic development, and adversely impacts on equitable access to basic energy services. Earlier on, the *1997 Welfare Monitoring Survey* reported that that female heads of households constituted a higher proportion of the poor both in the rural and urban areas. By 2004 the situation had deteriorated: the number of female-headed households in rural areas had grown to 31% out of which 80% were below the poverty line (Ministry of Gender, 2006). Their capacity to pay for energy supply continually is very limited. Energy policy should, therefore, take into consideration different socio-cultural and economic issues that exclude women from energy access benefits. In general, the prevalence of poverty among female-headed households is relatively higher than male headed ones. Moreover, women and children bear the brunt of lack of energy access through

heavy workloads and negative health impacts of continued biomass use. These facts must be taken into account when formulating national energy policies for achieving the required economic growth and ensuring effective poverty alleviation programmes.

2.2 Energy Situation

2.2.1 Energy Resources

In Kenya primary energy sources consist of fossil fuels (mainly petroleum, natural gas and coal) and renewable energy sources, which include biomass, wind, solar, hydro, and geothermal. As of June, 2011 petroleum accounted for 22% of the total primary energy consumed in the country, used mainly in the transport, commercial and industrial sectors. Electricity accounts for 9% while biomass accounts for 68%. Coal provides about 1% of the primary energy consumed in the country mainly for cement manufacturing (LCPDP, 2011).

2.2.2 Fossil Fuels

Petroleum is imported both in crude and refined forms and accounts for 25% of the national import bill (KNBS, 2011). Imported petroleum products include crude petroleum fuels, lubricating oils and greases. Crude oil is also refined locally at the Kenya Petroleum Refineries Limited (KPRL). Ongoing petroleum exploration indicates that there are commercially viable deposits in Turkana County. Deposits of natural gas have also been discovered off-shore, near Lamu. Currently small quantities of coal are imported for use in cement manufacture to complement heavy fuel oil process heat. The country has substantial coal deposits for commercial exploitation and the Government is fast tracking exploration and development of the resource for power generation and industrial use.

2.2.3 Renewable Energy Resources

The potential of renewable energy is vast and together the sources account for 68% of the country's overall energy mix currently. Renewable energy sources have the potential to enhance energy security, mitigate climate change, generate income, create employment and generate foreign exchange savings.

2.2.4 Biomass

Biomass fuels are by far the largest source of primary energy in Kenya with wood-fuel (firewood and charcoal and agricultural residue) accounting for 68%of the total primary energy consumption. About 55% of this is derived from farmlands of woody biomass as well as crop residue and animal waste while the remaining 45% is from forests (National Energy Policy, 2004). In spite of past efforts to promote woodfuel substitutes, the number of people relying on woodfuel has not been decreasing. Consequently, woodfuel will continue to be the primary source of energy for the majority of the rural population and urban poor. Woodfuel supply does not match demand in many parts of the country: the resources are being depleted faster than they are replenished. The woodfuel shortage is further compounded by widespread inefficient methods of production and use and lack of standards as well as unclear national targets for sustainable use.

2.2.5 Liquid bio-fuels

Liquid forms of bio-fuels are bio-ethanol and bio-diesel both of which are derived from biological sources. In Kenya, liquid bio-fuels are relatively unexploited. Ethanol is the most used bio-fuel, with the largest commercial production derived from sugar cane molasses, sugar beet and corn. Bio-ethanol is produced mainly for industrial and beverage use. In the 1980s bio-ethanol fuel was used for blending with gasoline but was stopped due to undeveloped market infrastructure and lack of a legal and regulatory framework. A strategy for re-introduction of bio-fuel blends in the market was developed by the government in 2010 but is yet to be fully implemented. Legislation for E-10 blending was gazetted in 2010 and facilities for E-10 blending were completed in Kisumu in 2011, but are not yet operational due to inadequate supply of ethanol from private distilleries. A bio-ethanol plant has been set up at Mumias Sugar Company to supplement existing distilleries at the Muhoroni Agrochemical & Food Company (ACFC) and Spectre International. CSOs, with support from government and development partners are facilitating the promotion of bio-ethanol as an alternative household cooking fuel through

generation of data on policy gaps, feasible funding options, private sector engagement in the production and marketing ethanol and stoves and mobilizing community uptake.

Bio-diesel is a processed fuel derived from biological sources that can be used in diesel-vehicles as well as improving household energy access through cooking and lighting. It is made from oils or fats, which are hydrocarbons. Fresh soybean oil is most commonly used, although bio-diesel can be made from mustard seed oil or waste vegetable oil. Other locally available feedstock options include *Jatropha curcas*, Castor, *Croton megalocarpus,* and sunflower. *Jatropha* is becoming the most widely used feedstock for the production of bio-diesel. There is no commercial extraction of biodiesel for blending but there are small-scale community projects being implemented by private sector, with varying degrees of success.

2.2.6 Biogas

The country has a huge potential for biogas production and use. The government has been promoting domestic biogas use since 1980s. Several biogas projects are being undertaken by the government, development partners and the private sector. There are good opportunities for electricity generation potential through large-scale biogas plants utilising waste from slaughterhouses, agro-processing or municipal waste. A number of pilot and small commercial biogas facilities for heat and electricity generation have been identified for utilizing a mixture of sisal waste and cattle dung. Banana leaves have also been used to generate biogas. An example of a large biogas facility using industrial organic waste is the Agro-Chemical and Food Company's bulk volume fermenter (BVF) at Muhoroni, generating 23,000 m^3 of gas per day from the distillery effluent. This biogas has been used to substitute fuel oil in running two medium-size boilers.

There is significant potential for generating biogas from cut flowers 80% of which are waste products (REM, 2009). The highest potential for energy generation from cut flower waste is in Nakuru County. In 2011 the Ministry of Energy initiated pilot projects for electricity generation from cut flower wastes in Kiambu (55kW) and Kajiado (120kW) counties with a view to scaling up the generation of electricity from other biogas sources. It is estimated that the potential electricity generation capacity from floriculture industry could be 20 megawatt (MW) and that from sisal industry could be 10 MW (REM, 2009).

The government with support from the Netherlands government is implementing a project named "Biogas for Better Life" which offers business opportunities as well as improved livelihood. The project aims at providing 2 million households in Africa with biogas digesters by 2020 out of which 8,000 digesters are targeted in Kenya by 2014. Implementation is through the Kenya National Domestic Biogas Programme (KENDBIP) which has facilitated the construction of 6,500 units within 2 years. Several domestic and institutional biogas activities are being undertaken by Ministry of Energy (MoE) and the Rural Electrification Authority (REA). The private sector is also implementing a number of similar initiatives all over the country. From a civil society perspective, there is need for greater awareness and promotion of biogas to overcome the social cultural barriers around the use of waste to generate energy for community services such as education and health.

A number of pilot and small commercial biogas facilities for heating and electricity generation have been developed. These include the 30 kW Dagoretti biogas plant in Nairobi supported by the United Nations Industrial Development Organisation (UNIDO) and the Kilifi Sisal Plantation/Dairy 150 kW plant.

2.2.7 Solar Energy

As a result of Kenya's favourable location on the Equator, it receives a daily insolation of 4-6kWh/m^2 which is a huge potential. The national energy policy recognizes the need to promote the development and use of solar energy as an alternative source. This policy is being implemented by carrying out demonstration projects and promoting the introduction of solar PV systems in public institutions such as schools, health and administration centres and for community water pumping, in off-grid areas. In

addition, the government is introducing solar energy systems to create hybrid off-grid power plants in the remote areas far from the national power grid.

The private sector has played a major role in promoting installation and use of Photo Voltaic (PV) systems in households and institutions around the country. A large number of households have solar PV systems installed mainly for lighting and powering electronic devices. A private investor (UBBINK) recently established a facility assembling solar PV panels in Naivasha. It is projected that by 2020 the installed capacity of solar PV systems will reach 10MWe, generating 22GWh annually (Draft Energy Policy, 2013).

Solar thermal is mainly used for drying and water heating. Solar dryers are widely used in the agriculture sector for drying of cereals and other farm produce. Utilization of solar water heaters (SWH) is mainly in households and institutions such as hotels, schools and hospitals. The demand for solar water heating is projected to grow and solar water heater units installed are projected to reach more than 800,000 by 2020 (Draft Energy Policy, 2013). The uptake level of solar water heating systems in Kenya is quite low despite the enormous potential provided by the abundant availability of the solar energy resource and the demand for low temperature water for both domestic and commercial applications. This is mainly due to lack of awareness of the long term benefits of installing such systems as well as the associated high initial cost. Installation of solar water heating systems to replace or supplement geysers would transform the current demand side management efforts by effectively using renewable energy for load management. In 2012, the Government developed Solar Water Heating regulations that make it mandatory for electricity consumers using more than 100 litres of hot water daily to install solar water heaters to supplement electric geysers. The private sector and civil society have introduced solar cooking to rural groups in various parts of the country albeit with limited success due to lack of adequate awareness, limited financing and insufficient research among others. This is a good initiative that requires promotion and awareness creation.

2.2.8 Wind energy

Kenya has a vast wind energy potential - as high as 346W/m^2 and speeds of over 6 m/s in many parts of the country, such as Marsabit, Kajiado, Laikipia, Meru, Nyandarua, Kilifi, Lamu, Samburu, Uasin Gishu, Narok and Kiambu (Wind Atlas, 2008). The installed wind energy capacity to the grid was 5.45MW as at June, 2012 and a further 20.4MW is expected to be commissioned in 2014. The private sector is also actively involved in wind power development mainly under the Feed-in-Tariffs policy. A 300MW wind power project is expected to be commissioned in 2017 by Lake Turkana Wind Power. Other committed projects include 60MW at Kinangop and 100MW in Ngong. Hybrid wind-solar and wind- diesel systems are at various stages of installation in Wajir (Habaswein, Eldas) Mandera (Rhamu, Takaba), Marsabit (Laisamis, Sololo, and North Horr) Lamu (Kiunga, Faza,) Turkana (Lokichoggio, Lokori) and Garissa (Dadaab). Using wind energy to substitute thermal generation will also lead to less CO_2 emission thus contributing to reduction of global warming. In order to expedite development of wind sites, the government is mapping out the potential and has so far installed 95 wind data loggers across the country. Wind energy provides an excellent opportunity for delivery of decentralized energy services such as electricity and water to rural communities.

2.2.9 Hydropower

Kenya's drainage system consists of five major basins: Lake Victoria, Athi River, Tana River and Ewaso Ng'iro North River basins. These basins contain the bulk of the country's hydro resources for power generation. The potential for hydro is of the order of 6,000MW; out of which, the current installed capacity is 812 MW (Kenya Power). The potential for small-scale hydro (with capacities of less than 10 MW each) is estimated at 3,000 MW nationwide; however, grid connected small-scale hydropower contributes only about 15.3 MW (MoE). There are several other small hydro schemes owned by the private sector, especially in the tea estates and community organisations that are not connected to the grid. Civil society organizations have also been engaged in promoting community managed Pico and Micro-hydro systems. More than 260 small hydropower sites have been identified (MoE). The largest number of sites is found in the Tana River drainage basin, mainly in the counties of

Kirinyaga, Murang'a, Meru and Tharaka Nithi. Currently the Ministry of Energy is undertaking resource assessment to develop a small hydro power atlas.

2.2.10 Geothermal

The country's geothermal potential is estimated to be 10,000MWe, spread over 14 sites in the Rift Valley (MoE). Geothermal power has numerous advantages: it is suitable for base load generation, is indigenous and is not affected by drought and climatic vulnerability. The current installed capacity of the geothermal energy is 248MW. The Government set up the Geothermal Development Company (GDC) in 2008 to undertake integrated development of geothermal resources through initial exploration, drilling, resource assessment and promotion of direct utilization. GDC has put in place a framework to drill about 1,130 wells to provide steam for the planned 5,530 MW of projected capacity by 2030. The Government continues to encourage the private sector to invest in geothermal energy so as to achieve the projected demand by the year 2030.

2.2.11 Municipal waste

As Kenyan cities grow in number and size, the potential of harnessing municipal waste as a major source of energy multiplies. The estimated solid waste generation in Nairobi city in 2010 was 1,924 tonnes per day (Integrated Solid Waste Management study, JICA, 2010). Most of the municipal waste in Kenyan cities and municipalities is disposed of in poorly managed dump sites. With appropriate waste-to-energy conversion technologies, municipal waste can be used to provide energy while helping to clean the environment. A feasibility study conducted by the Kenya Electricity Generation Company (KenGen) established that there is potential to generate 30MW using municipal waste from the Dandora (Nairobi) dumpsite. Plans are underway to conduct similar feasibility studies in other municipalities.

2.2.12 Biomass co-generation

Bagasse, a by-product of sugar processing, has a large potential for producing both process heat and electricity. Cogeneration using bagasse as a primary fuel is practiced in the domestic sugar industry in Kenya. It is estimated that the potential for electricity generation from bagasse is over 200MW. The industry has at least six sugar companies which produce an average 1.8 million tonnes of bagasse with fibre contents of about 18% by weight annually. This translates to a potential to produce 830GWh/year. Mumias sugar factory currently generates 38MW and exports 26MW of this capacity to the national grid. Kwale Sugar Company in the Coast region is constructing a cogeneration plant capable of exporting 18MW to the national grid. Other sugar companies are expected to diversify into the use of sugar processing by-product value addition through co-generation and bio-ethanol production.

2.3 Energy Supply and Demand

2.3.1 Electricity

The country has one large interconnected power grid and 14 mini-grids with a total installed capacity of 19.4MW comprising 0.51MW solar, 0.55MW wind and 18.3 MW of diesel generators. The government has embarked on a programme to increase the number of off-grid stations in the remote areas of the country, and introduction of solar and wind hybrid system in the existing and new mini-grids. So far 7 stations have renewable energy incorporated. The government in partnership with the Climate Investment Fund Scaling-Up Renewable Energy Programme (SREP) and development partners are in the process of scaling up this initiative with the aim to construct over 60 mini grids across the country.

Electricity as a secondary form of energy is versatile in application. Access to electricity is associated with rising or high quality of life. As of 2011 electricity provided 9% of overall energy requirements in Kenya, while fossil fuels and renewable energy provided 69%, respectively. In the financial year (FY) ended 30th June, 2012, 68.7% of the electrical energy was generated using renewable sources while

34% was generated using fossil fuels as detailed in Table 2.1. The country continues to experience significant constraints in the supply of electricity owing to rising demand, and in some years shortages arise from hydro power generation occasioned by the vagaries of weather. The supply of electricity increased to 7,670 Gigawatt hours (GWh) in 2011/12 from 7,303 in 2010/11. This represented a 5% increase compared to a 9% the previous year. The peak demand recorded in 2011/2012 was 1,236MW compared to 1,194MW the previous year.

Table 2.1 - Electric Power Generation Sources and Energy Generated in FY 2012/13

Sources of Electric Power Generation		**Installed capacity**		**Annual capacity**	
		MW)	**Percentage**	**(GWh)**	**Percentage**
Renewable Energy	Hydro	812.3	46.3	3,450	45.0
	Geothermal	248	14.1	1,498	19.5
	Wind	5.8	0.33	14.7	0.2
	Solar	0.51	0.03	0.3	0.004
	Cogeneration	26	1.5	100	1.3
	Imports	0	0	37	0.5
	Total	**1,092.10**	**62.3**	**5,100**	**66.5**
Fossil Fuels	Medium speed diesel (MSD)	463	26.4	2,108	27.5
	Gas Turbines	60	3.4	33	0.4
	Off-grid high speed diesel (HSD)	18.1	1.0	47.8	0.6
	Emergency Power Plants	120	6.8	381	5.0
	Total	**661.3**	**37.7**	**2,570**	**33.5**
Installed Capacity and Units Generated		**1,753.4 MW**		**7,670GWh**	

The Kenyan transmission network is interconnected with Uganda's system through a 132 kV double circuit transmission line. The arrangement allows for electrical energy exchange between the two systems. Kenya also has cross-border agreements with Tanzania which enable electricity supply to border towns from the nearest power grid. Quantities of imports and exports of electrical energy between Kenya and Uganda as well as between Kenya and Tanzania are detailed in Table 2.2.

Table 2.2- Imports and Exports of Electrical Energy

Year ended 30th June	**Kenya – Uganda (kWh)**		**Kenya – Tanzania (kWh)**	
	Imports	**Exports**	**Imports**	**Exports**
2005	105,627,168	19,894,364	267,733	n/a
2006	14,600,888	23,936,088	443,157	n/a
2007	12,684,112	73,479,000	434,946	n/a
2008	24,665,248	46,359,936	1,036,864	n/a
2009	28,570,508	26,557,446	1,220,868	n/a
2010	37,135,529	26,291,418	1,101,026	526,740
2011	29,946,605	30,265,350	860,527	838,800

The electricity supply industry in Kenya has been undergoing reforms and restructuring since the mid-90s in order to create appropriate legal, regulatory and institutional framework; ensure provision of affordable reliable, efficient and sustainable electric power supplies; increase the population's access to electricity as a means of stimulating economic growth; improve efficiency of power distribution and supply through reductions in technical losses and collection of revenues; and create a more competitive market structure with clear definition of roles for public and private sector players in generation, transmission, distribution and retail functions.

The demand for electricity has shown an upward trend since the year 2004 as a result of accelerated economic growth; peak demand increased from 899MW in 2004/05 to 1,231MW in 2011/12, while the number of electricity consumers more than doubled from 735,144 in 2004/05 to 2,038,625 in June 2012 as detailed in Table 2.3. The peak load is projected to grow to 2,511MW by 2015 and 15,026MW by 2030. To meet this demand, the projected installed generation capacity should increase gradually to 19,199MW by 2030. To meet the projected demand, the system expansion over the Vision 2030 period indicates that the total installed capacity will be obtained from geothermal – 26%, nuclear plants – 19%, coal plants – 13%, hydro plants – 5%, thermal plants (LCPDP 2013).

Table 2.3: Demand for electricity

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12
Energy Generated (GWh)	5,347	5,697	6,169	6,385	6,489	6,692	7,303	7,670
Energy Sold (GWh)	4,379	4,580	5,065	5,322	5,432	5,624	6,123	6,341
Peak Demand (MW)	899	920	987	1,044	1,072	1,107	1,194	1,236
Number of Consumers	735,144	802,249	924,329	1,060,383	1,267,198	1,463,639	1,753,348	2,038,625

Source: *Kenya Power and Lighting Company (KPLC) Annual Report and Financial Statements, 2012*

2.3.2 Coal

The use of coal in Kenya is mainly in process heat generation and cement manufacture. Coal, is mainly used by cement manufacturers to complement heavy fuel oil for process heat. In 2011, all coal used in Kenya was imported. Between 2006 and 2011 consumption of coal averaged 130,000 metric tonnes per annum; this constitutes less than 1% of the total primary energy consumed in the country. While the current consumption of coal accounts for less than one per cent of primary energy use in the country, this is expected to rise substantially, especially for electricity generation. Coal imports for the years 2004 to 2009 are given in Table 2.4.

Table 2.4: Coal imports 2004 to2009

Year	2004	2005	2006	2007	2008	2009
KES	1,083,769	731,607	820,773	934,578	1,491,007	1,356,343
Tonnes	155,000	128,000	171,000	156,000	159,000	138,000

Source: Statistical Abstract, 2010, Kenya National Bureau of Statistics

The country has commercially viable coal reserves in the Mui Basin in Kitui County. The Government has concessioned the blocks for coal resource development with the objective of generating 600MW from a coal fired plant to be put up in Kitui County, and thus local mining is expected to increase. In 2010, four hundred million tonnes of coal reserves were confirmed in one block. The coal has been analyzed and found to range in ranking from lignite to sub-bituminous, with calorific values ranging between 16 and 27 MJ/kg. Further exploration work is on-going in the three other blocks.

2.3.3 Petroleum

Kenya imports petroleum in form of crude oil, for domestic processing, as well as refined products. During the period 2009 – 2010 petroleum imports averaged 3.95million tones. The total quantity of petroleum products imported into the country grew by 14.1% from 3,844,600 tonnes in 2010 to 4,388,000 tonnes in 2011. The domestic petroleum products increased for the first time in four years to 125.2 thousand tonnes in 2011 from 95.1 thousand tonnes in 2010, following three years of running declines. During the same period, the total value of petroleum products exported, including re-exports, increased by 48.6% while the total import bill of petroleum products increased by 72.3% to KES 345,847.4 million. Total domestic demand for petroleum products rose by 1.9% in the same period.

Petroleum products are mainly consumed in the transport, manufacturing, commercial, residential and agricultural sectors, and for power generation. The average consumption of petroleum products in Kenya has been increasing over the years. In 2004, actual consumption was 2.9 million toe, rising to successively to 3.1 million tons of oil equivalent (ToE) in 2007, to 3.6 million toe in 2009, 3.77 million toe in 2010 and then to 3.9 million toe in 2011. The transport sector is the largest consumer of petroleum products (70%) followed by manufacturing (25%) and commercial sectors, respectively, and others (agriculture, tourism, power generation, and government). Retail pump outlets and road transport consumed 2 387 thousand tonnes in 2010, against aviation (625 thousand tonnes), industrial, commercial and others (429 thousand tonnes) and agriculture (34.5 thousand tonnes).

Kenya had no known commercial reserves of petroleum until January 2012 when Tullow Oil, spudded Ngamia I Well located at Lokichar within Turkana County. By July 2012, Tullow, an oil exploration and production company (OIEP), had discovered additional crude oil with a total pay zone of 143 metres between depths of 850 metres and 2340 metres. According to Tullow, the API gravity of the oil was estimated at between 300 and 350, indicating high quality oil. Further petroleum exploration is being undertaken both on-shore and off-shore in the country's four major Sedimentary Basins. Demand for petroleum products is projected to rise by 3.1% on average per annum for the years 2009 to 2030.

A large percentage of LPG is used mainly for cooking, of which 90% is in urban areas. Seventy percent of the LPG is imported and the rest is produced by the refinery in Mombasa. There is one import facility for LPG at Shimanzi with a total storage of about 200 metric tones. The East African Region is supplied through imports via the port of Mombasa and production from the refinery. Depots and filling plants across the region are mainly owned by larger Oil Marketing Companies (OMCs) who have integrated market presence. Current import and storage facilities cannot cater for the existing market demand and potential. Distribution is by road and rail though rail network systems are run down. Construction of an import & storage facility of 14,000 M.T. in Mombasa through public private partnership was completed in 2012. This import/storage facility is expected to boost availability and reduce cost as a result of no/low demurrage. Discovery of crude oil in the country is an added incentive to gas production at the refinery.

The demand for LPG in 2010 was 87.8 thousand tonnes compared to the demand of 64.6 thousands in 2006. Demand for LPG is expected to grow as a result of low cost of LPG especially when the import handling and storage facility is on board. This is also expected as a result of growth in GDP and which was estimated to grow at 4% in 2012. Table 2.5 shows the trends in LPG consumption between 2007 and 2011. It is estimated that demand for LPG will rise to 300 thousand tones in 2015 (MoE).

Standardization of domestic cylinders and valves as guided by the legal notice on LPG is likely to lead to an increase in users of LPG. Other factors likely to lead to an increase in the use of LPG in households include the fact that LPG as a product and LPG appliances are not taxed. The National Oil Company of Kenya also plans to implement the LPG Vehicle Project by to enhance consumption.

Table 2.5: LPG Consumption 2007-2011 (MoE)

Year	2007	2008	2009	2010	2011
Demand (000 Tones)	77.4	84.4	74.6	87.8	91.6

The major challenges in developing the LPG industry include: constrained import and insufficient inland infrastructure; unreliable supply; logistical challenges; escalating international prices which lead high costs of product and accessories; malpractices; ineffective enforcement and compliance and inadequate consumer education/sensitization.

Consumption of kerosene in households for lighting and cooking was about 316 thousand tonnes in 2010 as compared to about 200 thousand tonnes in 2003. In 1993, it was estimated that about 64% of urban households used kerosene for cooking.

2.3.4 Woodfuel

Wood fuel remains the highest supplier of household energy consumption in rural and urban Kenya. In addition, institutions and cottage industries, including tea factories rely heavily on wood for their energy needs. A study by the Kenya National Bureau of Statistics indicated that 68.3% of the country's 6.9 million households use firewood while 13.3% use charcoal (KIHBS, 2007). A Ministry of Energy Survey conducted in 2007, established that there were approximately 50,000 institutions including prisons, learning institutions hospitals, hotels and restaurants in Kenya each consuming about 270 tonnes of wood fuel per year. Moreover majority of the small and medium enterprises such as hotels, food vendors and small scale processing facilities use biomass as the primary source of energy.

2.4 Energy and economic development

Energy plays an important role in socio-economic development and environmental protection of a country. It stimulates agriculture, industry, commerce, transportation and other economic as well as social activities. It also satisfies basic human needs for food, jobs, clean running water, health services, housing, education and communication. Consequently, people need to have sufficient access to a full range of energy supplies and services to support human social and economic development, including energy for lighting, cooking, water and space heating, cooling, and information and communication. They also need energy for community services, including health care, education, public institutions, household fuels, mechanical power and electricity are important energy supplies. In addition, energy has continued to play a significant role as contributor to fiscal revenues through taxes, levies and duties imposed on various petroleum products, electrical energy and materials sourced by service providers for operations, maintenance and infrastructure expansion. In 2010, the contribution of the energy sector to the overall tax revenue was about 20%, equivalent to 4% of the national GDP.

The principal taxation policy pursued by the Government of Kenya (GoK) in the energy sector is based on the need to create a sustainable balance between fiscal revenue generation and ensuring accessibility of energy by the low income segments of the population at reasonable prices. GoK also uses taxation as a prudent policy instrument to discourage wasteful consumption of energy, and by extension, to encourage its efficient utilization in a cost effective manner.

Crude petroleum imports account for about 25% of the national import bill. Kenya Petroleum Refineries Limited (KPRL) operates the country's sole oil refinery at Mombasa, which meets about 30% of local demand for petroleum products. Most of the KPRL production is transported via the pipeline system.

The cost of energy has significant impact on economic activities particularly those that are energy intensive such as cement, steel, pulp and paper production. In a liberalized market such as Kenya's, energy prices are a significant determinant of competitiveness of locally manufactured goods relative to imports. In this regard, high energy prices impact negatively on domestic wealth creation, balance of payments and employment creation since consumers opt for cheaper imports.

2.5: Energy and Gender

Across the wide range of different energy technologies, women and men face disproportionate opportunities and impacts in terms of energy access. Yet the policy measures spelt out in Kenya's energy policy, Sessional paper No.4 of 2004 on energy, are gender-neutral with no specific mention of what will be done to eliminate gender disparities with respect to each policy measure. The policy does not indicate who the needy and vulnerable members of the society are and what specific measures will be undertaken to ensure that the benefits trickle down to these groups, and the type of benefits they should expect from these policy measures. Not specifically recognized is the fact that investment policy decisions determine: who benefits from which type of energy option; that poor women and men are unlikely to benefit from the large-scale commercial energy expansion programmes, especially if they do not support connections to households where the participation of women is important; and that many women and girls suffer from health problems related to gathering and using traditional fuels.

Energy pricing determines the level of access and use of clean energy. In Kenya, income disparities exist between men and women; this demands attention in policy formulation, as is the fact that some government tariffs and unregulated pricing will affect access to energy services and products. Gender inequalities exist in various aspects of community participation in energy delivery; moreover women's specific contribution in energy decision-making is not explicitly recognized. The policy does not state how the different gender groups can benefit from the positive aspects and how they are likely to be affected by the negative aspects.

2.6: National energy strategies and relevant targets

A number of strategies have been put in place in the country as part of ongoing efforts to improve access, increase capacity, improve generation, strengthen transmission and distribution systems and improve energy security. Some of these are highlighted below and targets given where available.

The Government plans to review and update biomass energy development plans, update biomass energy databases and expand improved stoves and charcoal kiln programmes, to eliminate the fuel-wood deficit. The rate of adoption of efficient charcoal stoves will be increased from 47% currently to 80% by 2010 and to 100% by 2020 in urban areas. Corresponding targets for rural areas are 40% by 2010 and 60% by 2020, respectively. Similarly, plans are afoot to increase the rate of adoption of efficient fuel-wood stoves from 4% currently to 30% by 2020. The government targets to make Kenya kerosene free by 2020 by availing alternative modern energy services.

The target electrification rates for rural households adopted in the Rural Electrification Master (REM) Plan time frame 2008-2018 reflect Government's strategy of achieving connectivity of 40% by 2020. As at June 2012, the government through KPLC and REA had provided electricity supply to 13,757 (65%) out of the existing 21,122 public facilities in the country identified in the 2009 Rural Electrification Master Plan. The short term (2012-2016) objective is to provide electricity to all public facilities including trading centres, schools, polytechnics, health centres, community water works and administrative offices. Households living around these facilities are expected to benefit by being within

reach of the grid. The number of customers connected under the Rural Electrification Programme (REP) rose significantly by 23.2% to stand at 382,631 as at June 2012, from 309,287 in June 2011.

Kenya's power industry generation and transmission system planning is undertaken on the basis of a 20 year rolling Least Cost Power Development Plan, updated every year. According to the 2011-2031 Plan, the forecast power demand would rise from 1,205MW and 7,391GWh in 2009, to 15,065MW and 92,380GWh in 2030. To meet this demand, installed generation capacity is projected to increase from 1,645MW in 2012 to about 19,000MW by 2030.

The strategy is to diversify the base-load from hydro to other sources of energy. The expected power supply from various sources will by 2030 be composed of: geothermal 5,110 MW, hydro 1,039 MW, nuclear 3,000MW, imports 2,000MW, diesel 1,635MW, natural gas 1,980 MW, coal 2,420MW, wind, 2,036 MW. The system expansion plan over the 20 year plan period indicates that 26% of the total installed capacity will be obtained from geothermal, 19% from nuclear plants, 13% from coal plants and 9% from imports. Wind and hydro plants will provide 9% and 5% respectively while Medium Speed Diesel (MSD) and Gas Turbines (GTs) – Liquefied Natural Gas (LNG) plants will provide 9% and 11% of the total capacity respectively.

The Government also plans to expand and upgrade transmission and distribution networks to enhance quality and reliability of the power supply. Priority projects for expansion of transmission constitute a total of about 1,400 km of 132kV lines, 900km of 220kV lines, 1250 km of 400kV lines and 700 km of 500kV High Voltage Direct Current (HVDC) lines. In order to meet anticipated electricity demand in the period 2015-2030, it is intended to improve reliability of transmission and distribution systems; this will involve transmission lines at 132 kV and 66 kV and the discontinuation of 33 kV lines. Distribution to urban and rural areas will largely continue at 11 kV and 33 kV, respectively. By the year 2020, capacities of primary and distribution substations are estimated to be 11,888 Megavolt Amperes (MVA) and 190,204 MVA, respectively, while high voltage (HV) lines and medium voltage (MV) lines are estimated at 7,925 km and 118,875 km, respectively. Corresponding estimates for 2030 distribution substation and transformer capacity are 37,565 MVA and 60,104 MVA, respectively. Those for HV lines and MV lines will be 25,043 km and 187,825 km, respectively.

Plans are also underway to reduce total electricity losses in the grid from 17.3% in 2012 to 13.5% by 2020. Related to this is the scheme to achieve 100% energy efficient lighting systems by 2020 and to switch to 100% energy efficient transformers by 2030.

Accelerated development and more widespread application of indigenous energy resources, especially renewable ones, is a key strategy of the Government. As it were, this approach is in line with the important strategy for ensuring optimum electricity generation mix through larger contribution by renewable energy sources; this includes plans to promote increased production of electricity from co-generation by the sugar industry to 300MW by 2030, from current installed capacity of 26MW supplied to the grid. Installed geothermal capacity stands at 248 MW, which is quite small, given that the overall potential of the resource is of the order of 10,000 MW. It is envisaged that installed wind capacity will be of the order of 2,000MW by 2030, while small-scale hydroelectric capacity will be about 225MW.

The government has established the Kenya Nuclear Electricity Board (KNEB) to spearhead introduction of nuclear energy in the country with a target to commission the first plant in 2022. KNEB is currently carrying out a pre-feasibility study, strategic plan and capacity building through local and international scholarships.

The Government intends to implement the Hybrid Mini-grid Project to increase the proportion of renewable energy (solar and wind) in existing and planned mini-grids to 30%. Hybrid mini-grids will replace the current operational model of expensive diesel-based mini-grid electricity supply, which is not environmentally friendly. Currently there are seven hybrid systems installed by the Kenya Power

and Lighting, producing 510kW from solar and 550kW from wind. Additional hybrid powered mini-grids in the remote areas are to be developed by the government in partnership with development partners and private sector. The Government is currently providing solar electric power systems in public institutions in arid and semi-arid (ASAL) areas. By December, 2012, 769 solar PV systems had been provided to public institutions including schools, health centres, administration offices and dispensaries. Appendix 2 presents additional details of national energy strategies relevant to achieving SE4ALL initiatives as envisaged in the review of the energy policy.

3.0 CURRENT SITUATION WITH REGARD TO SE4ALL GOALS

3.1 ENERGY ACCESS

3.1.1 Overview and Assessment

Definitions for energy access vary considerably, ranging from "ready availability of the services for use in the various sectors of economy, including in rural and among the rural poor" to "a household having reliable and affordable access to clean cooking facilities, water heating, space heating, space cooling, to a first connection to electricity (defined as a minimum level of electricity consumption) and then an increasing level of electricity consumption over time". What is important, however, is that the services should be of high quality, reliable and affordable. Of equal importance is the provision of access to modern energy for productive uses (such as irrigation, SMEs and community services (health, education, water pumping, street lighting and local government offices, information and communication facilities) which in turn support economic development.

The country has put in place strategies to accelerate access to modern energy services through public and private initiatives. The government is, however, facing a number of challenges in ensuring energy access for all. Some of these challenges include inadequate financial resources and long project lead time, lack of human capacity and sparse settlement patterns in the rural areas. The government, with support of development partners, has also allocated resources for the development of energy infrastructure. This effort provides opportunities for collaboration with private sector in enhancing energy access. Greater engagement of the civil society is also required. The government is also reviewing the energy policy of 2004 which was enacted in 2006, with a view to aligning it with Vision 2030 and the new constitution.

3.1.2 Modern energy for thermal application

Modern energy inputs for thermal application include electricity, LNG, LPG, kerosene, biogas and solar thermal. Majority of households have no access to modern thermal energy services and rely on traditional biomass. In 2006 only 0.6% and 3.5% of households were using electricity and gas respectively for cooking. Corresponding percentages in urban areas were 1.8% and 11.9%, respectively. By comparison, in the rural areas, only 0.2% of the households used electricity while 0.7% used gas (KIPPRA, 2010).

3.1.3 Availability and quality of energy for domestic use

Since its emergence in the 1980s and the successful introduction of the Kenyan Ceramic Jiko (KCJ), the Kenyan stove market has long been viewed as a pioneer in the East Africa region. For about 25 years, the local 'jua kali' artisanal base has grown, with some players expanding to producing thousands of stoves each month. Currently donor supported programmes, NGOs and social entrepreneurs have entered and influenced the market by building local capacity and exploiting the carbon finance opportunity.

The availability of improved cook-stoves is much higher in Kenya than the rest of East Africa. The sale and use of improved charcoal cook-stoves is high, primarily in urban and peri-urban areas and growing as urbanisation gathers pace. However, the cook-stove value chain is highly fragmented. Production of components is often done separately and many middlemen transport and retail the stoves countrywide. Carbon finance plays an important role in reducing the cost of quality stoves to the customer and is likely to continue as the main source of subsidy. Improved cook-stoves, both for domestic and institutional use are being promoted in an effort to shift from traditional to modern biomass energy technologies.

Access to modern fuels, such as kerosene and LPG, is relatively high in urban areas. Kerosene is ranked the third predominant cooking fuel, but is the most common type of fuel for cooking among 44.6% of urban dwellers. LPG is the mainly used for cooking and heating by high income earning

households mainly in urban areas. The use of LPG remains below 5% of the population. Initiatives aimed at accelerating the switch of users to cleaner technologies such as LPG by reducing upfront costs and purchasing quantity are been tested in the market.

The bulk of Kenya's population (67.7%) lives in rural areas while 32.3% live in urban areas. There are approximately 8 million households in Kenya with a total population of about 40 million. Household electricity access is about 30% of the population. Electricity is the second most common source of lighting. About 50% and 6% of urban and rural households, respectively, are connected to electricity. The total electricity sale in 2010/11 was 5,785GWh. The electrical energy consumed by customer category is as follows: commercial and industrial 9%, domestic 25%, and small commercial 16% (KIPPRA, 2010).

Kenya's geographical position is well suited for the development and use of solar energy, both photo voltaic (PV) and thermal. The use of PV systems has been established, albeit on a small scale; significant progress has been made and the potential for more widespread application is high, especially as the price of the units drops.

Solar water heating systems are readily available in the market and there is a growing number of trained technicians for installation and maintenance. The use of the systems is, however, limited to urban areas. Opportunities exist for more widespread development and application of solar energy for the drying of crops, fruits and other agricultural produce.

Biogas is a mature technology in the country and is commonly used in areas where zero grazing is practiced. The biogas appliances are locally manufactured by trained technicians. The government offers technical support through energy centres.

The challenges that limit the use of modern thermal energy include high prices of the energy and appliances, inadequate availability of modern energy and supply infrastructure countrywide, and high capital cost setting up modern energy technologies. There are also issues related to reliability, adequacy and quality of energy services to meet the needs of different users.

3.1.4 Affordability and pricing of energy

As a result of population increase, the demand for biomass fuel has been increasing and is already outstripping the supply. The cost of improved cook-stoves for household use ranges between US $ 5-10 and is generally affordable. The cost of firewood is about USD 1.25 per bundle (10kg), enough for a day's cooking. However, the price of the charcoal at USD 0.5 per kilogram is too high for most households (GACC Sector Mapping, GVEP, 2012).

The cost of kerosene has been increasing over time from about KES 65[1] per litre in 2009 to KES 90 per litre in 2012. The rising cost of kerosene has led to reduction in the quantity of fuel purchased on daily basis. The price of LPG in the market has been fluctuating, influenced by the prices on the world market and the exchange rates. The highest price (KES 4,000) per 13 kg cylinder was recorded in December 2011.The current price for a similar size is about KES 2,700. A complete set of LPG system (13 kg gas cylinder with a one burner cooker) costs about KES 12, 000. This amount of gas lasts about one month for a family of five members (PIEA, 2012).

The minimum connection fee for electricity, under the Rural Electrification Programme, is KES. 35,000. This is considered high by many households, particularly in rural areas. However, this connection fee is on average subsidized by 50%. Most households with electrical power use it for lighting and powering domestic appliances. The percentage of the household using electricity for cooking was 0.6% in 2009.

[1] USD 1 = KES 87 (May 2013)

The number of domestic households connected to the grid was 1,776,973 in 2011/12. The average annual domestic electricity consumption per household is 855kWh. Subsidies are applied to the first 50 units consumed for all domestic electricity customers. The retail electricity tariff structure is shown in Table 3.1. Many people are switching from conventional electrical water heating to instant water heating as a way of keeping down the bills. Being connected to the grid does not necessarily mean that households are using electricity to meet all their energy needs. The majority of households cannot, for example, use electricity for cooking because of cost implications. They mostly use it for lighting and ironing. Consequently, there is need for alternative, affordable modern energy options to complement electricity.

Table 3.1: Retail Electricity Tariffs Structure 2012 (Source: Kenya Power)

Tariff	Type of Customer	Supply Voltage (V)	Consumption (kWh/month)	Fixed Charge (KES/month)	Energy Charge (KES/kWh)	Demand Charge (KES/kVA/ month)
DC	Domestic Consumers	240 or 415	0-50	120.00	2.00	-
			51-1,500		8.10	
			Over 1,500		18.57	
SC	Small Commercial	240 or 415	Up to 15,000	120.00	8.96	-
CI1	Commercial/I ndustrial	415-3 phase	Over 15,000 No limit	800.00	5.75	600.00
CI2		11,000		2,500.00	4.73	400.00
CI3		33,000/40,000		2,900.00	4.49	200.00
CI4		66,000		4,200.00	4.25	170.00
CI5		132,000		11,000.00	4.10	170.00
IT	Interruptible Off-Peak supplies	240 or 415	Up to 15,000	240.00 – when used with DC or SC	4.85	-
SL	Street Lighting	240	-	120.00	7.50	-

3.1.5 Sustainability of energy resources

The demand for traditional biomass fuel has been rising steadily as a result of, among others, increase in population, and has been outstripping the supply. The current use of traditional biomass energy is therefore, unsustainable. Policies, strategies and proper planning for sustainable wood-fuel production and use are inadequate or non-existent. The biomass energy supply problem is compounded by the fact that most of the trees planted are intended for other purposes such as timber and construction. Inefficient production and use of charcoal in the face of ever rising demand for the fuel have led to unsustainable exploitation of trust lands leading to environmental degradation. The depletion of standing stocks of trees has huge implications on women and girls' workload (as they collect firewood from increasingly longer distances - the drudgery is significant) and access to education is affected. Nutritional choices are compromised by the time it takes to cook food and how much fuel is available to cook it, hence a challenge especially for children under 5 years of age. However, with proper biomass resources planning, development and management sustainability can be achieved.

LPG and kerosene, products of petroleum, are imported and thus pose supply insecurity and sustainability. The problem is compounded by the lack of storage and distribution infrastructure. However, the recently completed gas storage facility in Mombasa and the recent oil discovery will lead to the lower retail cost and increased use of the products over a period of time.

Kenya has good potential for renewable sources for electricity generation such as wind and geothermal much of which is yet to be developed. Despite vast renewable energy resource potential, exploitation of these has been slow. For example, geothermal exploration began in 1950s. However, the installed capacity is just about 248 MW. Widespread development and use renewable resources will ensure a sustainable energy future for the country.

Electricity supply has, over the last decade, been below the demand. This is attributed to slow expansion of the generation capacity and over-reliance on hydropower, which is prone to the vagaries of weather changes. In a number of cases this has led to frequent power rationing leading to reliability, adequacy and quality issues for the users and the procurement of expensive temporary thermal power to mitigate the shortfalls. The average outage repair time is 3.97 hours, and the number of low voltage breakdowns per 100 customers per year is 5.19 (Kenya Power).

During weekends, power outages often occur due to scheduled maintenance of the distribution systems. Scheduled load shedding programmes are mainly restricted to industrial customers in order to avoid supply interruptions to domestic customers. In 2010/2011, the un-served energy averaged 25GWh, with a maximum suppressed demand of 150MW. On average, the un-served energy stands at between 3GWh and 5GWh per month, with a maximum of 20MW of suppressed demand (for less than 3 hours per day). The estimated cost of un-served energy is currently 84 US cents/kWh (LCPDP).

Existing temporary diesel plants have been in the system in varying quantities for the last six years.

3.1.6 Modern Energy for Productive Uses

Productive uses of energy refer to the utilization and exploitation of energy for activities that improve wealth create jobs and increase economic activities in such sectors as agriculture, rural enterprise, health and education. They include land tilling, water pumping, agro-processing, food preservation, and medicine preservation.

The main sources of energy for productive uses are electricity and petroleum. In 2011/12 electricity consumption in the industries/commercial sector was 3,419GWh and in the small commercial sector 993GWh. Corresponding petroleum products in the industrial/commercial sector was 632.5 thousand tonnes. Transport accounted for 2,166 thousand tonnes while agriculture consumed 30.4 thousand tonnes.

Lighting may also be viewed from both the perspective of productive use and community services. For example, lighting for education (either in schools or institutions of higher learning or in households) leads to acquisition of knowledge which leads to increased productivity. Moreover, in market centres connected to electricity, lighting extends the period of economic activities and leads to growth in business.

Transportation is an important, enabling input. From a broad standpoint, it is an integral part of infrastructure without which many of the productive activities would not be undertaken effectively.

The development of agriculture and Small and Medium Enterprises plays a significant economic and social make up for the vast majority of people in Kenya, and energy is critical for them to earn a living. Small scale farmers' productivity is to a large extent based on human and animal energy and there is often insufficient mechanical, electrical and chemical (fuels) energy available to them. Mechanical power, in particular, is an important input in the farming system for land preparation, planting, cultivation, irrigation and harvesting. Access to quality energy supplies, an increase in the amount of

energy used and access to a wider range of energy services would improve productivity and create new earning and market opportunities. It would also reduce opportunity costs, ease drudgery and release time to enable new earning opportunities (Poor people's Energy Outlook, 2012).

The constraints to energy access for productive uses are similar to those encountered at domestic level. The growth of electricity consumption was 7.9% in 2011. Most of the electrical plant machinery and accessories are imported. Compared to other countries in the region the tariffs are cheaper except Egypt and South Africa.

3.2 ENERGY EFFICIENCY

3.2.1 Overview and Assessment

There is a high growth rate in energy demand that will require additional supply capacities. Associated with this is the need to put in place energy efficiency practices. Many benefits accrue from energy efficiency practices. At the consumer level this is reflected in reduction in the energy bill and reduced workloads especially for women. At the national level energy efficiency can significantly reduce foreign exchange costs of oil imports and of additional investment in power generation capacity. Examples of measures practiced in households, institutions and industry are the use of efficient lighting, improved cook-stoves, and high efficiency industrial motors.

In a 2010 study by the Kenya Institute for Public Policy Research and Analysis (KIPPRA), it was reported that between 20% and 70% of energy consumers did not practice any efficiency and conservation methods. A plausible reason for this is that consumers are more concerned about the cost of the appliances than about energy efficiency and conservation practices.

Barriers to the implementation of energy efficiency and conservation programmes include the high cost of introducing efficient and cost effective technologies, lack of awareness on opportunities offered, inadequate fiscal incentives, inappropriate and limited credit and financing mechanisms, and inadequate capacity for enforcement, monitoring, review and promotion of standards, regulations and codes of practice.

There is scope for achieving energy efficiency in biomass production, processing and utilisation, for example, in charcoal production with beneficial effects on sustainability. There is also potential for end use efficiency, for example, through utilisation of more efficient cook-stoves in the households. Benefits of efficiency can be realized through the purchase and use of improved technologies whose application conform to the regulations and standards as well as codes. Small and Medium Enterprises and community service institutions are areas in which substantial efficiencies can be realized and where the potential is high.

There are opportunities for energy efficiency in the different parts of the power system: generation, transmission, distribution and demand side management. There is scope for improved system efficiency through reduction of technical and commercial losses in the power system. In general, there is room for achieving substantial gains during processing, conversion, transport and end use of other energy forms.

In the industrial sector, studies and pilot projects that have been undertaken clearly show that there are significant prospects for energy efficiency, for instance in improved processes, more efficient appliances and equipment, good energy management.

3.3 RENEWABLE ENERGY

3.3.1 Electricity generation

Electricity is generated from both renewable sources and fossil fuels with renewable sources contributing 68%, mainly hydro (49%) and geothermal (19%). Only 14% of the hydropower potential (6,000MW) has so far been developed. So far geothermal installed capacity stands at 248 MW, about 2.5% of the total potential. Geothermal development activities have been accelerated in recent years and more generating plants will soon be on board. There is also significant wind energy potential in the country, yet only a meagre portion this has been harnessed for electricity generation. The largest wind power plant is rated at 5.1MW and was commissioned in August 2009. A further 20.4MW plant is under construction on the same site. Plans are underway to construct other wind power plants in Kajiado (100MW), Kinangop (60MW) and in Turkana (300MW).

The potential for cogeneration from sugarcane bagasse is estimated to be about 200MW. So far a 38MW plant built by the Mumias Sugar Company, of which 26 MW is supplied to the national grid. The other sugar companies generate electricity for their own use.

3.3.2 Hybrid mini-grids

The Government has installed several mini-grids in areas located far from the national grid. Previously, the stations were powered through diesel fired generators, but now renewable energy is being incorporated in the existing off-grid systems with the view of displacing the expensive fossil fuel. So far solar contributes 510kW while wind provides a total of 550kW in the mini-grid systems. The Hybrid Mini-grid Project which will be implemented under SREP is expected to increase the proportion of renewable energy (solar and wind) in existing and planned mini-grids to more than 30%. New mini-grids are being constructed across the remote areas.

3.3.3 Solar

It is estimated that 200,000 photovoltaic solar home systems have been installed in Kenya primarily for lighting and powering electrical appliances. Most of these solar PV systems are rated between 10We and 20We. Over the last three years, the number of home systems installed has grown at an average of 20,000 units per annum and the demand is projected to reach 22GWh annually by 2020. Solar water heating systems are being installed to transform Kenya's approach towards demand side management by effectively using renewable energy for peak load demand.

3.3.4 Biomass

Biomass in its traditional form is the most widely used form of energy in Kenya with wood-fuel consumption accounting for over 68% of the total energy consumption. A high percentage of households use the inefficient traditional three stone cook-stove.

There is rapid penetration of biogas technology for domestic cooking and heating. Biogas technology for institutional use is still in the pilot stages. There is a significant biogas generation potential from municipal waste, sisal, flower waste and coffee production estimated at 29-131MW (REM, 2009).

3.4 Use of renewable energy sources for thermal application and productive activities

Productive use is to be found in agriculture – water pumping, food processing and preservation, while thermal applications include water heating and space heating, crop drying etc. Majority of Kenyan households use biomass for cooking and heating as do many institutions and some industries. The other renewable energy sources used on limited scale are biogas, and solar water heaters. Many industries in Kenya - tea, coffee, sugar, brick and tile making industries among others - use biomass to fire boilers and kilns for generating steam and drying products.

3.5 Consolidated summary of problems with regard to energy access, energy efficiency and renewable energy

3.5.1 Energy access

Biomass fuels are the most important source of household energy in Kenya with woodfuel (firewood and charcoal) accounting for 68% of the total primary energy consumption. In spite of past efforts to promote woodfuel substitutes, the number of people relying on woodfuel is not decreasing. Consequently, woodfuel will continue to be the primary source of energy for the majority of the rural population and urban poor for as long as it takes to transform the rural economy from subsistence to a highly productive economy. Woodfuel demand frequently outstrips supply because the resources are depleted faster than they are replenished.

Reliance on inefficient cook-stoves and solid fuels has led to enormous burdens on families' livelihoods, especially for women and girls. For the most part, cooking remains a woman's local responsibility, and women bear the burden of not only cooking for their families, but also of gathering the necessary fuel. Yet, cooking energy remains the least developed energy sector in Kenya. Fuel scarcity and natural resource depletion affect large numbers of women. In addition, the difficult work of collecting fuel is rarely counted as productive or compensated labour. The use of biomass with basic cooking devices, combined with unsuitable cooking spaces, is the main cause of household air pollution in Kenya. Women and children are the main groups affected by the exposure to indoor air pollution, which is linked to acute respiratory infections responsible for 14,300 deaths each year.

The lack of access to modern energy has also led to heavy reliance on kerosene for cooking and lighting, posing health and environmental related issues. It will run counter to Kenya's policy of becoming kerosene free by 2020. It is therefore necessary to promote alternative lighting sources.

There is lack of gender disaggregated data for energy planning, low awareness on the benefits of accessing different energy options among users and low involvement of communities in the implementation of the policy strategies. Access remains a problem due to limitations of supply and high cost, hence inability of the poor to afford available energy services and supplies. Although immediate results of electrification are great among the poor, including women, they are limited by their restricted purchasing power, and those located in off-grid rural areas do not enjoy the benefits. In a centralized approach, the poor are not always the ones to be served, unless there is sufficient quantity of electricity available in the village.

Information on traditional energy systems is not readily available. Biomass energy databases are out of date, as are biomass energy development plans. Existing policies for improved woodfuel and charcoal cookstoves and for reducing the use of traditional fuels are inadequate, not to mention the lack of policies and strategies for charcoal production and use. The rate of adoption of efficient fuelwood and charcoal stoves is low, a pointer to the fact that not enough is being done to generate awareness on the problems and benefits of improved and new technologies.

LPG use in the country is low and the supply is subject to fluctuating prices of petroleum in the international market and exchange rate. Moreover, the going price is unaffordable to many, particularly in the rural areas. The situation is compounded by the fact that current storage facilities at Mombasa, Nairobi and other urban centres are inadequate.

Electricity supply has been below the demand over the last decade largely as a result of slow expansion of the generation capacity and negative impact of climate change on hydro power generation. This has given rise to frequent power breakdowns, rationing and procurement of expensive emergency thermal power to mitigate the shortfalls. The current penetration of electricity of 30% nationally is very low and many consumers find electricity tariffs generally high. High energy costs have implications to the manufacturing sector which is concerned about Kenya goods losing competitiveness in the international market. Manufacturers are spending up to 40% or more of their operational costs on

energy. This affects their bottom lines, straining expansion and the security of those in employment cannot be guaranteed (KAM). High cost of energy is still a major barrier to industrial growth in Kenya.

In addition upfront costs are prohibitive and essentially unaffordable, especially so in the rural areas, for example, the minimum connection fee for electricity, under the Rural Electrification Programme, is KES 35,000, a cost which is not affordable by some people.

3.5.2 Energy efficiency

A survey of Kenyan industries revealed that wastage of energy input ranged from 10% to 30%. This was attributed to lack of information, motivation and know-how as well as financial restrictions. At the end of the initial phase of the Global Environmental Fund-Kenya Association of Manufacturers (GEF-KAM) Industrial Energy Efficiency Project, in 2006, cumulative energy savings to the tune of 1,800GWh had been attained, equivalent to shutting down 200MW plant for one year. An important benefit of energy efficiency is that it is possible to avoid emissions of CO_2 to the tune of 5.2 million tons by the year 2015, corresponding to energy savings of about 16,130GWh over the period.

Energy efficiency has not been adequately embraced by the different categories of consumers. Consequently, energy efficiency practices in households, institutions and industry are inadequate to achieve any meaningful results. Among the barriers to the implementation of energy efficiency are the high cost of introducing efficient and cost effective technologies; lack of awareness of opportunities offered; inadequate fiscal incentives; inappropriate and limited credit and financing mechanisms; inadequate capacity for enforcement, monitoring, review and promotion of standards, regulations and codes of practice. At any rate, there is need for additional, new standards. There is also inadequate capacity to generate and disseminate energy efficiency and conservation information to consumers.

Another limiting factor is that the incentives that exist for increased private sector participation are inadequate for the purpose. Furthermore, information on energy efficiency activities and technologies is not comprehensive, and activities relating to energy efficiency are not adequately coordinated or harmonised.

The capacity to provide professional technical services for developing, designing and implementing energy efficiency projects to suit the needs of commercial, institutional and industrial consumers is inadequate for the task at hand. The same applies to the capacity to support the Government in formulating and implementing policies aimed at encouraging rational use of energy.

3.5.3 Renewable energy

The share of renewable energy in electricity generation has been fluctuating as a result of reduced output from hydro power in the wake of climate change and attendant challenges. During the initial stages, the development of geothermal power was slow but this is picking up with increased exploration and interest from development partners.

Woodfuel shortage is compounded by inefficient methods of charcoal production while agricultural waste is under-utilized. There is potential for the use of invasive species e.g. *prosopis* (mathenge) or water hyacinth. Further, the potential for briquetting from agricultural waste is of particular interest as this approach can provide a valuable alternative to charcoal production, but is yet to be fully exploited. Blending regulations for bio-ethanol are in place, but the supply is insufficient. Molasses is the main source of ethanol, but its supply is also limited. Two companies, the Agro-chemical & Food Company and Spectre International focus on the production of yeast, neutral and portable spirits for export and manufacture of alcoholic beverages. Mumias Sugar Company has also developed capacity for ethanol production.

Although the potential for biogas is large, from such sources as prisons, universities and schools, Farmer's Choice, the Kenya Meat Commission, Kenchic, sisal processing, flower farms etc., the penetration rate for this technology is still low. This is as a result of poor quality of design leading to

high failure rates; inadequate skilled man power and high cost of the systems. Ongoing support and initiatives need to be scaled-up development of biogas standards needs to be fast-tracked.

There is low uptake of solar water heating systems. The potential to replace geysers with solar water heating systems has not been fully exploited. Doing so would contribute to enhanced demand side management efforts that are currently in implemented. There is insufficient data on the number and performance of existing installations, limited capacity and no training facilities. Training facilities for new technologies is lacking.

Liquid biofuels such as bio-ethanol and biodiesel could provide cleaner alternatives to kerosene and charcoal but they are so far unexploited. Bio-diesel is in the early stages of development, with a few NGOs and private sector participating. A limiting factor is that there is no large scale feedstock production for example, jatropha, croton, castor among others. Besides, there is insufficient data on yields, silvi-cultural practices and other aspects of the value chain in general.

Despite the high potential for small hydro power many sites are yet to be developed. Below 10MW of small scale hydro has been installed for private use. The tea industry is a major consumer of wood, and it would serve them better to develop these sites to supply cheaper electricity and reduce their dependency on wood. This would in turn free up electricity for other users. Some of the small hydropower sites are also located near communities that are un-served by the grid, and developing these sites would provide them with cheap power.

A national atlas of small hydro is being prepared by MoE with feasibilities carried out in about 26 sites. Nevertheless, the development of small-scale hydropower is dogged by limited skilled manpower and capacity for local manufacture of turbines.

Lack of policy on electricity wheeling may present a barrier to investment in electricity generation, in general, and more specifically with regard to electricity from renewable sources. An important limiting factor is the lack of local entrepreneurs in renewable energy technologies and systems. In addition, there is inadequate data and information on solar energy and wind potential. Lack of trained personnel and inadequate incentives for local manufacturing is also a barrier.

3.6 National goals (from Government policies, plans, regulations) in relation to SE4ALL goals

This section presents national goals and strategies derived from existing policy and planning documents in the energy sector. These goals and strategies have been broadened and enhanced in the draft energy policy to reflect devolution into the counties and embracing of the constitution as presented in Appendix 2.

3.6.1 Energy Access

The biomass policy objective is to ensure sufficient supplies to meet demand on a sustained basis while minimising environmental impacts associated with biomass energy consumption. In this respect, the Government will: integrate into the formal education system biomass energy issues including research on biomass energy effects on climate and health; licence charcoal production to encourage its commercial production in a sustainable manner; promote private sector participation in biomass energy production, distribution and marketing; promote inter-fuel substitution; promote use of fast maturing trees for energy production; promote establishment of commercial woodlots including peri-urban plantations; offer training opportunities for informal sector artisans at the village level for the manufacture, installation and maintenance of renewable energy technologies including efficient cook stoves; and encourage private sector, NGOs and other self -help groups to accelerate their efforts in tree planting, and environmental protection.

The Government plans to reduce over reliance on traditional biomass energy as a source of cooking and heating, particularly in rural areas. Meanwhile, there are plans to harness agricultural waste as well as the potential of invasive species such as *prosopis* and hyacinth to increase the supply; plans are also underway to briquette agricultural waste which will reduce requirements for charcoal.

Other goals related to biomass development include expanding improved stoves and charcoal kiln programmes to eliminate the fuelwood deficit; licensing charcoal production to encourage its commercial production in a sustainable manner; promoting private sector participation in biomass energy production, distribution and marketing; reviewing and updating biomass energy development plans; and updating biomass energy databases.

The Government is involved in improved stove activities such as development of regulations and standards. Currently the government is involved in this sub-sector through the following programmes: Access to Clean Energy Services Programme, and Energy Plus and Kerosene Free Kenya initiatives. Several academic research institutions have also taken an interest in the cook-stove sub-sector to address the emerging knowledge development needs. The recent launch of the Global Alliance for Clean Cook-stoves provided a platform for sector players to come together and map out a country action plan.

To facilitate increased and widespread use of LPG, regulations were issued in 2009. The purpose of the regulations was to, among others, guide LPG operations in Kenya. For example, all LPG cylinders must conform to specified provisions. Furthermore, an LPG cylinder exchange pool was created to oversee cylinder business, which standardised LPG cylinders into capacities of 1, 3, 6, and 13 kg and allows exchange between oil marketing companies. Other regulations have also been issued in relation to energy management, improved cook-stoves, solar water heating, solar PV and gasohol blending; these are discussed in detail in section 4.2.

Additional measures undertaken to promote LPG consumption include: encouraging private sector to invest in LPG storage facilities to reduce its cost and facilitate affordability; educating the public on the cleanliness of use of LPG for cooking; promoting development and implementation of legislation and standards; instituting a Legal Notice to provide for exchange of cylinders of different brands and encouraging investors and competition. Exchange of cylinders is guided by the Exchange Pool Agreement which all oil marketing companies are signatories to.

The key drivers for promoting LPG include conservation of forests/re-afforestation by discouraging use of biomass (wood and charcoal); decreasing the health budget spending on indoor pollution; delivery of modern energy for cooking, heating & lighting to urban and rural locations; and making alternatives to biomass affordable, available and accessible.

Increasing access to electricity is a major commitment of the Government, which has, through REA, funded rural electrification activities on a cost-sharing basis with communities. REA administers the funds based on an equitable formula that reflects economic, financial and social development criteria. In addition, consideration is given to supporting either community or private sector managed national grid interconnected rural electrification projects through a one-off financial subsidy. Under this intervention, such communities and the private sector are allowed to charge a tariff reflecting the operating costs and a return on investments.

It is essential to ensure adequate supplies to meet anticipated expanded energy access. To this end, the Government is an active partner in promoting regional integration under the East African Power Pool (EAPP) initiative and regional interconnections. The regional power market is progressively evolving into a power pool with the anticipated interconnections with Ethiopia, Tanzania and the Southern African Power Pool (SAPP) countries and the strengthening of the link with Uganda.

3.6.2 Energy efficiency

Plans are underway to reduce electricity losses in the grid substantially by 2020. Related to this are strategies to achieve 100% energy efficient lighting systems by 2020 and to switch to 100% energy efficient transformers by 2030.

In 2006, the Kenya Association of Manufactures, in conjunction with the Government of Kenya, set up the Centre for Energy Efficiency and Conservation (CEEC) to (i) promote energy efficiency and conservation nationally; (ii) provide professional technical services for developing, designing and implementing energy efficiency projects to suit the needs of commercial, institutional and industrial consumers; (iii) support the Government in formulating and implementing policies aimed at encouraging rational use of energy; and (iv) organize and manage Annual Energy Management Awards (EMA) to promote energy efficiency and conservation.

The Government also partly supports energy audits, training of energy managers and awareness creation (about USD 341,000 per year). This is insufficient to cover the targeted scope for energy efficiency and conservation. It expected that the institution should be strengthened and its activities expanded to perform its task effectively. The Government also intends to encourage private sector participation in providing technical and financial support for energy conservation and efficiency; and to enhance the provision of energy audits and advisory services by the Ministry of Energy to institutions and companies including sensitization of industries and financial institutions on benefits of energy efficiency. A longstanding goal is to encourage demand-side management by industrial and commercial sectors. Another key goal is to promote the dissemination of energy efficiency and conservation information to consumers.

The transport sector, which consumes about two-thirds of all petroleum fuels used in the country, offers opportunities for achieving savings on imported fuels through energy conservation and fuel substitution. The Government will continue to pursue a number of policies to enhance efficiency in motor fuels and raise revenue. These include taxation to mitigate demand; development and enforcement of standards for fuel efficiency of motor vehicle engines as well as enforcement of speed limits in order to achieve savings in petroleum fuels; awareness raising on opportunities to conserve fuel; and alternative form of transport.

3.6.3 Renewable energy

The goal of the Government is to design and implement incentives to promote private sector investments in renewable energy and other off-grid generation, and to explore alternative innovative mechanisms for funding the Rural Electrification Programme (REP). An important dimension of this is to also explore innovative means for operating and maintaining the system in such a way to release funds for electrification expansion through on and off-grid systems. Furthermore, the Government plans to assist where necessary the public electricity suppliers to mobilise financial resources for establishment of revolving funds, to support financially viable extensions. The amount needed at any one time may be beyond the financial capability of a utility, and therefore priority will be accorded to industrial consumers and small-scale service establishments with potential for fast employment creation and substantial income generation.

New regulations that have been put in place by the Government are expected to significantly grow the markets for renewable energy technologies.

In selected cases, the private sector is encouraged to develop potential clean energy sites to generate electricity for their own consumption and to export the surplus to the national grid. In recognition of any efforts expended, the Government provides letters of intent to serious investors to appropriately guarantee purchase of their electricity on more favourable terms than for investors in fossil fuel fired stations, including a better fiscal regime for hydropower developers. Such support is, however, largely dependent on the economic benefits of the project, including the competitiveness of the tariffs offered.

The Government will also promote the development of appropriate local capacity for manufacture, installation, maintenance and operation of basic renewable technologies such as bio-digesters, solar water heating systems and hydro turbines; promote the development and widespread utilisation for renewable energy technologies which are yet to reach commercialisation; provide tax incentives to producers of renewable energy technologies and related accessories to promote their widespread use; and provide fiscal incentives to financial institutions to provide credit facilities for periods of seven years to consumers and entrepreneurs.

Specialised energy and electricity institutions have been created to accelerate the development of the energy sector in the country. Details of the institutions are given in section 4.3. Meanwhile, various flagship projects have been identified for implementation in the medium term pursuant to the objectives of Vision 2030. They include plans for developing renewable energy with emphasis on new technologies as a way of dealing with high cost of power occasioned by fossil fired generation whose contribution is increased during periods of drought. The strategic objectives are to increase power generation capacity, increase electricity access, develop new and renewable energy technologies, and improve security of supply of petroleum fuels. The strategies employed to achieve these objectives include legal, institutional and governance reforms; diversification of the country's energy sources; development, rehabilitation and expansion of generating power plants; regional interconnections; expansion and extension of the national grid; and energy efficiency and conservation.

The Government, in cooperation with relevant stakeholders, intends to develop and implement new mechanisms to comprehensively deal with different levels of generation as part of an effort to tackle electricity wheeling and related issues such as load profile, how much electricity and when to feed this to the grid, allowable loss level, etc.

The Government is promoting improved energy technologies through its energy centres (currently there are 15) country-wide. The energy centres demonstrate fast growing energy trees, solar PV systems, solar water heating systems, biogas technology, improved cook-stoves, solar cookers, fireless cookers and improved charcoal kilns. There are other organisations complementing the Ministry of Energy effort in promoting renewable energy technologies. The institutions involved include Improved Cook-stoves Association of Kenya (ISAK), Kenya Renewable Energy Association (KEREA), UNDP, GIZ, Association of Biogas Contractors of Kenya (ABC-K), UNIDO, Practical Action and Kenya Industrial Research and Development Institute (KIRDI).

Over ninety five sites with high wind potential have been installed with data loggers and data collection and analysis is in process with a view to committing over 500MW in the next 5 years. Furthermore, expressions of interest have been made for wind projects totalling 2,000MW. Three small wind turbine fabricators and one mechanical wind pump manufacturer (in the informal sector) are operating in the country. A number of solar PV companies are also importing and installing wind turbines. However, only a limited amount of the full wind potential has been exploited with 0.6MW in isolated power stations and 5.1MW fed into the national grid.

The Feed-in-Tariff mechanism was first introduced in 2008 to promote investments in grid connected renewable energy (see section 4.1.5). An economic and technical study for Small Scale Grid-connected Renewable Energy Systems has been completed.

The Government through the Ministry of Industrialization in partnership with UNDP, MoE, ERC and other stakeholders, has developed Minimum Energy Performance Standards (MEPS) for electrical appliances/equipment, and ERC will soon be making specific regulations to enforce the standards. These regulations are expected to be in place before end of next financial year. Other regulations are discussed in section 4.2.

There is an established commercial market and private sector players over and above programmes by the public sector. It is estimated that 20,000 solar home systems are sold every year. The solar lantern

market is growing rapidly at 80,000 units sold per year. There is also potential for on-grid solar PV with two pilot projects being implemented in Mombasa. Meanwhile, solar PV/wind-diesel hybrids are being implemented by the Government for isolated power stations with over 100 kW. Besides, over 1,000 off-grid public institutions have been electrified using solar PV and 19 solar water pumping sites through projects implemented by the Government.

Housed at KAM, the Regional Technical Assistance Programme (RTAP) has been established to provide technical assistance for those interested in funding renewable and energy efficiency projects. The focus is on assistance to financing applicants who may not themselves be experts in renewable energy or energy efficiency. In the process, RTAP helps to build local capacity in the development of energy efficiency and renewable energy projects. The projects require technical eligibility by a RTAP team before being financed. Over the past 16 months, RTAP has built a pipeline of 70 renewable and energy efficiency projects accounting for a capacity of 148 MW and debt finance of $227 million, 6 times above the available AFD credit line of $ 39 million.

4.0 POLICY, REGULATORY AND INSTITUTIONAL FRAMEWORK

4.1 POLICY FRAMEWORK

Kenya's policy framework includes Sessional Paper No.4 of 2004 and Vision 2030, while the legal framework includes the Energy Act, 2006 and the East African Community Customs Management Act 2004, (revised in June, 2012). The Government has also put in place the Feed-in-Tariffs policy to encourage investment in renewable energy technologies.

4.1.1 Energy Policy

Sessional Paper No.4 of 2004 is the main policy document for the entire energy sector, with the broad objective of ensuring adequate, quality, cost effective and affordable supply of energy to meet development needs, while protecting and conserving the environment. The specific objectives are to: (i) provide sustainable quality energy services for development; (ii) utilise energy as tool to accelerate economic empowerment for urban and rural development; (iii) improve access to affordable energy services; (iv) provide an enabling environment for the provision of energy services; (v) enhance security of supply; (vi) promote development of indigenous energy resources; and, g) improve corporate governance and accountability; and (vii) enhance legal, regulatory and institutional frameworks to create both consumer and investor confidence.

Laid out in the energy policy is a framework upon which cost-effective, affordable and adequate, quality energy services will be made available to the domestic economy on a sustainable basis over the period 2004-2023. The policy encourages energy efficiency and conservation in all sectors of the economy in order to reduce cost and wastage, and enhance competitiveness. Industries, businesses and institutions are the major consumers of commercial energy. Energy efficiency measures can reduce energy demand and costs, improve energy security (by reducing dependence on imported petroleum), improve competitiveness and help to mitigate climate change by lowering green-house gas (GHG) emissions.

The policy recognizes renewable energy as a critical energy source in Kenya; and identifies the need to develop fiscal and regulatory frameworks to create an enabling environment to accelerate the development and utilization of the renewable energy technologies in Kenya. The policy recognizes the need to remove barriers and constraints to adoption of energy efficiency and conservation technologies. It encourages private sector participation in providing technical and financial support for energy conservation and efficiency. Other recommended measures include provision of energy audits, training on energy management, undertaking demonstration projects to show the benefits from investment in energy efficiency and conservation, establish energy and equipment testing laboratories, promotion of cost effective industrial energy efficiency and conservation measures, encourage demand side management (DSM) by industrial and commercial sectors and development of standards, codes of practice on cost effective energy use.

4.1.2 Review of the energy policy

A number of changes have taken place over the years, bringing with them many new challenges and opportunities and necessitating a major policy review, which is also intended to incorporate relevant provisions of the new constitution (Constitution, 2010) and Vision 2030. The review of the policy proposes a broadening of the specific objectives to, among others:(a) utilize energy as a tool to accelerate economic empowerment for the national and county governments, urban and rural development; (b) improve access to quality, reliable and affordable energy services; (c) promote development of indigenous energy resource; (d) promote energy efficiency and conservation; (e) foster international co-operation in energy trade, investments and development; (f) promote energy research, development, training and local manufacture of energy plant, equipment, appliances and materials; (g) promote appropriate standards, codes of practice and specifications for equipment, systems and processes in the energy sector; (h) promote diversification of energy supply sources to ensure supply security; and (i) protect consumer interests. The new policy is also expected to take into account the

present political dispensation to specific counties and the relationship that will exist between the central government and counties; among the issues to be considered is how to provide for the phased transfer of energy services to the Counties in accordance with Chapter 11, Article 174 of the Constitution.

4.1.3 Energy Act of 2006

The Energy Act, 2006 applies to organizations or persons importing, exporting, generating, transmitting, distributing, supplying, using electrical energy; importing, exporting, transporting, refining, storing and selling petroleum or petroleum products; producing, transporting, distributing and supplying of other forms of energy; and to all works or apparatus for any or all of these purposes. It deals with the licensing of electrical energy, petroleum and natural gas. It empowers the Minister of Energy to promote the development and use of renewable energy technologies and to develop and manage a prudent national energy efficiency and conservation programme. The Energy Act 2006 established a number of institutions (discussed in section 4.3) including the Energy Regulatory Commission, the Energy Tribunal and the Rural Electrification Authority.

4.1.4 Review of the Energy Act

The Energy Act, 2006 will be repealed and consolidated into an omnibus law, bringing together the various pieces of legislation in energy and petroleum while ensuring alignment to the Constitution 2010, Vision 2030 and related legislations (The Land Act, 2012: repeals the Wayleaves Act, Cap 292 and The Land Acquisition Act, Cap 295; The Land Registration Act; 2012, The National Land Commission Act, 2012, The Environment and Land Court Act, 2011; The Geology, Minerals' and Mining Bill, 2012; The Mining Act (Cap 306); among others). The Energy Act, 2013 is expected to amend and consolidate the law to provide for the legal, institutional and regulatory framework in the energy and petroleum sub-sectors. Provisions will be made in relation to the functions of the national and county government consistent with the spirit and aspirations of the Constitution, 2010 and Vision 2030.

4.1.5 Renewable Energy Feed-in-Tariff policy

The FiT Policy was first issued in March, 2008 to facilitate the development of renewable energy resources in the country and to promote electricity generation from Renewable Energy Sources (RES). The second edition of the FiT policy was released in 2010, while the third edition was released in December, 2012. The RES targeted include wind, biomass, small hydropower systems, geothermal, biogas, solar and municipal waste. The policy allows sale of RES generated electricity at a pre-determined fixed tariff for a period of 20 years. Standardized power purchase agreements have also been developed but limited to projects of up to 10MW, connected at distribution voltages as embedded, non-dispatchable generators.

4.1.6 Vision 2030

Kenya Vision 2030 is a long term development strategy; it recognizes energy as one of the anchors for the realization of the Vision's three pillars -economic, social and political. Projects recommended under Vision 2030 and overall economic growth will increase demand on Kenya's energy supply. Before Vision 2030, the government put in place the Economic Recovery Strategy for Wealth and Employment Creation (2003- 2007), which served as a short term development strategy and which underwent continuous policy review.

4.1.7 East African Community Customs Management Act 2004

The East African Community Customs Management Act 2004, (revised in June, 2012) exempts from import duty compact fluorescent lamps (CFL) and lamps made from light emitting diodes (LED) for domestic and industrial use.

4.2 REGULATORY FRAMEWORK

A number of Regulations are in place, including the Energy (Energy Management) Regulations, 2012; the Energy (Solar Water Heating) Regulations, 2012; Energy (Solar PV) Regulations, 2012 and Energy (Improved Biomass Cook-stoves) Regulations (in draft).

4.2.1 Energy (Energy Management) Regulations, 2012

Energy (Energy Management) Regulations, 2012 were developed to facilitate efficient use of energy through better understanding of supply and use, management and the implementation of energy efficiency and conservation measures. The Regulations target Industrial, Commercial and Institutional consumers of energy all of which offer the highest potential for energy efficiency and conservation. They were developed to facilitate the implementation of Energy Efficiency and Conservation as outlined in Sections 105 and 106 of the Energy Act, 2006. The regulations govern operations and licensing of energy management and conservation, including licensing of Energy Auditors and Audit firms; provide an opportunity for financiers to finance implementation of the Energy Management Plans (EMP) developed through the energy audits; and beneficiary institutions to achieve 50% of the recommended measures within three years.

4.2.2 Energy (Solar water heating) Regulations, 2012

The uptake level of solar water heating systems in Kenya is extremely low in spite of the availability and high potential of the resource and of the huge demand for low temperature water for both domestic and commercial applications. The overall objective of Solar Water Heating Regulations is to promote uptake and guide the incorporation of low temperature solar water heating systems in industrial, commercial and residential buildings. Expected benefits comprise development and utilization of indigenous energy resources; enhanced national energy security through diversification of energy supply mix and reduction in the over reliance on petroleum imports; reduced demand for expensive fuel fired peaking power plants resulting from grid electricity peak demand attributed to water heating; increased environmental protection through reduction of green-house gases as a result of reduction in the use of petroleum fuels and biomass for water heating; and increased employment, capacity building and income generation resulting from the expanded solar water heating industry. The Energy (Solar Water Heating) Regulations, 2012, require that all premises with hot water needs of a capacity exceeding 100 litres of water per day install solar water heating systems. Existing premises that require a capacity exceeding 100 litres per day will install solar water heating systems within a period of five years from the date the regulations i.e. by September, 2017.

4.2.3 Energy (Solar PV) Regulations, 2012

The solar PV market in Kenya is among the largest and most dynamic in the developing countries with the highest per capita growth of over 10% per year over the past decade. Most activities in this field are related to the sale of household solar PV systems, which account for 75% of sales. In spite of this, market reviews and field reports have returned persistent complaints of underperformance or complete failure. The objective of the Regulations (which are in line with the provisions of the Energy Act, 2006) is to improve the quality of products and services offered in solar PV sector and to streamline the manufacture, design, installation, maintenance and use of solar PV systems or components to ensure that end users obtain value for money; improve distributed electricity service delivery; and facilitate sustainability of the PV market in Kenya. Furthermore, they provide a licensing framework for solar PV value chain and facilitate proper use of solar PV systems, while minimizing the supply of sub-standard components and installations. They also provide for a monitoring system. Other expected benefits are to: promote fair business practices in the industry; protect end-users from sub-standard and auxiliary products (solar inverters and batteries) in the Kenyan market; and facilitate collection and maintenance of solar PV industry data.

4.2.4 Energy (LPG) Regulations, 2009"

LPG legal requirements are contained in the Energy Act No. 12 of 2006. Pursuant to the Energy Act, Legal notice No. 121 of July 2, 2009 was gazetted to guide LPG operations. This Legal Notice

regulates all aspects of LPG business activities. All LPG cylinder marketers must conform to the provisions. An LPG Cylinder Exchange Pool was created to oversee cylinder business, and LPG cylinders were standardized into four sizes: 1, 3, 6 & 13 kg. Cylinder accessories were also standardized.

4.2.5 Energy (Improved Biomass Cook-stoves) Regulations (draft)

The Energy (Improved Biomass Cook-stoves) Regulations are still in draft; they relate to mandatory use of energy efficient cook-stoves for institutions and large biomass energy users. The Regulations will additionally regulate the manufacture, design and installation of cook-stoves. It is expected that these will become law by December 2013. The basis of the Regulations is the Kenya Standards KS 1814-1:2005 Biomass stoves - performance requirements and test methods. It stipulates mandatory use improved cook-stoves by institutions and businesses.

4.2.5 Other renewable energy Regulations

These relate to Biogas, Energy (Biodiesel Licensing), Energy (Gasohol Blending) and Charcoal (Rules). The Biogas Regulations (Draft), which aim to streamline design, installation and maintenance of biogas systems in Kenya, are also about to be completed. So are the Energy (Biodiesel Licensing) Regulations, 2009 (Draft), for licensing of Biodiesel business in the country. The blending of biodiesel is expected to comply with the Kenya Standard KS B5 - Specification for Biodiesel – B5 - Automotive Gas Oil Blend. There has not been much interest from the industry largely as a result of the high cost associated with producing biodiesel. The Energy (Gasohol Blending) Regulations, 2010, promote the use of bio-ethanol and provide a framework for blending of motor gasoline with power alcohol to produce gasohol. They also designate Kenya Pipeline Company's depots in Kisumu, Nakuru and Eldoret for blending. The depots are ready for use but the regulations are not yet operational because of insufficient supply of bioethanol. Finally, there are the Charcoal Rules 2009, under the Kenya Forest Services, Ministry of Forestry and Wildlife that promote sustainable charcoal production. The rules are currently being revised to among others address the issues of complete value chain and sustainability.

4.3 INSTITUTIONAL FRAMEWORK

The **Ministry of Energy** is responsible for formulation and articulation of energy policies through which it provides an enabling environment to all stakeholders, training of manpower, preparation of Least Cost Power Development Plan and mobilization of financial resources. Institutions and corporations associated with the Ministry include:

Energy Regulatory Commission: The Energy Act, No.12 of 2006 established the Energy Regulatory Commission (ERC) to regulate importation, exportation, generation, transmission, distribution, supply and use of all forms of energy including electrical energy, petroleum, renewable and other forms of energy. The Commission also protects the interests of consumers, investors and other stakeholders in the energy sector. It is responsible for collecting and maintaining energy data.

Energy Tribunal: This was also established by the Energy Act, to hear and determine appeals from the decisions of Energy Regulatory Commission.

The Kenya Electricity Generating Company (KenGen): is a government parastatal responsible for electric power generation and development in Kenya, producing over 60% of electricity consumed in the country.

The Kenya Power and Lighting Company (KPLC): is a state corporation that is responsible for electricity distribution and retail sales.

The Geothermal Development Company (GDC): This is a state-owned company established to be in charge of geothermal resource assessments including exploration, appraisal, production drilling, steam collection and selling to Independent Power producers (IPPs) and KenGen for electricity generation.

The **Kenya Electricity Transmission Company Limited (KETRACO):** is responsible for the national transmission grid. Its core functions are planning, designing, constructing, owning, operating and maintaining high-voltage electricity transmission lines.

The Rural Electrification Authority (REA): Created by the Energy Act 2006, is responsible for implementation of government Rural Electrification Programme.

Independent Power Producers (IPPs): private companies which generate electricity and sell it in bulk to KPLC. Currently, seven IPPs are operating in the country contributing about 30% of the effective generating capacity to the national grid.

The Kenya Nuclear Electricity Project Committee: Established to spearhead nuclear electricity development programme initially and mainly through capacity building. Recently (2012) transformed and gazetted as the Nuclear Electricity Development Board.

The National Oil Corporation of Kenya (NOCK): is a state corporation mandated to participate in all aspects of petroleum industry which include upstream and downstream activities. It is a government organ charged with the responsibility of petroleum exploration and marketing.

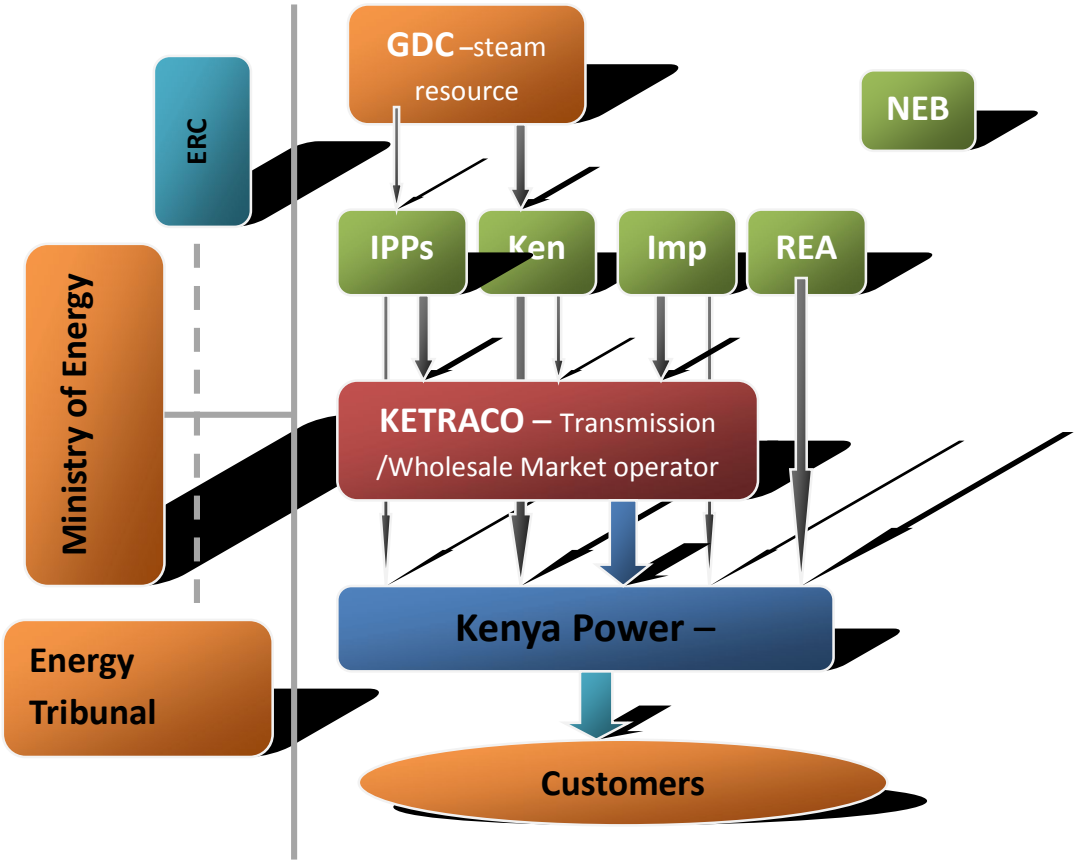
The Kenya Pipeline Company Limited (KPC): is responsible for storage, transportation and handling of refined petroleum products from Mombasa to inland.

The Kenya Petroleum Refineries Limited (KPRL): is a limited liability company with its main business being processing of crude oil to products including LPG.

Oil Marketing Companies
These include the large multinational oil marketing companies and the private local oil marketers

Other Government Ministries/institutions working with Ministry of Energy include the Ministries of Environment and Mineral Resources, Agriculture, Livestock Development, Forestry and Wildlife, Local Government, Housing, Industrialization etc. The Ministry of Energy also works closely with private sector organizations such as the Kenya Association of Manufacturers, which promotes energy efficiency and conservation.

Fig. 4.1 Structure of the Energy Sector- (Source: National Power planning team -LCPDP)



5. ONGOING PROGRAMMES AND FINANCING

The energy sector has various programmes financed and implemented by different stakeholders including partnerships with bi-lateral and multi-lateral development partners, international organizations, civil society and CBOs. Appendix 1, 3, 4, 5, 6 and 7 while not an exhaustive list of all the initiatives in the country, details some of the on-going and completed programmes. The programmes are categorized according to whether they are initiated by the Government, run jointly with the Government, private sector, partnerships with development organizations and civil society initiatives.

5.1 Government Initiated Programmes

These programmes cover projects in electrical power and renewable energy development. Electrical power development projects include hydro power generation, mainly additions to existing power plants or to operating geothermal plants, wind energy, thermal power generation, and transmission system construction. The hydro power generation schemes comprise a 24 MW unit at Kindaruma in addition to an 8 MW plant at the same site, and a 24.2 MW plant at Sang'oro. Geothermal programmes include Olkaria 1 units 4 and 5 (140 MW), the Scaling-up Renewable Energy Programmes (SREP) Menengai Phase I (400MW) and the Eburu plant (2.5 MW). There is an ongoing project on wind energy at Ngong (20MW). The thermal generation projects include the Muhoroni Medium Speed Diesel (MSD) 80MW plant and the LNG 300MW plant. All are intended to enhance national power generation capacity.

Projects for improving power transmission in the country comprise: Sang'oro-Sondu Miriu 132 KV transmission line; Mombasa –Nairobi, 475 km 220/400KV double circuit; Rabai – Malindi – Garsen – Lamu transmission line, 220 KV; and Mumias – Rangala 34 km 132KV single circuit line, with two 23 MVA substations.

The renewable energy projects include the High Grand Falls project (700MW) and other viable hydropower projects; Government extension of KES.30 million annual grant to CEEC through the Kenya Association of Manufacturers to support the undertaking of energy audits; installation of solar PV systems in public institutions; installation of solar/wind/diesel off-grid hybrid systems; piloting 1500 solar lanterns to selected schools; installation of 40 metre- high wind masts and data loggers; and the E-10 bio-ethanol blending facility in Kisumu. Exploration for geothermal resources in the Elementaita-Lanet prospective area is on-going. A summary of Government initiated programmes and projects is presented in Appendix 1.

5.2 Programs run jointly with the Government

Programmes run jointly by different partners and the Government include: Development and Implementation of Standards and Labelling in Kenya, funded by United Nations Development Programme (USD 10.7 million), aimed at reducing energy related CO2 emissions; Access to Clean Energy Services in Kenya, also funded by UNDP to the tune of USD 650,000 which includes a study to establish the viability of ethanol as a household cooking fuel, implemented by Practical Action, and development of standards for small hydro-power. The French Development Agency (AFD) is funding a (long term and concession programme on "Supporting and Financing Renewable Energy (RE) and Energy Efficiency (EE) Projects in East Africa" - about USD 3.8 million. Additional information on some of the programmes run jointly by different partners and the Government are presented in Appendix 3.

5.3 Private Sector Initiatives

There are several private sector driven initiatives promoting energy efficiency and renewable energy. The SNV and Netherlands supported Biogas Initiative for Africa, Kenya component, which aims at

reducing dependence on firewood in rural households by promoting household biogas digesters is being implemented by KENFAP, and over 6,000 biogas plants have been completed to date. Others include: an end-use energy efficiency improvement project expected to reduce demand for non-renewable fuelwood by replacing less efficient household stoves with a more energy efficient design, which is part of the Kenya Improved Woodstoves Programme, implemented by Climate Pal-French/Kenya Company; promoting improved wood stoves in rural areas where open fires and traditional fuelwood stoves are the norm, by Paradigm Kenya; the provision and servicing of 20,000 domestic gasifiers and 5,000 fireless cookers (African Christians Organization Network (ACON)); youth-focused, improved cook-stove initiative for Positive Empowerment (CO2 balance Improved Stove Partners); Kenya Fuel Efficient Stoves in East Africa for reducing emissions and improving livelihoods (CARE Denmark); Clean Cooking in Kenya Initiative (Lalkhan Bazar); and Energy Efficient Component of the Fast Start Climate Programme 2011 (implemented by KAM through CEEC) - to undertake comprehensive energy and investment-grade audits. The Lake Turkana Wind is involved in a 300MW wind project to diversify electricity sources and enhance national power generation capacity. Additional details on some of the on-going private sector initiatives are presented in Appendix 4.

5.4 Partnerships with development organizations

The Energy and Environment Partnership Programme which is funded by Finland, Austria, and DFID supports a number of government and private sector initiatives under the coordination of the Ministry of Energy. Private Sector for Development in Agriculture Programme (PSDA) promotes improved wood stoves (GIZ). In 2012, EnDev (GIZ) signed a memorandum of understanding with the Ministry of Energy to expand their coverage in the promotion of improved stoves and solar lanterns for households. They are also discussing implementation of solar PV mini-grids in areas selected areas.

Other projects implemented in partnership with development partners include the Lighting Africa/IFC/World Bank program, which mobilizes the private sector to build sustainable markets that provide safe, affordable, and modern off-grid lighting to Africa's communities who have no access to electricity. The Catholic Agency for Overseas Development (CAFOD) is an international development and relief organization that works through partnerships in over forty (40) countries in the world. In Kenya CAFOD has partnered with the Catholic Diocese of Kitui, Dupoto E-Maa, Catholic Diocese of Isiolo and Solar Works Ltd in implementing a four-year programme known as “Community-Based Green Energy Programme” (CB-GEP). The Programme, with support from the European Commission (EC) is being implemented in Kitui County (Mutomo, Mwingi and Kitui Districts), Isiolo County (Isiolo and Gabatulla Districts) and Kajiado County (Kajiado North and Central Districts).

The Heinrich Böll Foundation's regional office in Nairobi focuses on the generation of knowledge as well as awareness and advocacy work in the areas of renewable energy, climate change, sustainable food production, and extractive industries.

The Renewable Energy and Energy Efficiency Partnership (REEEP) is a non-profit, specialist change agent aimed at catalyzing the market for renewable energy and energy efficiency, with a primary focus on emerging markets and developing countries. REEEP’s Voluntary Carbon Offsetting scheme is a mechanism by which governments (both local, regional and national), companies and other institutions can outsource the purchase of CDM or Gold Standard Verified Emissions Reductions (VERs) to REEEP as part of a carbon reduction strategy. The Renewable Energy Ventures (K) Ltd. is a renewable energy and energy efficiency project development and advisory firm, located in Nairobi, Kenya, with headquarters in Washington DC, USA. It works closely with clients to help reduce their energy consumption, recommend alternative energy sources, and identify technology partners and structure and source of funding for implementation.

The Solar Lanterns Initiative seeks to replace one million kerosene lamps with solar lanterns. The initiative provides solar lanterns to Kenya's off-grid households, who are currently dependent on kerosene lamps.

UNIDO office in Kenya has focused on pilot climate change adaptation energy interventions, policies and measures. An important component of the project relates to clean production of tea from micro-hydro for firewood substitution. This aims at reducing the consumption of firewood at tea factories by empowering the community to generate electricity from micro hydro and selling it to the tea factory. Other components are energy for water security, to enhance access to piped water; and sustainability and household energy, to provide energy alternatives for household cooking and lighting. Additional details about these partnerships are presented in Appendix 5.

5.4 Civil society initiatives

Civil society in collaboration with other stakeholders continues to develop, test and disseminate a wide range of energy technologies and delivery models. The range of activities implemented includes improved cook stoves, solar lighting and cooking, biogas, biofuels, and community managed small hydro. Many NGOs are active in the promotion of household energy and up-scaling production capacity of improved cookstoves. A lot of work has been done on monitoring indoor air quality in households and highlighting the impacts of in-door air pollution arising from different technologies. Civil society has also been active in community sensitization and awareness creation, training and policy advocacy, including gender mainstreaming in the energy policies and programmes.

Appendix 6 lists examples of CSO-led energy initiatives in Kenya. The projects include, the Improved Cook Stoves for Households and Institutions Project (2011-2015); Developing Energy Enterprises Program (DEEP) – (2008-2013); Improved cookstoves; and Portable Solar Lighting Program (Energizing Development, EnDev) (2012 -2015); Monitoring Indoor-air Quality (Practical Action); Community Pico and Micro-hydro pilot projects (Practical Action); and Policy Innovation Systems for Clean Energy Security (PISCES) project (Practical Action, with support from DFID).

6. GAPS AND BARRIERS

Arising from the synopsis in section 3.5 "Consolidated summary of problems with energy access, energy efficiency and renewable energy", this section presents the gaps and barriers to the achievement of SE4ALL goals. These are viewed in two perspectives: those that are critical to investment; and those that prevent the achievement of national goals. Table 6.1, while not making a distinction between the two perspectives presents critical gaps and barriers to investment in energy access, energy efficiency and renewable energy. The table also highlights the identified critical gaps and barriers to achievement of national goals with regard to financing and policies as well as institutions and capacities. In addition, it identifies the opportunities and preconditions for scaling up stakeholder engagement and investment in support of national SE4ALL goals.

Table 6.1: Gaps, barriers and opportunities for SE4ALL

Energy Efficiency		
Gaps	**Barriers**	**Opportunities**
Insufficient capacity to collect process and disseminate EE information to investors and consumers.	Inadequate audit tools and equipment at CEEC, ERC, KAM and other relevant bodies Inadequate trained personnel to carry out periodical energy audits Inadequate monitoring equipment for large energy consumers eg. Firm & SMEs EE information is not comprehensively compiled	Capacity building for consumers Capacity building for EE auditors (CEEC, KAM, MoE, ESCOs, training institutions) Support to research, National data collection/surveys Enhance funding of energy audits
Few firms carrying out energy audits and practicing energy management	High costs of Energy Audits Lack of awareness Lack of incentives	Policy incentives Operationalization of Energy (Energy Management) Regulations, 2012
20-70% of energy consumers do not practice energy efficiency-(KIPPRA, 2010)	– Higher cost of energy efficient appliances – Poor quality appliances – Inadequate awareness	– Enforce standards and labelling through subsidiary legislation – Awareness raising initiatives – improved energy production and conversion equipment
High electricity transmission and distribution losses	– Inadequate investments – Long project lead times – Long power transmission distances	– Increase funding – Mobilize domestic financial resources – Institute supply side management measures – Encourage distributed generation (close to load centres)

Energy Access		
Gaps	**Barriers**	**Opportunities**
Majority of rural population and urban poor have no access to modern energy; 70% have no access to electricity, only 3.5% of households use LPG.	– High cost of energy provision – Inadequate development strategies and financing for domestic energy provision – High interest rates on loans – High cost of electricity connection – Non-operationalization of fiscal incentives – High end user cost of electricity – Inadequate LPG distribution facilities	– Credit facilities to consumers through MFIs etc. – Create a green energy fund – Implement fiscal incentives – Enhance public private partnerships (PPP) – Interministerial energy coordination committee – Switch from imported fossil fuel based generation to local alternatives such as geothermal, wind and coal
	– Remoteness of rural areas – Low economic empowerment – Demographic and settlement patterns	– Enhance off-grid and mini-grid power development – Develop efficient distribution and storage infrastructure for LPG – Clustering homes in new settlements
	– Perceived high political and commercial risk by private investors	– Provision of alternative guarantees eg. Partial Risk Guarantee (PRGs) – Granting of letters of comfort
	– Inadequate standards and lack of enforcement of existing standards – Difficulty in acquisition of way-leaves – Increasing levels of vandalism	– Implement policies and enforce regulations
	– Cultural practices which inhibit adoption of new practices	– Awareness creation
	– Poorly developed market infrastructure	– Removal of bottlenecks to ensure a competitive business environment
	– Insufficient local technical capacity	– Enhance technical training

Renewable Energy		
Gaps	**Barriers**	**Opportunities**
Inadequate skilled renewable energy technicians and engineers	– Mismatch between market needs and training curriculum – Lack of specialized training in institutions on RE technologies	– Develop tailor made courses for RE technicians and engineers – Equip training institutions with appropriate equipment
Slow domestication of technology manufacture and assembly	– High costs of technology transfer – Lack of skills for domestication	– Facilitate local manufacture and assembly through financing, policy etc. – promote research
Low uptake of renewable energy technologies	– High upfront cost of project development – Lack of financing by investors for feasibility studies – High cost and complexity in land acquisition	– Creation of a fund for RE investment – Collection of data on RE resources and conduct feasibility studies – Developing carbon trading projects – Enhance PPP – Involvement of Civil Society – Institute land reforms
Low penetration of IPPs in geothermal development	– High exploration and drilling cost for geothermal – Long lead time for geothermal power development	– Provision of alternative guarantees eg. Partial Risk Guarantee(PRGs), – Risk mitigation facility for dry wells – Promote direct use of steam for industrial processes and agriculture
Low penetration of renewable energy private power producers	– Lack of power wheeling policy – Lack of wheeling tariff – Lack of net-metering and banking – Lengthy negotiations in the PPA process	– Development of appropriate policies for wheeling, net-metering and banking – Standardized non-negotiable PPAs for small scale (less than 10MW) grid connected RE.
Lack of enforcement of existing RE regulations	– Inadequate capacity to operationalize the regulations	– Build the capacity of relevant institutions and provide enabling environment for the private sector
	– Most potential areas are far away from the grid	– Extension of transmission network – Develop mini-grids
-Poor quality of RE generation and storage equipment	– Lack of adequate enforcement of standards – Influx of counterfeits	– Ensure provision of standards and labels – Enforce standards – Establish adequate testing facilities – Consumer awareness

Stakeholders in the energy sector

There are many stakeholders in the energy sector including multi-lateral development partners, private companies, international organizations, civil society, CBOs, academic and research institutions. A comprehensive list is provided in Appendix 8.

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APPENDIX 1: Government initiated programmes/projects

	Program/ Project	**Objectives**	**Extent of implementation**
1	*Exploration for geothermal resources in the Elementaita-Lanet prospective area.	- Promote development of indigenous geothermal resources. - Enhance security of energy supply	Pre-feasibility stage.
ELECTRICAL POWER DEVELOPMENT			
1.	*Third unit of Kindaruma Hydro. 24 MW in capacity	- Enhance National Power Generation capacity	Complete
	*8 MW Kindaruma	- Kindaruma optimization of the existing unit	Ongoing
2.	*Sang'oro Hydropower station Capacity: 24.2MW	- Enhance National Power Generation Capacity.	Complete
3.	*Olkaria 1 units 4&5 Geothermal Power plant Capacity 140 MW	"	Contract Awarded
4.	Muhoroni MSD 80 MW Thermal plant	- Enhance National Power Generation Capacity in Western Kenya.	Ongoing
5	*Eburru Geothermal Power Plant 2.5 MW	"	Complete
6.	*Ngong Wind 1 Phase II and 8 Ngong wind II totalling to 20 MW	"	Ongoing
8.	LNG (Thermal) Capacity:300MW	"	Planned
9.	*Sang'oro-Sondu Miriu 132 KV Transmission line.	"	Complete.
10.	Mombasa – Nairobi 475 km 220/400KV double circuit.	- Enhance power Transmission	Ongoing.
11.	Rabai – Malindi – Garsen – Lamu Transmission line 220 KV.	"	Sub-station foundation works ongoing.
12.	Mumias – Rangala 34 KM 132KV Single circuit line with two 23 MVA substation.	"	
RENEWABLE ENERGY DEVELOPMENT			
13	Implement High Grand Falls project (700MW) and other viable hydropower projects		Planned
14	Government extend KES30	- Carry out energy audits	On-going

	million annual grant to CEEC through Kenya Association of Manufacturers	and give technical support on energy efficiency and conservation to industries	
15	Install Solar PV systems in institutions	- Install solar PV systems in public institutions	Solar PV systems installed in over 800 Public institutions
16	Install Solar / wind, /diesel off grid hybrid system funded by SREP at a cost of US Dollar 10 million	- Substituting diesel in thermal generation.	Plan
17	Piloting 1500 solar lanterns to 10 students per school in selected schools	- 1,500 solar lanterns distributed to 100 selected schools to reduce use of Kerosene	Completed
18	Solar Thermal	- Support to private sector to install solar water heating systems	Planned under SREP
19	Install 40 metre- high wind masts and data loggers	- 95 masts and data loggers installed	Data collection and analysis ongoing
20	Small /hydro	- Development of small hydropower atlas	Ongoing
21	E-10 bioethanol blending facility in Kisumu has been constructed by government.	- Reduce use of petroleum in transport industry	Complete
22	Biodiesel	- Fabrication of prototype processing plant in collaboration with Numerical Machining Complex (NMC)	Ongoing
23	Woodfuel & environmental conservation	- Rehabilitation of degraded water catchment areas	Ongoing
24	Improved stoves/jikos	- Promotion of improved firewood and charcoal stoves	Ongoing
25	Monitor and supervise coal development in Mui Basin	- Enhance security of power supply.	Coal Blocks Concessioned.
26		- Promoting development of indigenous coal resources - Enhance energy mix	Pre-feasibility stage.

KPLC –DSM: CFL Project – pilot done in which 1.25 million CFLs were distributed. A second phase for scaling up the project aiming to distribution of 3.3 million CFLs was registered as a CDM in December 2012. Efficient Transformers Project: applied for CDM and is in the process of registration.

*Also considered as development of renewable energy

Appendix 2: Summary of Government Goals and Strategies (As in the Draft Policy)

Objective	Strategies
a. Electricity access - achieve 100% connectivity by 2030	▪ Continue to implement a sustainable customer connection policy through competition to increase to at least 750,000 customers annually by 2022. ▪ Ensure that a liberalized market is in place. ▪ Provide capacity building and financial assistance to community based projects. ▪ Implement cooperation arrangements with County Governments for accelerated implementation of rural electrification programme. ▪ Provide for the criteria to access funds for electrification of marginalized areas from the Equalization Fund under Article 204 of the Constitution. REA shall continue to implement cross-county rural electrification connections. ▪ Concession government owned off-grid (isolated) power stations within the framework of the Privatisation Act. ▪ Where commercially viable, progressively connect off-grid systems to the national grid. ▪ Provide incentives for local assembly and manufacturing of energy infrastructure equipment and their use. ▪ Seek financing of clean energy projects through carbon credits under clean development mechanism (green energy) and other financing associated with clean energy. ▪ Package attractive energy investment instruments which will be appealing to investors in energy sector. ▪ The government will provide necessary support for the implementation of the energy projects in the populated areas including facilitation of acquisition, relocation and resettlement of project affected persons. ▪ The Cabinet Secretary to ensure implementation of the integrated energy master plan.
b. Energy Generation	The current and future strategy is to diversify the base-load from hydro to other sources of energy. ▪ To generate 19,00MW by 2030
c. Environmental Protection and sustainable biomass use	▪ Identify and reserve land for use in biomass energy production and undertake awareness programmes to sensitize the public on the importance of the various land uses such as for biomass, food production and other human needs. ▪ Undertake studies to identify and promote the most appropriate biomass energy conversion technologies. ▪ Promote inter-fuel substitution to reduce the over reliance on wood fuel. ▪ Strengthen existing Energy Centres and establish others to cover all counties with a view to promote

	efficient biomass energy use. ▪ Promote the use of biomass briquettes as alternatives to woodfuel in cooking, water heating and steam generation. ▪ Promote alternative sources of energy and technologies as a substitute for biomass. ▪ The Government plans to review and update biomass energy development plans, update biomass energy databases and expand improved stoves and charcoal kiln programmes, to eliminate the fuel-wood deficit. ▪ The rate of adoption of efficient charcoal stoves will be increased from 47% currently to 80% by 2010 and to 100% by 2022 in urban areas. Corresponding targets for rural areas are 40% by 2010 and 60% by 2022, respectively. Similarly, plans are afoot to increase the rate of adoption of efficient fuel-wood stoves from 4% currently to 30% by 2022.
d. Make Kenya kerosene-free by 2020	**a) Biogas Promotion as an alternative to kerosene for domestic and commercial energy needs.** ▪ The Government to facilitate the construction of at least 10,000 bio-digesters in Kenya under the "Biogas for Better Life" programme in collaboration with private sector. ▪ The government is partnering with the flower farms to construct two power generation biogas plants. ▪ Prepare guidelines and regulations for biogas installations contractors/technicians. ▪ Undertake a comprehensive study on the viability of bottling biogas for rural development. ▪ Start a pilot biogas bottling plant. ▪ Promote the use of biogas as an alternative to woodfuel and kerosene for domestic and commercial energy needs. ▪ NERA to roll out biogas initiatives to remaining public institutions including prisons, schools and hospitals. ▪ Roll out biogas bottling plants across the country in conjunction with the counties **b) Promotion of Solar PV and Solar Water Heating** ▪ Roll out a programme to distribute solar lanterns as substitute for kerosene in lighting rural areas, poor peri-urban and urban settlements. ▪ Develop a programme for raising awareness on requirements for conformity with mandatory regulations for solar water heating systems and ensure installation of at least 700,000 SWH units. ▪ Install 100% of all the remaining public facilities with solar PV systems in off grid areas.

	c) Bio-diesel and Gasoline Blending All vehicles in the country to use at least 30% ethanol-gasoline (E-30 Mandate) blend while all vehicles in the country to use at least 5% biodiesel blend. Isolated power generation plants to use 100% biodiesel. ▪ Facilitate the farmers to access cheap farm inputs and high yielding fast maturing bio-fuel feedstock. ▪ Undertake a comprehensive study on the viability of bio-fuels and map out potential bio-fuels production feedstock and locations nationally and across counties. ▪ Government to grant fiscal incentives including a 3 year tax holiday for bio-fuel production projects in so far as such entities are marketing the products solely for blending. ▪ Government to identify and set aside land in potential locations for piloting of bio-fuel feedstock production ▪ The National and County Governments to allocate land for growing bio-fuel feedstock.
e. Developing human and technical capacity in energy development	**Creation of more specialised institutions that that will support the implementation govenment policies in energy sub-sector which shall include the following:** ▪ The government shall create a National Energy Advisory Council to advise on all sector matters. ▪ The Government shall establish the Energy Efficiency and Conservation Agency (EECA) as a fully-fledged national public entity to promote energy efficiency and conservation. ▪ The Government shall put in place mechanisms to enhance public participation in energy matters. ▪ Establish inter-ministerial collaboration of relevant stakeholders to ensure coordination at policy, regulatory and operational levels on matters relating to development of energy resources. ▪ Establish an independent least cost development planning committees for all energy sources. ▪ Establish an Energy Finance Corporation as a company under the companies Act and registered as a financial institution under the Banking Act. ▪ Establish a National Energy Institute by 2014 to undertake training, innovation and local manufacture, research, development, dissemination, nurture talent and to enhance capacity building in the energy sector. ▪ Establish a Renewable Energy Research Centre within the National Energy Institute for the handling of renewable energy promotion, potential analysis, mapping and other related studies. ▪ The Government shall establish an inter-ministerial Renewable Energy Resources Advisory Committee (RERAC) composed of members representing ministries in-charge of Energy.

f. Development of Coal Resources	As per the 2011 least cost power development plan (LCPDP), coal is projected to provide 2,400MW of electricity by 2030. In phase 1 blocks in the Mui Basin have been concessioned for coal resource development with the objective of generating a coal fired plant
g. Development of Geothermal	**Geothermal to provide at least 5,500MW of geothermal electric power generation by 2030** ▪ The Government will develop and implement a framework for the Geothermal Development Plan to provide steam for the planned 5,500MW to meet projected capacity by 2030. ▪ The Government shall support and fund the Geothermal Development Company (GDC) so as to manage the geothermal exploration risk and attract investors. ▪ The Government will continue to encourage the private sector to invest in geothermal subsector through various means including PPP and joint venture arrangements so as to achieve the projected supply of 5,500MW by the year 2030. ▪ The government will promote research, development, dissemination and capacity building for geothermal development through provision of fiscal and other incentives. ▪ Generate at least 70% of electricity from renewable resources and build the necessary transmission infrastructure.
h. Development of hydropower resources	▪ Promote protection of the environment, catchment areas and water towers. ▪ The Renewable Energy Research Centre in the National Energy Institute to collect hydrological data on hydros. ▪ Create awareness and disseminate information on the benefits of small hydros and its coexistence with other usages of the resource. ▪ Provide incentives to promote the local production and use of efficient small hydro power systems. ▪ Formulate and enforce standards, legal and regulatory regimes for small hydros.
i. Development of Municipal and Industrial waste	**Facilitate at least 1200MW of co-generation capacity from municipal and industrial waste**. ▪ The national and County Governments to promote the utilization of municipal and industrial waste as sources of energy. ▪ Prepare integrated solid waste management plans and roadmaps.

	▪ Develop criteria for certification schemes for cogeneration projects. ▪ Undertake pilot programmes to generate at least 50MW of electricity using municipal/industrial solid waste. ▪ Promote the utilization of municipal and industrial waste as sources of energy in municipalities across counties. ▪ Implement integrated solid waste management plans and roadmaps jointly with County Governments
j. Nuclear Energy-4,000 MW by 2030	▪ The government has established the Kenya Nuclear Electricity Board (KNEB) to spearhead introduction of nuclear energy in the country with a target to commission the first plant in 2022. KNEB is currently. ▪ carrying out a pre-feasibility study, strategic plan ▪ capacity building through local and international scholarships ▪ For nuclear development, the Government shall ensure compliance with international standards for plant siting, construction, operation, decommissioning and waste management, to ensure proactive preventive approach to managing the environment, health and safety risks ▪ To commission the first 1,000MW nuclear plant(s) by 2022. ▪ Embark on the implementation of the next 2,000MW nuclear power plant(s). ▪ Commission 4,000MW of nuclear electricity power.
k. Cogeneration from Bagasse and agro-residues	**Facilitate at least 1200MW of co-generation capacity from bagasse and agro-residues.** ▪ Accelerate investment in efficient and emerging technologies. ▪ Undertake capacity building programmes in cogeneration technologies. ▪ Carry out a comprehensive study on cogeneration potential. ▪ Develop a model Power Purchase Agreement (PPA) for cogenerated power. Formulate and implement a national strategy for coordinating development of co-generation. ▪ Undertake RD&D in co-generation technologies. ▪ Collaborate with the players in the sugar industry to address governance issues
l. Energy Security, Health, safety and Environmental	**The government aims at facilitating provision of clean, sustainable, affordable, reliable and secure energy services at least cost while protecting the environment in the following manner:** ▪ Enhance sectoral, regional, gender and environmental considerations in energy planning and development.

	▪ Provide for the mandatory environmental liability policy by entities in the sector. ▪ Develop and implement Environmental Impact Assessment (EIAs) guidelines for the energy sector. In addition, the Environmental Management Plans developed through EIAs should be enforced. ▪ Mainstream weather and climate data and information to the sector's core activities. ▪ Develop Guidelines to ensure compliance to relevant international conventions to energy sector. ▪ Support the implementation of Environment, Health and Safety Management Systems (EHSMS) in all energy related facilities. ▪ Promote the concept of resilience: that is the ability at every relevant level to detect, prevent, and, if necessary, to handle disruptive challenges while minimizing damage to humans, infrastructure and the environment. **This shall be instituted into the energy production and delivery systems, and in particular the following broad policy measures will be undertaken by all the energy sector investments.** ▪ Enhance and strictly enforce penalties for vandalism of energy sector infrastructure which continue to cause immense losses as well as energy supply interruption. In addition, enhance and strictly enforce penalties for handling vandalised energy sector equipment and materials. ▪ Support the development of standards for equipment, products, protective equipment and operating practices, and facilities, in the energy sector etc to ensure safe operations in the sector. Where local standards are lacking, international standards shall apply. ▪ Incorporate disaster preparedness and mitigation into energy policy and management planning. ▪ Ensure that the energy sector is well represented in international climate change negotiations to improve the investment climate for CDM projects. ▪ Collaborate with other stakeholders such climate change secretariat on energy issues to address climate change challenges. ▪ Initiate measures to increase carbon sinks, for example through afforestation.
m. Other Strategies	▪ Encouraging energy firms to source development funds from alternative sources such as the capital market, Retirement Benefits Schemes (RBS), Savings and Credit Cooperative Societies (SACCOs) etc. ▪ Review the Income Tax Act, (Cap 470), the Customs and Excise Act, (Cap 472) and the Value Added Tax Act (Cap 476) to provide fiscal incentives in the energy sector. ▪ Develop a National Energy trading market in the country including spot and long term markets for energy products. ▪ Provide for demarcation of roles between the National and County Governments as far as the energy sector

	is concerned. ▪ The Government will support Public Private Partnership (PPP) as provided for in the PPP Bill, 2011. Systems have been set for participation of private sector in financing, construction, development, operation, or maintenance of infrastructure or development projects through concession or other contractual arrangements and the establishment of institutions to regulate monitor and supervise project agreements or infrastructure or development projects. ▪ Develop a blueprint and road map for national implementation of energy programme. ▪ Develop reliable databases for all forms of energy and an investment guide. ▪ Promote appropriate standards, codes of practice and specifications for equipment, systems and processes in the energy sector. ▪ Undertake research in energy areas that will enable the country to adopt a low emissions path it avoid a high-emissions path. Educate the public and entities/industry to reduce their carbon foot print. ▪ Encourage research to establish the risk of electromagnetic radiation associated with transmission lines and establish guidelines on high voltage installations including generation systems, transmission lines and enforce safety measures.
n. Transmission Plan	▪ In the long term the LCPDP provides for development of an estimated 16,000 km of new lines at an estimated present value cost of US$ 4.48 billion by 2030. Increase distribution substation capacity HV lines, MV lines and distribution transformers to 38,000MVA, 25,000 km, 190,000 km and 60,000MVA respectively. ▪ Strategies ▪ Ensure adequate and timely national transmission infrastructure is put in place including evacuation of electrical energy. ▪ identified priority projects for implementation of transmission lines comprising 1400 km of 132 kV, 2700 km of 220 kV and 1250 km of 400 kV AC lines as well as 650 km of 500 kV HVDC line between 2011 and 2014 ▪ It is planned that approximately 5,000 km of new transmission lines will be constructed at an estimated cost of about US$ 2billion by 2022. ▪ The Government to accelerate regional inter-connection of transmission networks. ▪ Facilitate open access to the transmission and distribution networks, designate a system operator and encourage regional interconnections to enhance regional electricity trade. ▪ Commence regional electrical energy trading through the regional energy trading centre. ▪ .Expand the distribution network to an additional 16,000 km of medium voltage, 1,000 MVA of distribution substations, 50,000 km of low voltage lines and 3,000 MVA of distribution transformers so as to connect 1.5 million new customers by 2016 the Government shall provide a mechanism for determination of wheeling charges applicable to distribution lines.

	▪ Promote competition through open access in transmission and distribution and provide mechanisms to reorganise the existing PPAs to accommodate a competitive power market structure ▪ Increase HV lines, primary substation capacity, MV lines, distribution transformers and LV lines. ▪ Plans are also underway to reduce total electricity losses in the grid from the current 17.3 % to 13.5% by 2020. Related to this is the scheme to achieve 100% energy efficient lighting systems by 2020 and to switch to 100% energy efficient transformers by 2030.
o. Off grid power generation	**Facilitate generation of 500MW electricity from solar** ▪ Develop a programme to convert Diesel stations to hybrid power generation systems involving solar energy sources. ▪ Installation of all the public facilities with solar PV systems in off grid areas. ▪ Promote installation of at least 200,000 units of solar PV home solar systems. ▪ Facilitate development of 3,000MW wind energy generation capacity ▪ Collect and compile wind energy data and update the wind atlas. ▪ Develop a programme to convert diesel stations to hybrid power generation systems in high potential wind resource areas. ▪ Plan transmission lines to facilitate evacuation of power from areas with high wind potential to major load centres. ▪ Hybrid Mini-grid-Increasing the proportion of renewable energy in the diesel power plants to 30% ▪ The Government intends to implement the Hybrid Mini-grid Project to increase the proportion of renewable energy (solar and wind) in existing and planned mini-grids to 30%. Hybrid mini-grids will replace the current operational model of expensive diesel-based mini-grid electricity supply, which is not environmentally friendly. Currently there are seven hybrid systems installed by the Kenya Power and Lighting, producing 510kW from solar and 550kW from wind. Additional 27 new hybrid powered mini-grids in the remote areas are to be developed by 2017. The Government is currently providing solar electric power systems in public institutions in arid and semi-arid (ASAL) areas

Appendix 3: Programs run jointly with the Government

Project Title	Budget US$	Project Description/Objectives	Duration
Development and implementation of the Standards and Labelling Program in Kenya (United Nations Development Programme (UNDP))	10.7 million	The objective of the project is to reduce energy related CO_2 emissions in Kenya and other East African Community countries by improving energy efficiency of selected appliances and equipment in residential commercial and industrial sectors	Ongoing
Energy Efficient Component of the Fast Start Climate Programme 2011: Implemented by KAM through CEEC.	KES 240 million-grant from DANIDA	To undertake 100 comprehensive energy audits and 50 investment-grade audits (IGAs) within a period of two years. In addition two (2) promotional campaigns with national coverage will be conducted, especially targeting SMEs.	
CARE (Denmark) Uganda Carbon Bureau Ltd. (UCB) CARE International in Uganda CARE International in Tanzania, Rwanda, and Kenya		Fuel Efficient Stoves in East Africa: Reducing Emissions and Improving Livelihoods	Ongoing
Access to Clean Energy Services in Kenya (UNDP)	650,000	1. Bioethanol pilot project for household cooking 2. Biomass gasification technology 3. Development of standards for small hydro power schemes 4. Development of training curricula and harmonizing solar manuals for solar technology 5. Development of standards for cookstoves	Ongoing
Supporting and Financing Renewable Energy (RE) and Energy Efficiency (EE) Projects in East Africa: Long term and concessional financing is being made available by the French Development Agency (AFD) to two commercial banks (partner banks) in each participating country (Kenya, Uganda, and Tanzania).	3.8 million (Technical & financial support)	1) The Regional Technical Assistance Programme (RTAP) operated by KAM provides technical support to project sponsors (pre-feasibility, feasibility or technical support) and makes recommendation to partner banks in order to mitigate the technical risk. The introduction and implementation of the initiative will improve energy efficiency, increase availability of "new" power, and reduce GHG emissions thus mitigating climate change. 2) Provision of KES 286 million (2.6 million Euros) in	Ongoing

		technical and financial support for renewable energy (RE) and energy efficiency (EE) investments in Kenya, Uganda and Tanzania. The amount has been funded by an AFD grant of KES 66 million (600,000 Euros) and an Africa Infrastructure Trust Fund of the European Union grant of KES 220 million (2 million Euros). The project is part of the environmental credit lines extended by AFD to local banks in Kenya, Uganda and Tanzania. 3) The entire package comprises a generic line of credit (LC) for each country at soft conditions. In Kenya the project funds will be available through CFC Stanbic and Cooperative Banks. A total of KES 3.3 billion (30 million Euros) has been availed to the two banks for onward lending to businesses that wish to invest in RE and EE projects. In Kenya the expected investments should reach around KES 6.16 billion (56 billion Euros).	

Appendix 4: Private Sector initiatives

Initiative	Value	Objectives	Status
1. Lake Turkana wind project 300MW		Diversify the source of power and enhance National Power Generation capacity	Ongoing.
2. Climate Pal-French/Kenya Company (Kenya Improved Woodstoves Program)		The program is an end-use energy efficiency improvement project that will reduce demand for non-renewable fuel wood by replacing less efficient household stoves with a more energy efficient design.	Ongoing
3. Paradigm Kenya Email: info@theparadigmproject.org Call: 719-884-2727 Visit us: 619 N Cascade Ave # 110 Colorado Springs, CO 80903-325	1 750 000	Appropriate stoves technology for Kenya: is the business Started by the Paradigm Project to sustainably meet the clean-burning cook-stove needs of Kenyans still cooking over open fires and traditional stoves.	Ongoing
4. African Christians Organization Network,(ACON) Salim Mayeki Shaban, May 10, 200 P.O Box 323, BUNGOMA 50200 Kenya 1stfl.KCBBuilding +254727621841 Email:salimshaban2005@gmail.com Principal Officer: Salim Mayeki Shaban		Western Gasifier Stove Project To provide and service 20,000 TLUD gasifier cook stoves and 5,000 fireless stoves.	Ongoing
5. CO_2balance.com 1 Discovery House Cook Way Carbon zero (CO_2balance) Taunton Somerset TA2 6BJ United Kingdom info@carbonzerofederation.com		CO_2 balance improved stove Partners Kisumu Initiative for Positive Empowerment (KIPE) is a youth-focused non-partisan, non-religious not-for-profit non-governmental membership organization supporting young people infected and affected by HIV/AIDS.	Ongoing

Initiative	Value	Objectives	Status
6. BioEarth Inc. SUNNY TOWER, 4th Floor, 291 CDA AVENUE, LALKHAN BAZAR, CHITTAGONG, BANGLADESH Phone: 88-031-2854963 , Mobile: 88-01731-390745		Clean Cooking in Kenya Initiative G3300 Envirofit BioEarth Inc. in collaboration with K-Rep Development Agency for The "Clean Cooking in Kenya Initiative to supply 500,000 Improved Cook Stoves	Ongoing

Appendix 5: Partnerships with development organizations

Partnership	Details
1. Lighting Africa, a joint IFC and World Bank program	Lighting Africa works on: product quality assurance, market cell: ligancy, consumer education, Business support and access to finance. It mobilizes the private sector to build sustainable markets that provide safe, affordable, and modern off-grid lighting to Africa's un-electrified communities. The program is working to increase energy access and provide better lighting to 2.5 million people by 2012 and 250 million by 2030. Since 2010, close to 1.5 million people have cleaner, safer, better Lighting and improved energy access thanks to Lighting Africa and its stakeholders. Affiliations: Renewable Energy Ventures (K) Ltd. Solataa Ltd, Sollatek Electronics, Sunlite Solar, Smart Solar Ltd. Sun Transfer, The Africa Renewable Energy & Access Grants Program, Asia Sustainable & Alternative Energy Programme, The Energy Sector Management Assistance Programme, Global Environment Facility, governments of Italy, Luxembourg, Netherlands, Norway, USA, The Public Private Infrastructure Advisory Facility, The Renewable Energy & Energy Efficiency Partnership **Contacts:** IFC, CBA building, 4th Floor, Upper Hill, Mara/Ragati Road P.O. Box 30577-00100, Nairobi, Kenya Cell phone :+254 20 275 92 00 Website: www.lightingafrica.org
2. CAFOD	The overall objective of CAFOD's Programme is to increase access to modern, affordable and sustainable energy services for 301,996 households through 88 institutions and 64 rural community-based groups in rural and peri-urban areas in Kenya and specifically:

Partnership	Details
	Procure and install solar PV and solar water heating Systems, and energy saving jikos in 56 schools in rural and peri urban areas of selected counties; Install solar water pumping irrigation systems for 56 greenhouses to benefit 56 rural community groups; Install solar PV refrigeration systems and solar water purification plants in 32 selected health centres; Establish 8 solar powered community based ICT centres in rural and peri urban towns to support youth groups; Train selected business groups on business management and supporting them to develop business plans; Train local artisans/technicians and provision of technical support; create community awareness and facilitate inter-partner visits; Undertake baseline surveys, mid and end-term evaluations.
3. Hivos–Africa Biogas Partnership Programme (ABPP)	The Africa Biogas Partnership Programme (ABPP) is a partnership between Hivos and SNV in supporting national programmes on domestic biogas in six African countries. The Programme aims at constructing 70,000 biogas plants in Ethiopia, Kenya, Tanzania, Uganda, Senegal and Burkina Faso providing about half a million people access to a sustainable source of energy by the year 2013.The overall objective of the ABPP is to contribute to the achievement of the Millennium Development Goals through sustained construction of domestic biogas plants as a local, sustainable energy source. This will be fulfilled through development of a commercially viable and market-oriented biogas sector. The Programme is financially supported by the Directorate General for International Cooperation (DGIS) of the Dutch Ministry of Foreign Affairs and SNV. The financial contribution of DGIS amounts to €30 million, covering approximately one third of the total programme costs. These funds are channelled through Hivos, which carries out the role of fund and programme manager, operating from Nairobi. SNV provides capacity building services in the six countries and takes responsibility for knowledge management at the international level. Knowledge and skills gained by SNV through setting-up of large-scale domestic biogas programmes in Asia is shared in the ABPP programme. The ABPP is part of a broader objective of DGIS targeting the provision of sustainable energy to 10 million people by the year 2015. **Contacts:** East-Africa ACS Plaza, 3rd Floor Lenana Road P.O. Box 19875 00202 Nairobi, Kenya Telephone: + 254 20 3861372 / 3 / 4 E-mail: info@hivos.or.ke
4. Heinrich Boll Foundation	The Heinrich Böll Foundation's regional office in Nairobi focuses on the generation of knowledge as well as awareness and advocacy work in the areas of renewable energy, climate change, sustainable food

Partnership	Details
	production, and extractive industries. AFREPREN (Nairobi) is conducting studies and advocacy work on renewable energy production in Eastern Africa and the Horn of Africa; all this has helped to bring about, in 2007, the new feed-in legislation that encourages investment into small-scale and sustainable generation of electricity by Independent Power Producers. They are supporting forest protection activities undertaken by the Green Belt Movement and work towards strengthening the capacity of organisations and institutions addressing climate change, especially with regard to adaptation finance. Partners: COVAW - Coalition on Violence against Women, FEMNET,AWC - African Women and Child Feature Services, FIDA - Federation of Women Lawyers ,Green Belt Movement, AFREPREN, Coast Rights Forum, ARRF - African Research & Resource Forum SID East Africa - Society for International Development ,Institute of Economic Affairs, CMD - Centre for Multi-Party Democracy KEFEADO - Kenya Female Advisory Organisation **Contacts:** East Africa / Horn of Africa Regional Office Heinrich Böll Stiftung, Forest Road, PO Box 10799-00100 GPO, Nairobi, Kenya Tel: +254 (0)20 2680745, -2613992, -2613997 Email: ke-info@ke.boell.org Website: www.boell.or.ke
5. Renewable Energy for Sustainable Development Africa (REEEP)	The Renewable Energy & Energy Efficiency Partnership (REEEP) is a non-profit, specialist change agent aiming to catalyze the market for renewable energy and energy efficiency, with a primary focus on emerging markets and developing countries. REEEP's Voluntary Carbon Offsetting scheme is a mechanism by which governments (both local, regional and national), companies and other institutions can outsource the purchase of CDM or Gold Standard Verified Emissions Reductions (VERs) to REEEP as part of a carbon reduction strategy. REEEP looks for small scale projects which cover renewable energy and energy efficiency, and also have sustainable development benefit for the local population. REEEP places a priority on projects which can be replicated and/or scaled-up. Partnerships: ABN AMRO Bank NV, ABPS Infrastructure Advisory, AEA Technology, AEA-Albania Energy Association, AEAEE, AFREPREN/FWD, African Development Bank, African Forum for Utility Regulation (AFUR), AGAMA Energy, AGRINERGY Ltd, Agroils, AHEAD Energy Corporation, Alliance To Save Energy, American Council On Renewable Energy (ACORE), Appellate Tribunal for Electricity, India, Artson Green Solutions Limited, ASEAN Centre for Energy

Partnership	Details
	Contacts: Email: info@reeep.org Website: www.reeep.org
6. Renewable Energy Ventures Kenya Ltd	Renewable Energy Ventures (K) Ltd. is a renewable energy and energy efficiency project development and advisory firm, located in Nairobi, Kenya with headquarters in Washington DC, USA. It works closely with clients to help reduce their current energy consumption, recommend alternative energy sources, and identify technology partners and structure and source for funding for the implementation. The Solanterns Initiative seeks to replace 1 Million Kerosene Lamps with Solar Lanterns. The initiative provides solar lanterns to Kenya's off-grid households, who are currently dependent on kerosene lamps. Solar lanterns contribute to improvement of health and saves money. Affiliations: Lighting Africa IFC. **Contacts:** Renewable Energy Ventures (K) Ltd. P.O. Box 10644 – 00100 Nairobi, Kenya, Phone: +254 20 359 5602, E-mail: Email:info@africarenewables.com Website: www.africarenewables.com, www.solanterns.com
7. UNIDO	UNIDO in Kenya has focused on pilot climate change adaptation energy interventions, policies and measures. The components of the projects are as follows: **Component 1:** Clean production of tea from micro-hydro for firewood substitution The aim of the project is to reduce the consumption of firewood at tea factories by empowering the community to generate electricity from micro hydro and selling it to the tea factory. The tea factory is required to commit to buying electricity from the community and reduce firewood consumption, while the community commits to reforestation especially in water catchments. 20 kW of the electricity is also reserved for use by the community. **Component 2:** Energy for water security The aim of this project is to enhance access to piped water by providing free electricity for pumping water by generating electricity from the sewage plant and biogas and transmitting it to the water pumping station. **Component 3:** Sustainability and household energy The aim of this component is to provide energy alternatives for household cooking and lighting by establishing 3 CPCs with a focus on productive activities like LED lamp and green charcoal production

Partnership	Details
	using agricultural waste and invasive species (water hyacinth, *prosopis juliflora* e.t.c). The CPCs must provide significant diversification of livelihoods. **Contacts**: P.O. Box 41609 United Nations Avenue Gigiri, Block Q, Room 118 Nairobi ,Kenya Telephone:+254 207624369 Fax :+254 207624368 E-mail:office.kenya@unido.org Website: http: www.unido.org

Appendix 6: Civil Society Initiatives

Many NGO programs are currently active in the country, concentrating on scaling up production capacity, business development and improving access to finance for cookstove producers. The following table lists examples of cookstoves and household lighting initiatives in Kenya.

	The Improved Cook Stoves for Households and Institutions Project (2011-2015)	**Developing Energy Enterprises Program (DEEP) – (2008-2013)**	**Improved Cookstoves for East Africa**
Who	The project is run by HIVOS, working with SCODE - a local NGO and assembler of improved cookstoves.	Implemented by GVEP International with technical support from IT Power.	Collaboration between Uganda Carbon Bureau, Care International and the Nordic Climate Facility
What	The program aims to build the capacity of SCODE a local NGO and stove assemblers so that they can go on to further support small scale producers, end users and institutions with the aim of scaling up the commercialization of the technology. SCODE will open up 5 new branches under the project.	The program provides business and technical support to existing micro energy enterprises through training, mentoring, and market linkages. It also links entrepreneurs to financing through its loan guarantee program to enable them to expand their businesses. The program has trained over 300 entrepreneurs in Kenya.	The project aims to provide sustainable access to affordable and efficient cook stoves. Improving affordability of these cook stoves is achieved by the setting up of a CDM Program of Activities (registered 2011) that will provide stove suppliers with access to revenue from the CDM carbon market.
Challenges	Maintaining consistent quality of the cookstoves when parts are sourced from different suppliers.	Changing mindset of entrepreneurs to realize market potential of energy business.	Delays in registering project in country. Identification of suitable stove producers to work with.
Partners	HIVOS, SCODE, EU, ETC. Foundation, Practical Action Eastern Africa.	IT Power, Practical Action, Coastal Rural Support Program Kenya	Uganda Carbon Bureau, CARE International, Nordic Climate Facility.

	Improved Stoves and Portable Solar Lighting Program	**Kenyan Stoves Project (Energizing Development, EnDev) (2005 – 2012)**	**East Africa Energy**
Who	SNV provide capacity building and advisory services in renewable energy. It's is supported by ETC Foundation through Practical Action Eastern Africa.	Implemented by German based NGO GIZ (formerly under the PSDA program) and Practical Action Eastern Africa and EAETDN Uganda and Tanzania.	East Africa Energy is an NGO focusing on reducing carbon emissions through market based approaches.
What	Since 2011 SNV have expanded their activities into the cookstove sector working on a model for commercialization. They are working with various partners including GIZ and ISAK and Envirofit distributors to build capacity, create market linkages, strengthen distribution and improve access to finance.	The project supports access to modern cooking energy by promoting the sustainable production, marketing, installation and use of improved cooking stoves. These stoves include the portable or installed Jiko Kisasa stove and the built–in mud or fired brick stove, the Rocket.	East Africa Energy is distributing the Envirofit imported charcoal stove in urban areas of Kenya through development of a network of vendors. They are also linking with existing networks to distribute products through. The project will be linked to carbon finance to provide the stove at a subsidized price.
Challenges	Raising consumer awareness on improved cookstoves. Developing standards for the sector.	Maintaining quality standards amongst producers. Educating end user on proper use & maintenance of the stoves.	Delays in registration of the carbon project. Monitoring of the stoves for tracking purposes.
Partners	GIZ, ISAK,	Ministry of Energy, Ministry of Agriculture, Ministry of Education	Envirofit, Advance Aid
Who	Policy Innovation Systems for Clean Energy Security (PISCES) is a DFID funded energy research project whose purpose is to increase	Practical Action.	Implemented by Practical Action in partnership with the Renewable Energy Department of the Ministry of Energy, with funding from UNDP,

	available knowledge and understanding of the policy trade-offs between energy, food and water security in the context of Bio-energy		GEF, SEP.
What	Objective: To provide policy makers with information and approaches that they can apply to unlock the potential of bio-energy to improve energy access and livelihoods in poor communities. Results: Baseline data collection and surveys - on bio-energy access and delivery - Socio-economic, technical and equity analysis; - Theory and model testing through action research and pilot demonstrations;	Work in Western Kenya demonstrated an infrastructure required for quality production of ceramic stoves including paddle mould producers and skilled potters. The project provided technical support across the value chain to ensure commercial sustainability	To demonstrate potential of small hydro in delivering decentralised energy services, and the potential of Community ability in managing micro-hydro projects effectively.
Partners	• University of Dar es salaam, TZ • MS Swaminathan Research Foundation, India • African Centre for Technology Studies, Kenya • University of Edinburgh, UK	Ministry of Agriculture-Home Economics Department; European Union, DFID, Civil Society Challenge Fund.	Ministry of Energy, UNDP GEF.

Appendix 7: Proposed investment and financing plan for the RE hybrid off-grid programme

NO.	STATION	GROUP	PROPOSED SOLAR PV (KW)	PROPOSED WIND (KW)	ESTIMATED SOLAR CAPITAL COST (USD)	ESTIMATED WIND CAPITAL COST (USD)	ESTIMATED TOTAL CAPITAL COST (USD)	PROPOSED FUNDING AGENCY
1	Lodwar	A	250	0	2,039,895	0	2,039,895	NDF
2	Hola	A	100	0	815,958	0	815,958	NDF
Sub-total							**2,855,853**	
3	Mandera	A	200	0	1,631,916	0	1,631,916	AFD
4	Wajir	A	800	300	8,397,761	2,117,082	10,514,843	AFD
5	Merti	A	100	100	2,344,429	705,694	3,050,123	AFD
6	Habaswein	A	100	0	815,958	0	815,958	AFD
7	Elwak	A	100	0	815,958	0	815,958	AFD
8	Baragoi	A	100	100	2,344,429	705,694	3,050,123	AFD
9	Mfangano	A	100	0	2,293,867	0	2,293,867	AFD
10	Rhamu	B	100	0	1,223,937	0	1,223,937	AFD
11	Eldas	B	100	0	1,223,937	0	1,223,937	AFD
12	Takaba	B	100	0	1,223,937	0	1,223,937	AFD
13	Lokichoggio	B	150	0	1,223,937	0	1,223,937	AFD
14	Lokori	B	150	0	1,223,937	0	1,223,937	AFD
15	Faza	B	100	100	1,223,937	705,694	1,929,631	AFD
16	Kiunga	B	150	0	1,223,937	0	1,223,937	AFD
17	Hulugho	B	150	0	1,223,937	0	1,223,937	AFD
18	Laisamis	B	150	0	1,223,937	0	1,223,937	AFD
19	North Horr	B	100	100	1,223,937	705,694	1,929,631	AFD
20	Lokitaung	B	150	0	1,223,937	0	1,223,937	AFD
21	Dadaab	B	100	100	1,223,937	705,694	1,929,631	AFD
22	Maikona	B	100	100	1,223,937	705,694	1,929,631	AFD
23	Lokiriama	B	150	0	1,223,937	0	1,223,937	AFD
24	Banisa	B	100	100	1,223,937	705,694	1,929,631	AFD
Sub-total							**44,060,313**	
25	Nachokui	C	100	100	3,215,016	776,294	3,991,310	WB
26	Turkwel	C	150		3,470,148		3,470,148	WB
27	Kaeris	C	100	100	3,215,016	776,294	3,991,310	WB
28	Liboi	C	150		3,470,148		3,470,148	WB
29	Gari	C	150		3,470,148		3,470,148	WB
30	Dukana	C	100	100	3,215,016	776,294	3,991,310	WB
31	Bubisa	C	100	100	3,215,016	776,294	3,991,310	WB
Sub-total							**26,375,684**	
32	Illeret	C	150		3,470,148		3,470,148	KfW
33	Darade	C	100	100	3,215,016	776,294	3,991,310	KfW
34	Furole	C	100	100	3,215,016	776,294	3,991,310	KfW
35	Kibish	C	150		3,470,148		3,470,148	KfW

36	Lokamarinyang	C	100		3,215,016		3,215,016	KfW
37	Kokuro	C	150		3,470,148		3,470,148	KfW
38	Nadapal	C	100		3,215,016		3,215,016	KfW
Sub-total							**24,823,096**	
39	Napeitom	C	150		3,470,148		3,470,148	Dfid
40	Kerio	C	150		3,470,148		3,470,148	Dfid
41	Oropoi	C	150		3,470,148		3,470,148	Dfid
42	Todonyang	C	150		3,470,148		3,470,148	Dfid
43	Loyangalani	C	100	100	3,215,016	776,294	3,991,310	Dfid
44	Lowarangak	C	100		3,215,016		3,215,016	Dfid
45	Kakuma	C	100	100	3,215,016	776,294	3,991,310	Dfid
46	Haut	C	100	100	3,215,016	776,294	3,991,310	Dfid
47	Kalokol	C	100	100	3,215,016	776,294	3,991,310	Dfid
Sub-Total							**33,060,848**	

Notes:

(a) Group A comprises the existing mini grid stations, Group B comprises the mini-grid stations under construction while Group C comprises the proposed green field mini- grid stations.

(b) For stations where the renewable energy is to be installed in the existing power station, we have assumed a cost rate for solar PV and wind of 5,102.64 and 4,000.00 US$/kWp respectively, and for batteries 3,056.94 US$/kWh based on recent tenders.

(c) For Wajir solar PV plant, which is to be installed in a new site as the space where the diesel plant is located is insufficient (already land is allocated), we have assumed a rate of 7440.26 US$/kWp based on Mandera plant as there will be civil works for control building and approximately 5km of power line to evacuate the power.

(d) For green fields, we have assumed a daily energy requirement of 600kWh based on current requirement for Merti Power Station which has been operating for the last five years. We have assumed battery storage of 700kWh will be required. We have added an estimate of USD 235,294, 538,235 and 47,059 for distribution system, civil & mechanical works and standby generator respectively.

(e) It is assumed that all the renewable energy projects will have batteries of one hour storage capacity for stabilization.

(f) We have considered an option of increasing the battery storage for the stations of Mfangano, Merti and Baragoi which have very low demand, so as to operate 100% from renewable energy most of the time with diesel on being on standby.

Appendix 8: Stakeholders in the Energy Sector

Many organisations are active in the power sub-sector, including private companies, national financial institutions and multilateral organisations. Examples include the World Bank, AfDB, AFD, IFC, KfW, JICA, EU, China Exim, the East Africa Cables, Power Technics (switch gear manufacturers), ABB, Wartsila, Mann, Niigata etc. The major actors in modern energy for productive use are KAM, Energy Auditors, Carbon Asset firms, AfDB, KTDA, practical Action UNIDO, UNDP, UNEP and GIZ. Private Sector Actors in thermal energy for households include improved cook-stove Association of Kenya, Practical Action-cook- **s**toves/bio-ethanol, SNV-Biogas, GIZ, UNIDO, UNDP, TERI and Paradigm-cook-stoves. Private Sector Actors include: SACCOs, MFIs, Energy CBOs, KTDA, Renewable Energy product manufacturers, importers, wholesalers, retailer and technicians Solar PV manufacturers such as UBBINK. Private sector players in energy efficiency and conservation comprise KAM/CEEC, Energy Audit Firms, Energy Service Companies (ESCOs) and GIZ.

Appendix 9: Sustainable Energy for All Taskforce

	Name	Organization
1.	Eng. Isaac N. Kiva	Ministry of Energy(MoE)
2.	Ms. Faith H. Odongo	MoE
3.	Eng. Justus M. Mbithi	MoE
4.	Mr. John K. Maina	MoE
5.	Mr. Francis Nderitu	MOE
6.	Eng. Boniface Kinyanjui	Kenya Power
7.	Ms.Karen Giathi	UNIDO
8.	Mr. Timothy Ranja	UNDP
9.	Mr. Edwin I. Nateminya	UNDP/MOE
10.	Ms. Lydia Muchiri	Practical Action
11.	Mr. Charles Muchunku	KEREA
12.	Eng. Nicholas Gachie	KAM
13.	Mr.Pavel R. Oimeke	ERC