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ENERGY EFFICIENCY IN KENYA: PUBLIC AWARENESS, STRATEGIES, CHALLENGES AND OPPORTUNITIES

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About the study:

This research report presents an analysis of the state-of-the-art of energy efficiency at the household level in Kenya. It particularly focuses on public awareness and behaviour, critical actors, policy instruments and the challenges for achieving energy efficiency in the country. It is published under the framework of the transformAfrica program: Towards ecological and social transformation in Africa.

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Martin Brown Munene
Africa Development Resources
and Capacities Institute

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LIST OF ABBREVIATIONS AND ACRONYMS

CEEC	Centre for Energy Efficiency and Conservation
CFLs	Compact Fluorescent Light
CIDPs	County Integrated Development Plans
CLASP	Collaborative Labelling and Standards Program
CSOs	Civil Society Organisations
DANIDA	Danish International Development Agency
EE	Energy Efficiency
ERC	Energy Regulatory Commission
GEF	Global Environment Facility
GHGs	Greenhouse Gases
IEA	International Energy Agency
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
KAM	Kenya Association of Manufacturers
KEBS	Kenya Bureau of Standards
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KIRDI	Kenya Industrial Research and Development Institute
KPLC	Kenya Power and Lighting Company
LED	Light Emitting Diodes
LPG	Liquefied petroleum gas
MEPS	Minimum Energy Performance Standards
MoEP	Ministry of Energy and Petroleum
MTP	Medium Term Plans
NDCs	Nationally Determined Contributions
NGOs	Non-Governmental Organisations
SDGs	Sustainable Development Goals
UN	United Nations
UNDP	United National Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency in International Development
WRI	World Resources Institute

SUMMARY

This report provides an analysis of energy efficiency (EE) in Kenya. It particularly evaluates the public awareness of EE, the pertinent policy instruments, associated measures for achieving EE, and the challenges facing the realisation of EE in the country. It recommends reinforcements to and amplification of ongoing successful EE initiatives, and incorporation of alternative EE solutions based on global best practices towards the promotion and achievement of EE goals in Kenya.

Based on a desktop research and a survey of 137 households in Kenya, this report provides insights into the various energy demand and consumption aspects that influence the adoption of EE practices in the country. These include the different types of energy being used domestically in the household level, the respondents' knowledge of EE, household energy consumption monitoring/tracking trends, respondents' perception of EE, knowledge on the potential EE practices, benefits associated with EE, and their knowledge regarding climate change dynamics and how these compare with domestic energy use. It further explores the potential motivations for adopting EE practices as well as the current and preferred EE knowledge sharing platforms/channels to enhance knowledge and diffusion of EE ideas and options.

It concludes that the prevalent energy use practices are not necessarily energy efficient. The key determinant for energy use practices appears to be primarily the socioeconomic class (i.e. linked to wealth/poverty) and education levels of the household decision-makers. These attributes also seem to influence the choice of energy and information sources. In effect, the study establishes that some pockets of Kenyans adhere to EE practices while others do not. Other factors that play a role in this include the cost of energy and appliances, user attitudes and access to adequate information on energy conservation and efficiency.

Most households have limited options for switching energy sources and use. This is largely due to the monopoly of Kenya's national electricity utility company, the Kenya Power (formerly known as the Kenya Power and Lighting Company, KPLC). We find that there have been and are several EE policies/regulations and initiatives in the country. However, their implementation and effectiveness face (or faced) a myriad of challenges including lack of support from the regulators, the regulated and the political leadership. Most Kenyans also are oblivious of these regulations or policies and the specific EE initiatives in their localities.

1. INTRODUCTION

1.1. Background

In the last few decades, climate protection, sustainable economic development and energy security have received increasing attention. Access to clean, affordable, reliable and sustainable energy has been identified as one of the key requirements in sustainable development (Vera and Langlois, 2007). Energy is increasingly at the centre of international debate on development, disaster risk reduction, environment and climate change (UN, 2015; World Bank and IEA, 2015). Energy access has also been termed as one of the most important social justice issues of the modern times. Energy poverty is for instance considered a major challenge and hindrance to development especially in developing countries like Kenya (Bugaje, 2006; Butler, 2018; UNDP, 2005). Energy poverty not only aggravates food insecurity, water scarcity and vulnerability to climate change, but also adversely affects the general health and wellbeing of the people (Holtermann and Nandalal, 2015; Joubert, 2016; Leck et al., 2015).

Providing abundant energy to all without causing harm to the planet is an immense challenge facing humanity (Cassidy, 2014; DOE, 2018; Marić et al., 2016). If a high-energy future while protecting the natural world for posterity is a desired outcome, then the environmental consequences of energy production and use must be considered at all levels of decision-making processes. Financing of efficient clean energy development and use is a critical factor as well when considering sustainable energy pathways (Gillingham et al., 2009; Sarkar and Singh, 2010; Wang, 2013). Energy solutions that overlook economic costs are not realistic, especially in a highly unequal world where billions of people currently can't afford access to basic energy services (Gillingham et al., 2009).

The big question then becomes: how can progress be made? Although there may be a raft of possible answers to explore, one of the most promising solutions that is preoccupying governments, academic and research institutions, and the civil society is promoting energy efficiency (EE) and energy conservation practices.

1.2. Energy efficiency

Energy cannot be created or destroyed - what happens is that energy undergoes conversion or transformation from one form to another when transferred by an appliance or equipment. In this conversion process, some of the energy is transferred by the device in a useful form (such as light in case of a bulb) while some is 'wasted', i.e. transformed into a non-useful form (such as heat in case of a light bulb) (Kosky et al., 2013). Thus, EE is a measure of the useful energy transferred compared to the total energy supplied. It is the ratio between the useful output and input of an energy conversion process. It can be expressed in decimal or as a percentage (multiply by 100 to express as a percentage). Thus,

$$Energy\ efficiency = \frac{Useful\ energy\ out}{Total\ energy\ in}$$

In practical terms, EE means using less energy to produce the same amount/level of service or useful output (Cassidy, 2014; Patterson, 1996). EE is used in many occasions to mean all energy saving efforts including energy conservation (which implies reduced energy consumption for example by choosing to use less energy service – e.g. driving, heating or lighting less -- so that some energy is left/available for future use). It is easy to see why the two concepts are used together, especially because energy conservation can be achieved through efficient energy use (such as through energy-efficient appliances) in which case energy use is decreased while achieving a similar outcome or by reduced consumption of energy and related services (Chung et al., 2006; Gadonneix et al., 2010; Mastelic et al., 2014; Patterson, 1996). Seen this way, conservation of energy is a product of EE practices.

For instance, EE can be achieved by changing appliances such as boilers, fridges, kettles, and microwaves for more efficient versions, or replacing traditional incandescent bulbs with Light Emitting Diode (LED) and Compact Fluorescent Light (CFL) - which require less electricity to produce equal or more lighting (Goswami and Kreith, 2007). In addition, EE measures such as installing double glazing and insulating cavity walls and loft spaces can make heating or cooling a space more efficient by reducing the amount of energy required for the purpose (Cassidy, 2014; DOE, 2018). EE appliances or systems are designed to waste (i.e. transfer energy in non-useful form) as little energy as possible.

EE is seen as a key to a 'safe, reliable, affordable and sustainable energy system' for the future. It is also regarded as "the quickest and least costly way of addressing energy security, environmental and economic challenges" (IEA, 2014a, p. 3). EE is playing an increasingly important role in the contemporary society. Its importance in environmental sustainability, global economy and enhancing personal finance form three broad, key reasons EE is attracting so much interest.

Environmental reasons: High consumption of energy is associated with increased carbon emissions into the atmosphere and depletion of reserves of natural energy resources such as oil, coal, gas and vegetation cover. Thus, there is an increasing need to reduce overreliance on these energy sources. One way to do that is to ensure that energy is used as efficiently as possible at all levels whether household, corporate or industrial.

'The economy' reasons: The modern global economy is heavily dependent on oil and gas, as well as other naturally occurring vegetation sources. As these resources decline, especially in rural Africa where wood, charcoal and kerosene still constitute the bulk of energy units being consumed, their cost will increase. This has the potential to not only cause financial imbalances around the world but also increased energy poverty in many areas of the society. In this regard, EE also becomes an important social justice issue.

Budgetary reasons: Almost nobody would want to pay more than they should for everyday necessities like heating (e.g. hot water), lighting, and cooling (refrigeration). It

thus makes sense to be energy efficient to meet the energy needs while paying as little as possible (that is, with the least cost). Reducing the amount spent on energy would also leave countries and individual/household consumers with some change to spend on other necessities needed for their subsistence and development. This can improve the quality of life and reduce poverty levels for many across the globe.

The benefits of EE also go well beyond the mere reduction of energy demand (and consumption). Its potential to boost economic growth, augment social development, advance environmental sustainability, ensure 'energy-system' security, reduce energy poverty, reduce demand and consumption, and help build wealth has been recently documented in more general terms (IEA, 2014b).

1.3. Why this study?

EE plays a critical role in achieving Kenya's climate protection targets, especially the nationally determined contributions (NDCs) under the Paris Agreement on climate change (UNFCCC, 2015). It is also central to the achievement of the country's Vision 2030 (Republic of Kenya, 2008), the national development blueprint which aims to make Kenya a middle-income country by 2030. Despite the great importance EE could potentially play in promoting sustainable development and wellbeing, assessments indicate that under existing policies, about 66% of the economically viable EE potential available between now and 2035 will remain unrealised because EE is routinely and significantly undervalued (IEA, 2014c). In addition, the energy transition discourse appears to be preoccupied with energy generation (Breeze, 2014; Shaheen et al., 2005), and more recently, fairly on energy storage technologies and options (Díaz-González et al., 2012; Dunn et al., 2011; Hall and Bain, 2008; Hordeski, 2002).

In Kenya, public attitudes and habits concerning energy efficiency measure have remained largely unexplored, despite the increasing focus on the workings of the country's electric utility giant, the Kenya Power – which until 2011 was known as the Kenya Power and Lighting Company (KPLC). It is undisputable that civil society organisations (CSOs) and local stakeholders play a crucial role in formulating and implementing EE policies and standards (Jairaj et al., 2013; Smith, 2012). For instance, they raise public awareness within their jurisdictions as well as participate in the actual implementation of the policies on the ground. Their participation is especially important not just because such initiatives and policies affect their constituents, but also because they are significantly aware of the specific legal, administrative, and technical challenges that might obstruct successful implementation of EE policies and/or initiatives.

Generally, the involvement of Kenyan civil society and local stakeholders in the development and implementation of energy efficiency policies and (public) initiatives is less explored and thus not well understood. Some studies on energy efficiency have been undertaken with a focus on institutional or corporate level undertakings (Ronoh, 2018). However, such studies do not report the role of corporate stakeholders, particularly, the suppliers of energy alternatives in facilitating EE in Kenya. They instead focus more on EE measures put in place by corporations that are considered to be large scale energy consumers especially as a way for them to reduce their cost of operations. As a result, the

level of public awareness on energy efficiency has been unclear especially among small scale energy consumers. Lack of awareness (or failure of communication) is one of the possible high potential barriers to EE (Mutua and Kimuyu, 2015).

Kenya was actively involved in the design of the post-2015 global development agenda. The Country's Permanent Representative to the UN co-chaired the UN General Assembly Open Working Group on SDGs that was mandated to develop a set of sustainable development goals. She has thus been a vocal, top advocate on the resulting framework, the 2030 Agenda for Sustainable Development. However, when the SDGs were adopted in 2015, the country was in the third year of implementing the second Medium Term Plan[1] , MTP (2013-2017) (Republic of Kenya, 2013). The preparation of the third MTP (2018-2022) and the second generation of County Integrated Development Plans (CIDPs) is underway, and SDGs are to be mainstreamed therein. In addition, the country was part of the 2017 voluntary national review of the high-level political forum on sustainable development. However, most of these have been happening at the high ranks without much awareness of the civil society and other relevant local stakeholders, hence their limited participation in development and implementation of EE policies and measures.

Energy markets and market prices influence consumer decisions on energy consumption and investments in more energy-efficient products and equipment (Gillingham et al., 2009). But consumers cannot make informed decisions if they are not aware of EE solutions and options available to them. This is one of the impediments to the advancement of EE measures in the country. Understanding the challenges that must be overcome is central to improving EE (Grueneich, 2015).

This report addresses some of the above gaps by analysing public awareness on energy efficiency in Kenya and identifying challenges and opportunities for scaling up the adoption of energy efficiency technologies and practices. It maps out the status quo of EE policies and initiatives in Kenya particularly focusing on the public awareness for those measures and analyses the different relevant stakeholder perspectives, such as decision-makers, companies, civil society, and citizens. It also assesses the level of awareness of citizens of different EE approaches; analyses the obstacles and opportunities for implementing EE measures in Kenya; and identifies some of the good practices and initiatives in Kenya that might be replicated.

1.4. Target users and expected outcome

This study contributes to knowledge and data that could be useful in not only the promotion of awareness of EE measures, but also increased adoption of the same and participation of all stakeholders in enhancing EE. This research paper is expected to promote a more sustainable use of energy in support of the debate on EE improvements in Kenya and facilitate capacity development and knowledge dissemination targeting diverse audiences. The primary target users of this report are the state and non-state actors interested in EE in Kenya. These include policy- and decision-makers, companies trading in energy products (including those that trade in sustainable energy sourcing

1 : Kenya's long-term economic development blueprint, the Kenya Vision 2030, guides the countries development trajectory. It is being implemented in five-year rolling Medium Term Plans (MTP) since 2008.

and technologies), NGOs, Civil Society Organizations, research institutions and academic institutions. The secondary target group will be the private sector actors in the industrial and mining, commercial, tourism, public buildings, transport and educational sectors whose energy consumption habits impact the aggregate national EE outlook. Furthermore, the paper can be used to form the basis for further research and development of educational material on energy efficiency in Kenya.

The remainder of this report is set out as follows: Section 2 focuses on the research methodology, which includes a detailed description of the sampling method and data collection techniques and analyses. Section 3 presents the study findings and discusses the results, while Section 4 provides the conclusion (which includes identifying some of the limitations of the study) and recommendations.

2. RESEARCH DESIGN

We applied a mixed-method study approach (Denscombe, 2008; Johnson and Onwuegbuzie, 2004) where both quantitative and qualitative research methods were used to collect and analyse data on household energy efficiency. In this section, we explain the research approach, data collection and analysis techniques, study site selection and survey sampling procedure.

2.1 Approach

The study was undertaken in two main stages. The first stage entailed the collation of knowledge on energy efficiency in Kenya through desktop research and stakeholder interviews. The desktop research was guided by questions regarding the state of energy efficiency in Kenya and focused especially on the public awareness of energy efficiency, the challenges and impediments to energy efficiency measures, and opportunities for realistic and (potentially) high-impacting energy efficiency initiatives. The second stage involved a household survey to collect data on public awareness, opinions and practices of residents relevant to energy efficiency.

2.2 Data collection and analysis

For this study, both primary and secondary data were collected. Secondary data collection involved extensive desk study where we reviewed publications and documents from the Kenyan government such as the Acts of Parliament, regulations, and/or various (strategic) plans relevant to EE. The Least Cost Power Development Plan (2011-2031 and the revised 2017-2037 version), Development of Power Generation and Transmission Master Plan (2015-2035): long term plan for energy efficiency and the Vision 2030 objectives and referred to as the Energy Efficiency Report, Kenya (2015- 2035) as well as many reports of the Energy Regulatory Commission (ERC) were of interest and importance too. We also consulted reports and briefs published by different international institutions such as the World Bank, United Nations Development Programme (UNDP) and other United Nations (UN) bodies and the International Energy Agency (IEA). Lastly, reports from some non-governmental organisations (NGOs) that have worked or are working on this topic (especially in Kenya) were also reviewed. The data from these secondary sources were collated, corroborated and interpreted to fulfil the study objectives.

The secondary data were complemented with primary data, which were collected through interviews with various stakeholders working on EE related activities such as the Ministry of Energy and Petroleum, Energy Regulation Commission, Kenya Association of Manufacturers, and the UNDP.

Further a household survey was carried out to collect data on public awareness on energy efficiency practices and initiatives by the residents of predetermined localities. The questionnaire contained both open-ended and closed-ended questions, which were administered by trained Research Assistants (RAs) in October 2018.

Data from the interviews were analysed to answer the set-out research questions and to also develop policy recommendations that highlight some of the opportunities for scaling up energy efficiency practices at different levels and sectors. Quantitative data from the survey were captured and entered in Microsoft Excel sheet. These were then cleaned, analysed and presented in summary tables and graphs as deemed appropriate. The study followed relevant ethical considerations and was done in accordance with the ADRC Institute's Research Ethics Guidelines for Low-Risk Research.

2.3 Survey site selection and sampling procedures

2.3.1 Survey site selection

The household survey was carried out in 7 counties namely Nairobi, Kajiado, Makueni, Nakuru, Murang'a, Kiambu and Machakos. These were purposely selected considering the time and financial resources available without compromising on the representativeness of the data collected in terms of social and economic differences among the respondents. The site selection within each county was categorised under rural, semi-urban, urban slum, urban middle and urban-upper, and areas.

2.3.2 Survey sampling procedure

A total of 137 households were surveyed (each respondent represents an individual household). As illustrated in Table 1 and Table 2 below, Nairobi County was oversampled to compensate for its high and diverse population while respondents from the rest of the counties ranged between 14 and 17. The survey was undertaken between Wednesday 17th October and Tuesday 23rd October 2018. On average, each interview took 30 minutes.

Several measures were taken to ensure that the data collected was accurate. For example, the respondents were expected to be residents and owner or head (a key decision maker on energy consumption) of the household that was visited by the enumerator. Where necessary, probing and data triangulation were employed to ascertain credibility and authenticity of collected data. In addition, the data collected were entered (and analysis done in case of qualitative data) as soon as possible to ensure proper recall and enhance the quality of interpretation.

3. RESULTS AND DISCUSSION

In this section, we provide a summary of the sample demographics, key energy efficiency instruments and measures in Kenya and highlight some of the initiatives supporting EE related activities/practices both on the demand and supply sides of the energy value chain. We further report back on the perspectives from some of the stakeholders who were interviewed and also the households we surveyed during the study. Some of the challenges and opportunities that EE can bring are also highlighted in this section.

3.1 Demographics

COUNTY	Kajiado	Kiambu	Machakos	Makueni	Murang'a	Nairobi	Nakuru
# OF HH RE-SPONDENTS	17	16	14	16	16	43	15

Table 1. Respondent household distribution per county.

COUNTY N=137	SUB- COUNTY	WARD	LOCATION	# OF HH (N)
MAKUENI	Kibwezi West	Mulala	Mulala	16
KAJIADO	Kajiado North	Nkaimurunya	Nkaimurunya	17
MACHAKOS	Machakos Town	Machakos Central	Machakos Central	14
NAKURU	Naivasha	Lakeview	Pipeline	15
	Naivasha	Hell's Gate	Nyamathi	
	Gilgil	Mbaruk-Ebburu	Eburru	
	Naivasha	Viwandani	Site	
MURANG'A	Murang'a East	Kinyona	Githima	16
	Murang'a South	Kamahuha	Sabasaba	
	Maragua	Kaharati	Wairure	
KIAMBU	Ruiru	Gitothua	Tatu City, BTL	16
	Githonguri	Kahawa Wendani	Kahawa Sukari	
	Kiambaa	Ndenderu	Ruaka	
NAIROBI	Embakasi West	Kariobangi South	Buruburu	13
	Embakasi South	Mukuru Kwa Njenga	Mukuru Kwa Njenga	8
	Roysambu	Roysambu	Roysambu	5
	Westlands	Parklands	Parklands/ Muthaiga	4
	Dagoreti North	Kilimani	Kilimani	3
	Starehe	Nairobi Central	Upper Hill	4
	Ruaraka	Mathare North	Mahare North	3
	Mathare	Huruma	Huruma	3
TOTAL				137

Table 2. Detailed distribution of respondents by administrative units.

Considering that energy use regimes are largely a factor of socioeconomic status of each household, disaggregation by neighbourhood is necessary and important. Instead of asking about each household's income, each neighbourhood's general outlook/state is considered to be the average of the socioeconomic status of its residents. Thus, the

respondents can be grouped accordingly as rural (25%), semi-urban (27%), urban-upper (9%), urban-middle (33%) and urban-slum (6%) - see Chart 1.

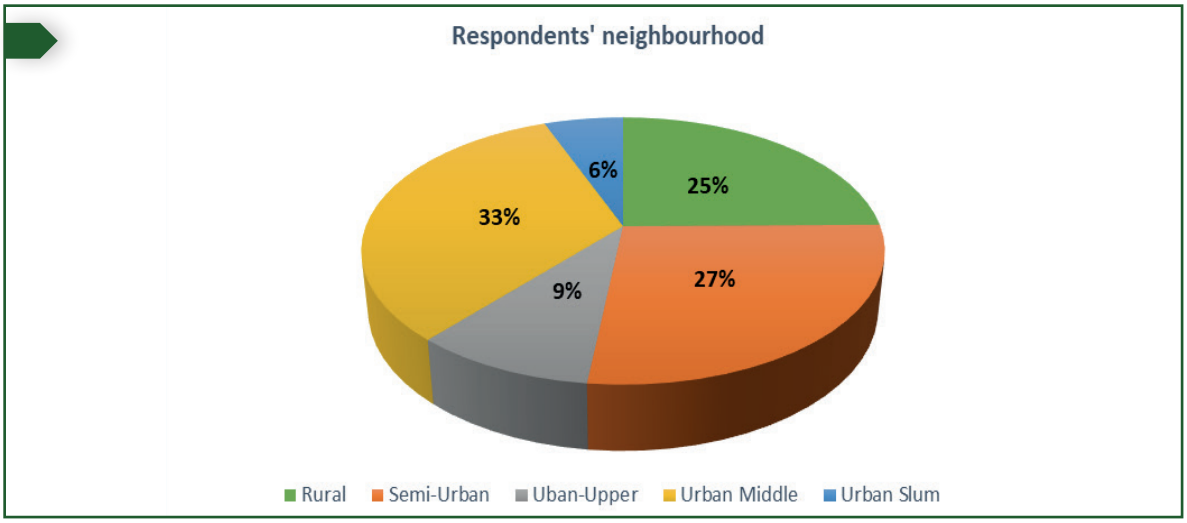

Chart 1. Respondents' distribution by neighbourhood.

In terms of gender, the female and male respondents accounted for almost equal proportions at 51% and 49% respectively. The proportion of those under the age of 35 years (youth) was equal to that of respondents above 35 years as illustrated in Table 3.

RESPONDENTS' AGE	PERCENTAGE
18-24	13%
25-35	37%
36-50	39%
Above 50	11%
TOTAL	**100%**

Table 3. Respondents' distribution by age.

95% of the respondents had at least the basic primary school education, and 73% of the respondents had some form of employment while 26% did not. Of those employed, 44% were formally employment while the majority of 56% were under informal employment.

Most of the residences (52%) were rented while 45% of them were owner-occupied. The remaining 3% lived in their homes through other alternative arrangements -see Chart 2.

Among those who marked their residence ownership as "other" include respondents living in company/government houses, or those who were not the actual owners of the homes within which they were interviewed but lived and undertook energy-related activities within them as the key decision makers, e.g. relatives of the actual home owners.

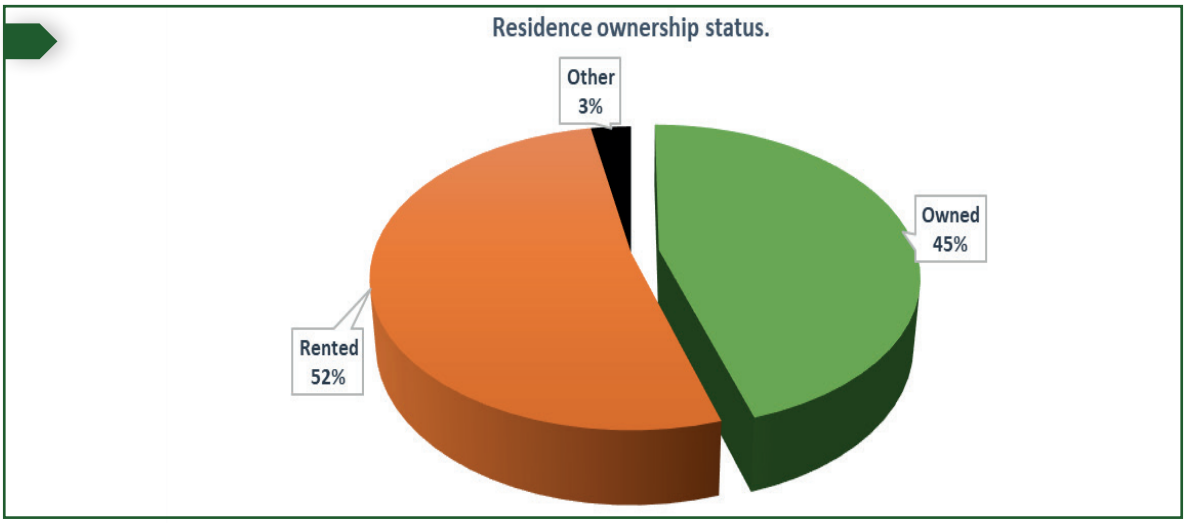

Chart 2. Respondent distribution by ownership of the residence.

3.2 EE Instruments and Measures in Kenya

The desktop review revealed that there are several policies, legal and regulatory frameworks for the energy sector in Kenya, and which are aimed at supporting one or more aspects of energy efficiency and conservation in the country. Table 4 shows a list of these – although we don't claim it to be exhaustive. Since an analysis of these is beyond the scope of this report, we only highlight a few key instruments that we deem relevant for this study.

INSTRUMENT/MEASURE	FROM	TYPE
Clean Energy Services Programme	2011	Subsidies
Designation of Energy Users Gazettement	2013	Strategies
Electric Power (Electrical Installation Work) Rules	2006	Requirements
Electric Power Generation Licences	2014	Permitting
Energising Development Kenya Country Programme	*2006	Requirements
Energy (Appliances' Energy Performance and Labelling) Regulations, 2015	2015	Requirements
Energy (Blending of Power Alcohol with Motor Gasoline) Regulations, 2010	2010	Requirements
Energy (Complaints and Dispute Resolution) Regulations, 2012	2012	Requirements
Energy (Electricity Licensing) Regulations 2012	2012	Requirements
Energy (Energy Management) Regulations, 2012	2012	Guidelines
Energy (Solar Water Heating) Regulations, 2012	**2012	
Renewable Energy Regulations: Energy (Improved Biomass Cookstoves) Regulations 2013	2013	Requirements
Energy Act 2006	2006	Requirements
Energy Regulation 2009 on Biodiesel Licensing	2009	Requirements
Feed-in tariffs and a policy Instrument for promoting renewable energies and green (economies in developing countries (Nairobi, Kenya	2012	Requirements
FiT policy: feed-in-tariffs policy on wind, biomass, small-hydro, geothermal, biogas and solar resource generated electricity	2012	Feed-In Tariff
Kenya Climate Venture Facility (KCVF) Project	2012	Strategies

Kenya Electricity Grid Code	2008	Requirements, Standards
Kenya National Commission for UNESCO (KNATCOM) Act 2013	2013	Strategies
Least Cost Power Development Plan 2011-2031	2011	Action Plans
National Energy and Petroleum Policy 2015	2015	Requirements
Power Purchase Agreement (PPA) - Simplified Agreement Developed for Kenya	***2016	Tax Levels
(Sustainable Energy for All (SE4ALL	2011	Subsidies
Sessional Paper No. 4, 2004 on Energy	2004	Requirements

Instrument amended in 2015 and 2016 *
The instrument was annulled in August 2018**
(The instrument was amended in 2014 and ended this year (2018***

Table 4. Energy Efficiency Measures and Instruments in Kenya.

The Session Paper No. 4, 2004 on energy is one of the earliest key government documents on the matter. Its aim is to lay the policy framework for cost-effective, affordable, adequate and quality energy services sustainably from 2004 through to 2023. The enactment of a new and robust energy law is one of its key agenda for action. Under sections 5.6 and 6.6.6 it highlights the benefits and challenges of energy efficiency and conservation in Kenya and the intention of the government to promote energy efficiency and conservation respectively. The possible direct savings on energy costs by consumers and the reduction in foreign exchange costs of oil imports and of deferred additional investment in power generation capacity that the electricity supplier could get as some of the benefits for promoting EE programs and initiatives are contemplated in this report. Moreover, it also reflects on the potential competitive advantage of Kenyan products at the global market due to reduced energy input cost. The report further identifies some of the challenges facing EE efforts in the country including high costs procuring efficient energy technology and products; lack of awareness on these EE technologies; inadequate fiscal incentives; inappropriate and limited credit/financing mechanisms; and inadequate capacity to promote and monitor penetration. The government provides recommendations for addressing the identified barriers and constraints. The recommendations include encouraging private sector participation in providing EE technical and financial support; supporting energy audit exercises; establishing energy and equipment testing laboratories; creating awareness on EE practices; encouraging demand side management; and developing standards and codes for EE practices.

The other critical document is the Energy Act of 2006 – which was part of the aforementioned Sessional Paper's action agenda. Its scope is broad and covers all forms of energy, but the Act provided a regulation for implementation of energy efficiency and conservation activities especially under Sections 104, 105 and 106. Section 104 of the Act describes the energy efficiency and conservation programme by listing the powers of the cabinet secretary in charge of energy, which include the development and management of the national energy efficiency and conservation programme; develop requirements for particulars for standard labels on equipment and appliances in consultation with Kenya Bureau of Standards; promote awareness creation and research and development activities; support pilot projects and education curriculum development; and implement international co-operation programmes. Section 105 of the Act elaborates the duties and powers of the ERC as including designation of energy

users and inspecting designated facilities, while Section 106 of the Act describes the duties of the owner of the designated facility and penalty in case of default.

The Energy (Energy Management) Regulation of 2012 gives details of how to implement the sections 104, 105 and 106 of the Energy Act 2006. The Regulation provides guidelines on how the ERC will perform its duties and responsibilities; who and how to carry out energy audits; and the establishment of minimum energy requirements for the bulk energy users.

The ERC also gazetted the Energy (Appliances' Energy Performance and Labelling) Regulations, 2015. This regulation details what is expected from the manufacturers, the type of energy efficiency tests to be carried out on appliances and equipment, accredited laboratories to carry out these tests and the display of labels showing the efficiency rating (shown as a star). The equipment and appliances listed include self-ballasted lamps, double capped fluorescent lamps, ballasts for fluorescent lamps, refrigerating appliances, non-ducted air conditioners and three-phase cage induction motors.

Kenya's Intended Nationally Determined Contribution[2] (INDC) of July 2015 further demonstrates the efforts the government is putting in promoting energy efficiency. Through its communication to the UNFCCC, Kenya voluntarily pledged to enhance its energy efficiency across various sectors as one of the mitigation measures to achieve a low carbon, climate resilient development pathway. Moreover, the recently released special report by the Intergovernmental Panel on Climate Change on the implication of global warming of 1.5oc pre-industrial level has listed energy efficiency as one of the mitigation options in the energy demand sector. The report clearly states the need to increase diffusion of energy efficient appliances and equipment across all end use sectors such as the households, buildings and industries.

3.3 EE initiatives in Kenya

According to reviewed secondary literature, the government of Kenya, working together with other stakeholders, has implemented various EE initiatives with the aim of reducing production cost; reducing pressure on the national electricity generation, transmission and distribution facilities; reducing environmental degradation and greenhouse gas emissions; improving energy utilization and cost index; reducing pressure in imports; and improving in energy conservation measures. A study by KIPPRA in 2009 indicated that the estimated national energy saving for all forms and sources of energy was KES. 24.20 billion, which translated to 7,604,374 giga joules, with the household sector having the highest energy saving potential (KIPPRA, 2010). This is because the evening lighting demand from the household accounts for a major portion of the peak load therefore leading to a reduction in the system load factor, which is a measure of the efficiency of utilization of the available capacity.

2 The INDCs were submitted before the 21st Conference of Parties (COP21) to the UNFCCC in December 2015 where the Paris Agreement was adopted. Afterwards, these (some with amendments) became NDCs – nationally determined contributions for each country.

The various EE initiatives have focused on the supply and demand sides of the energy system. To reduce energy losses on the supply side, there have been several deliberate efforts by the Kenya Power to reinforce the electricity system so as to enable it to cater for the growing load. Such efforts have been through installation of energy efficient transformers; establishment of more primary sub-stations to reduce the length of distribution lines and relocating of transformers to load centers and grid extension; and capacitors installations on the power system. All these were through the Distribution System Reinforcement and Upgrade component under the Energy Sector Recovery project. For example, the last mile connectivity program first phase aimed at maximizing transformer usage where households lying within 600metres of earmarked transformers were connected to the grid using low-voltage networks and services at a subsidized connection fee of KES 15,000. The second and third phase involved transformer maximization, installation of new transformers and extending the low voltage network to more households.

On the demand side, several efforts have been carried to reduce the consumer load therefore reducing losses on the supply side hence enabling the system to serve more customers. Such initiatives targeting the consumers include use of energy efficient appliances in the household sector; energy efficiency improvements in buildings; solar water heaters installation in residential sector; energy efficient street lighting programs; and support to Kenya Association of Manufacturers (KAM) to undertake energy efficiency audits and other programs for the industrial sector.

Use of energy efficient appliances in the household sector involved adoption of Low Emitting Diodes (LEDs), which lasts longer than the ordinary incandescent lamps, generate less heat (no cooling needed) and saves up to 80% of energy used on lighting. Moreover, the use of electronic ballasts for fluorescent tube lighting saves energy as it uses up to 40% less energy, is flicker free and eliminates hum. The government through KPLC rolled out the distribution of 1.25 million in 2010 and 3.3 million energy saving bulbs in 2013 in their phase I and II campaign on energy efficient lighting program respectively that targeted the middle- and low-income households. Phase I of the programme was estimated to have saved up to 60MW of energy while Phase II saved an estimated 150MW of energy both especially during evening peak demand. The reduction in peak demand was reported to consequently lead to an annual reduction in GHGs emissions of about 145Mt CO2e (Byrne, 2013).

For cooking, households are advised to use improved biomass cookstoves such as the Kenya Ceramic jikos, jiko koa, ecozoom, envirofit, rocket stoves among others that have higher efficiencies as compared to the traditional three-stoned cookstove and inefficient jua kali charcoal stoves. Furthermore, promotion of energy efficient electrical equipment and appliances has been carried out. The unaffordability of these remain a major impediment to their accessibility.

Apart from the lighting equipment, programs to enhance the use of energy efficient refrigerators, air conditioners, washing machines and entertainment appliances were implemented. Manufacturers and distributors of these appliances were expected to carry out energy efficiency testing of all their appliances and indicate the level of energy

efficiency on the appliance. The local distributors were also given a window, which ended in July 2018 to sell all their old stock, where any inefficient appliances and those without efficiency labels will be confiscated. Moreover, importation of equipment and appliances without the energy efficiency stickers were halted. In residential areas, apart from the use of energy efficient equipment and appliances, residential owners are expected to install solar water heaters instead of electric water heaters that consume a lot of electricity. However, the enforcement of this regulation has been a challenge. For instance, a high court appeal barred its enforcement in May 2018 (Damary, 2018). Subsequent objections from the Members of Parliament in August 2018 who termed its enforcement as 'punitive' led to it being repealed (Mutai, 2018). Energy efficient street lighting programs involved installation of timers on all street lights, which turned on security lights in the evening and off in the morning to ensure that lights are switched on only when necessary. Moreover, the use of photo sensors for security lights in residential areas that turn on at night and off during the day.

In the industrial sectors, the government and private sector actors through KAM collaborated to promote energy efficiency in the sector. Through this partnership, The Ministry of Energy and Petroleum (MoEP) and KAM established the Centre for Energy Efficiency and Conservation (CEEC) in 2006, where the center runs a program to help companies identify energy wastage processes, determine saving potential and recommend measures to be implemented. Various companies undergo energy, and resources and climate change audits, company managers undergo specialized trainings, and companies can participate in Energy Management Awards and also exchange visits for benchmarking purposes. With support from MoEP and the Danish International Development Agency (DANIDA), KAM through CEEC have been able to carry out more than 1000 general and investment grade energy audits at a subsidized cost, trained more than 400 energy managers in industries and supported the establishment of the Association of Energy Professionals of East Africa in 2016. Moreover, through the auditing initiatives, an estimated KES. 12 billion has been saved in the last 12 years.

3.4 Stakeholder perspectives on EE

Various stakeholders are involved in energy efficiency initiatives and projects in Kenya. On the government side, the Ministry of Energy and Petroleum, Ministry of Trade and Industry, Energy Regulatory Commission, Kenya Bureau of Standards, Kenya Industrial Research and Development Institute and Kenya Revenue Authority have been in the forefront in supporting EE activities. In the private sector, Kenya Association of Manufacturers have been the main supporter of EE activities mainly targeting the bulk energy consumers such as the industries. The United Nations Development Programme has also funded various EE projects and initiatives. Other donor agencies such as USAID, GEF, DANIDA, SIDA and the French Development Agency have also supported projects on EE and conservation.

Our interviews with some of the above stakeholders indicated their acknowledgement of the significant role that energy efficiency can play in enhancing energy access and also offering an opportunity for consumers to support climate change mitigation actions. The stakeholders highlighted the critical role that the household sector can play in contributing to Sustainable Development Goal 7 on promoting access to affordable,

reliable and sustainable energy for all through the adoption of EE technologies. Moreover, the uptake of energy efficient technologies at the household level could contribute to Kenya's goal of reducing their GHGs emissions thus contributing the global climate change agenda. This is through the reduction in use of fossil fuel generators for extra energy production especially during the peak hours. The already existing EE initiatives from the stakeholders' interviews showed that they will continue targeting the households and residential areas where there is great potential for scaling up the use of energy efficient technologies. They also indicated that immerse efforts are required in order to fully tap into the potential of the household and residential sector in supporting energy efficiency and conservation efforts as the adoption is still very low.

3.5 Public awareness of different EE approaches

The study sought to establish the level of public awareness of EE in general and EE measures in particular. The questionnaire was thus designed to ascertain the respondent's level of knowledge of EE by including both self-evaluation questions (self-reported) and evaluated ones - through their ability to define EE-related concepts and mention of a relevant policy or legal instrument in Kenya. Their views on the necessity of such legal frameworks were sought.

The respondents were asked whether they had "heard of the terms 'energy efficiency". The majority (76%) responded affirmatively while 24% had not heard of the term. With over three quarters of the population having heard the concept before, it seems to imply that EE is not a new concept in the country. To further investigate this, respondents were asked whether they could define the concept.

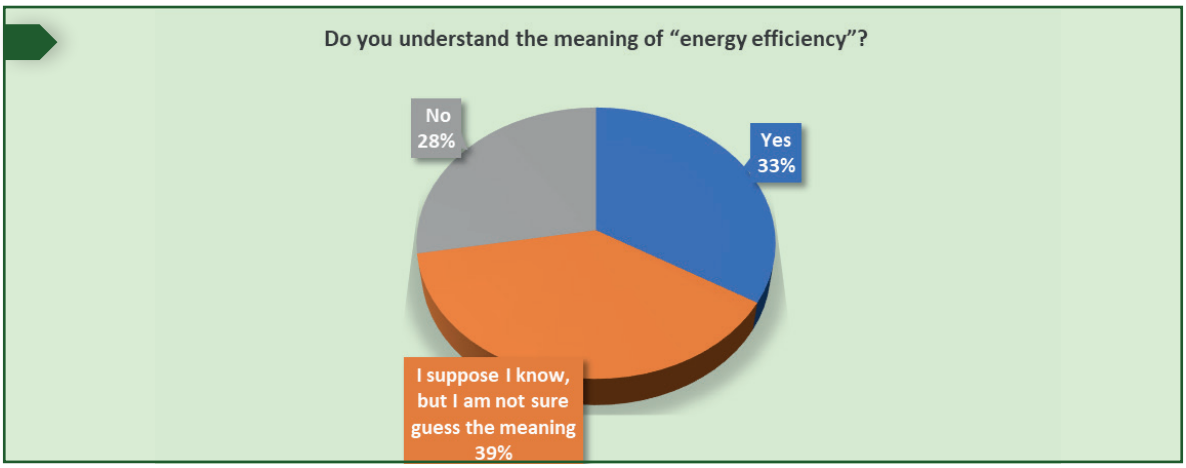

Chart 3. Respondents confident they can define «energy efficiency».

A consistent finding was recorded where 33% of the interviewees felt they understood what EE meant, while another 39% could try to define the concept. Thus, over 72% of the population were confident they could provide some definition of EE. The definitions given by the respondents who were able to define or could attempt to define it included words such as enough energy; effective use of power; using electricity well; correct use of energy resources; wise use of resources; proper use and sustainability of natural resources for future energy use; efficient energy use; using energy without wasting;

proper utilization of energy; and clean and sustainable use. This seems to confirm that the respondents had an idea of what they said they could define. Four more EE-related terms - energy consumption, energy sufficiency, and energy transition - were posed to the respondents.

Whereas they could define energy consumption, conservation and sufficiency with relative ease in that order, 57% of them could not define energy transition at all while another 21% could only guess the meaning of the concept. Similar representations were reported in respondents' inability or struggle with defining energy sufficiency while roughly 31% of the interviewees could only guess the meaning of the other three concepts (see chart 4).

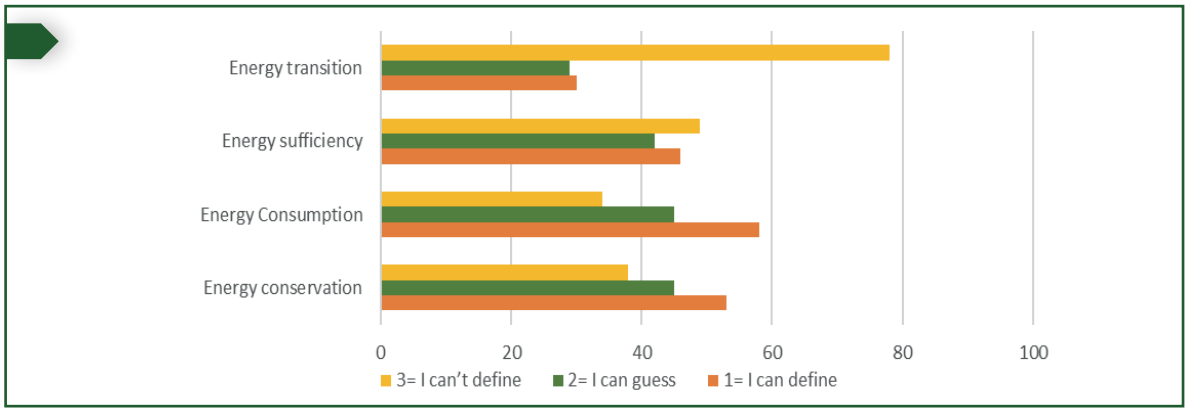

Chart 4. Respondents' knowledge and awareness of other energy-related concepts

It appears that many Kenyans have an idea, but not a holistic understanding of EE. Thus, many may have heard about it mainly in school, but only a few know what it entails in practice. This is corroborated by further findings of this study.

In terms of knowledge regarding policies on energy efficiency, most of the respondents (66%) did not know if there existed EE-related laws in Kenya. However, there was strong agreement (by 93%) on the need for legal frameworks to govern energy use in the country (see Chart 5 for more details).

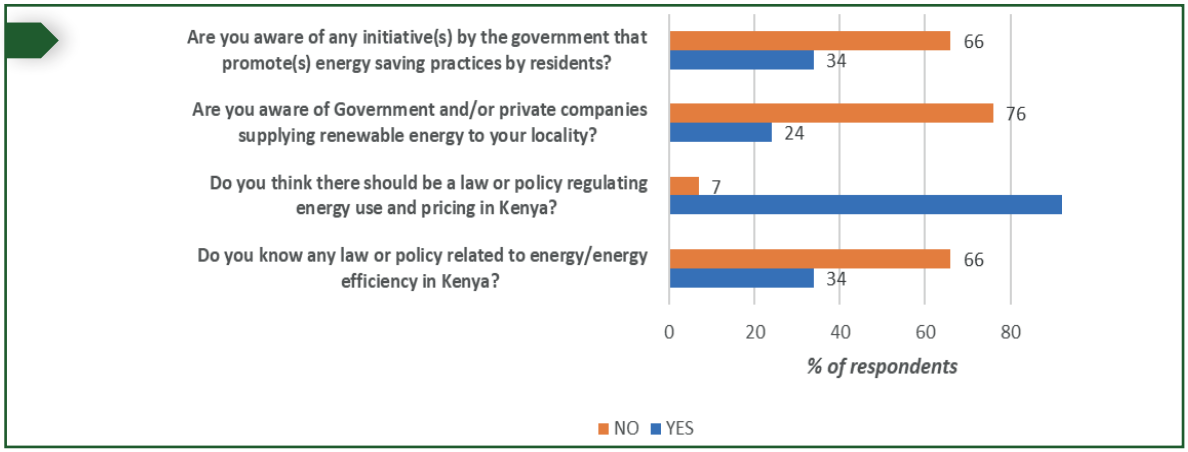

Chart 5. Public awareness of EE-related measures, instruments and initiatives.

Most respondents (76%) said they were not aware of any initiatives by any stakeholder that was supplying renewable energy in their locality. The evidence presented and discussed in subsections 3.2 and 3.3 of this paper demonstrates that there are many of these instruments/measures and initiatives. Therefore, it appears that these respondents did not have access to information on alternative/renewable energy initiatives, policies and measures. Without such knowledge and information, it is highly unlikely that most households would access even the subsidised energy services that may be available, nor would they seek financing for EE measures for their households.

3.6 Energy Consumption/Use Habits

This study also sought to establish which energy sources respondents and their households rely on in their ordinary day-to-day domestic tasks. Their responses are capture in Table 5.

Energy Type	Electricity	Charcoal	Wood	Kerosene	Gas	Other
Cooking/ Heating	9	17	8	10	55	0
Lighting	86	0	1	37	0	6
Bathing	44	25	30	16	5	5
Ironing	80	3	42	1	0	2
Doing other energy-dependent tasks	77	13	7	4	1	6
Total (Frequency)	**296**	**58**	**88**	**68**	**61**	**19**

Table 5. Sources of Energy for Performing Specified Roles in Kenya

Table 5 and Chart 8 show that electricity[3] is the most relied on source of energy in domestic tasks. In fact, electricity is used over three times more than the second polled source (wood) of energy for the surveyed households. The non-renewable sources of energy - kerosene and gas (LPG) – account for about 22% (129 out of 590 votes) of energy used at the domestic level among the surveyed households. If the non-renewable sources of electricity (e.g. thermal) are factored in, this number might go higher.

The survey respondents were asked what they considered to be their biggest concern regarding their household energy usage. They were given three choices: environmental pollution, depletion of non-renewable resources of energy, and 'other' which allowed them to list anything else that did not fall in the first two categories. 72% listed their responses as either environmental pollution (41%) or depletion of non-renewable resources of energy (31%). The "Other" category only listed the cost of energy as the biggest concern for 28% of the respondents. We anticipated that this category would have more responses as the cost of energy would be a key concern for energy users. However, the response was not entirely surprising considering the majority did not regularly track their monthly energy consumption and therefore the cost as shown in chart 6.

3 About 70% Kenya's installed electricity capacity is derived from renewable sources or energy (mostly hydroelectric, but also increasingly geothermal). The country's potential for renewable energy generation is high, and Kenya is already ranked top in Africa and 9th globally on geothermal electricity generation (for more details see IRENA, 2018; REN21, 2018; Wood, 2018).

When asked if they knew how to resolve their identified concerns, only 10% felt they had

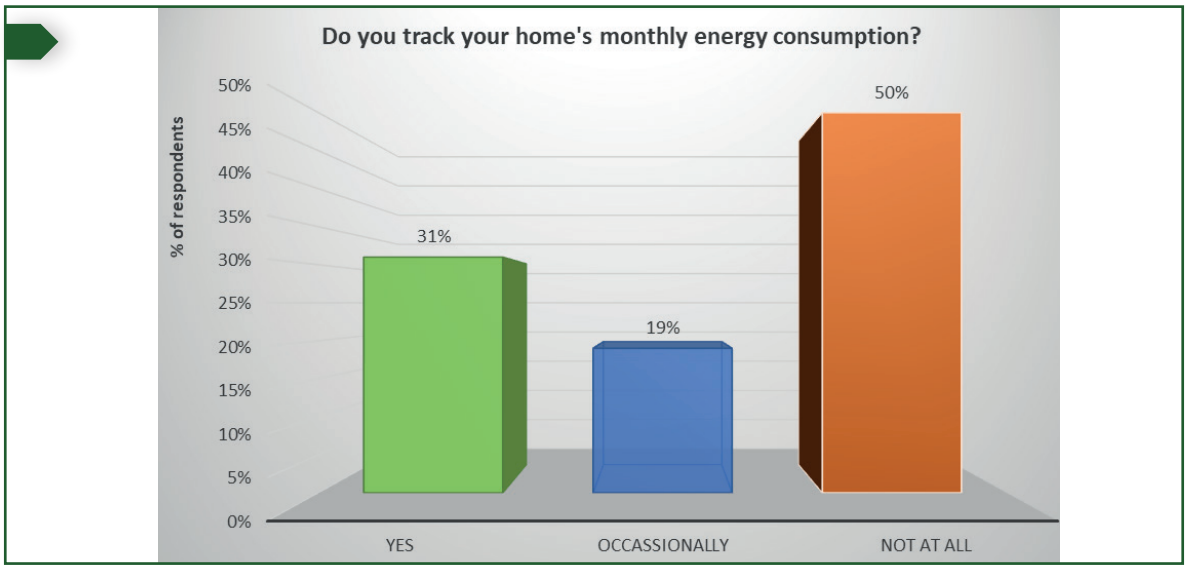

Chart 6. Proportion of respondents who knew or tracked their home's monthly energy consumption.

found and were implementing what they thought was a perfect solution – see Chart 7 for more details.

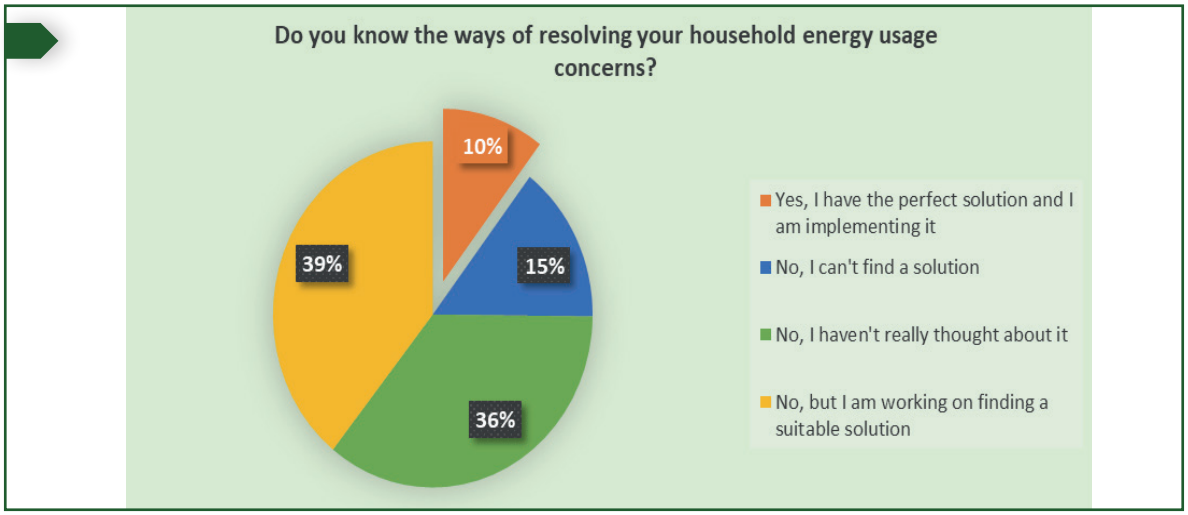

Chart 7. Respondents addressing energy usage concerns.

The above findings demonstrate the need for enabling households address their energy challenges. A starting point would be helping those that are already looking for solutions but have been unsuccessful. Energy efficiency literacy campaigns can be helpful to the 36% who have not thought about the solutions to their energy concerns.

However, a closer look at the energy source used for the individual tasks reveals some interesting dynamics. Whereas electricity is used for all other tasks, LPG tops as the preferred choice for cooking. As shown in Charts 8 and 9, non-renewable energy sources are mainly relied upon by the respondents for cooking/heating.

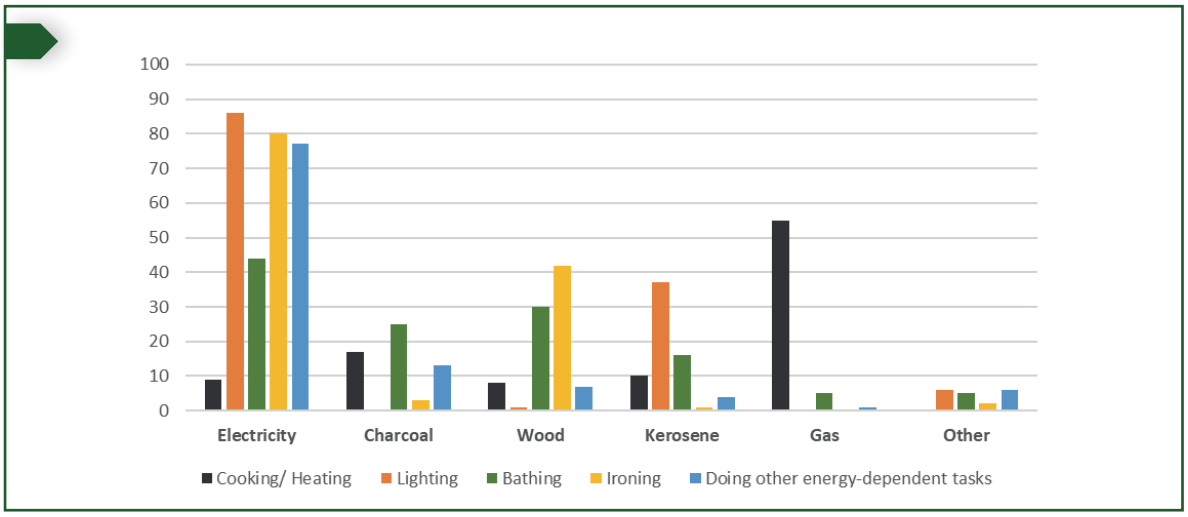

Chart 8. Sources of energy for specific household tasks.

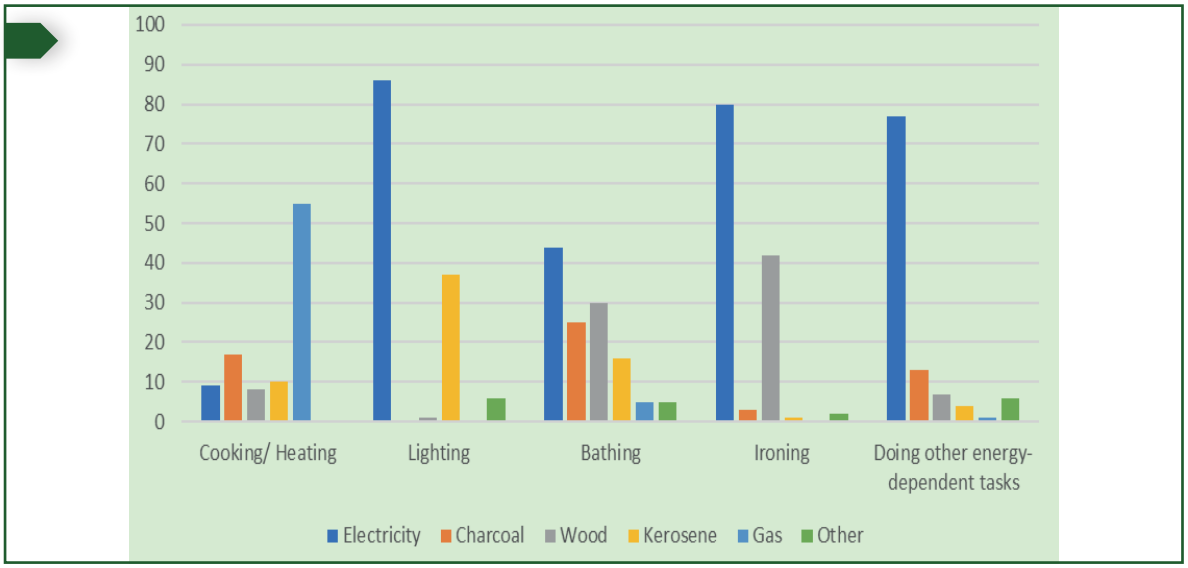

Chart 9. Domestic tasks and energy used to undertake them.

Given the energy-intensiveness of this activity, this is an undesirable situation that needs to be addressed. The heating referred to here is not heating the house. Only a small proportion of Kenyan households heat their homes during cold seasons (19%) or cool them during hot seasons (12%) – and this is understandable because extreme weather (especially temperature) variations are not common in these areas of Kenya. Rather, heating here refers to other forms of heating such as heating water, food etc.

3.7 Household-level Energy Efficiency Measures and Practices

Achieving EE requires implementing some practices and/or taking some measures to maximise on energy available. At the household level, possible measures could include changing to alternative sources of energy (that are cleaner, for instance), replacing old appliances and gadgets with energy efficient ones and generally changing behaviour to

reduce energy consumption and/or wastage. Table 6 the various energy saving practices and how likely or unlikely that the households use them to reduce energy consumption.

MEASURES	VERY LIKELY (%)	LIKELY (%)	NEUTRAL (%)	UNLIKELY (%)	HIGHLY UNLIKELY (%)
Changing to an alternative energy source.	17.65	52.21	5.88	15.44	8.82
Replacing old appliances with energy efficient ones	31.58	40.60	7.52	12.78	7.52
Reducing the energy consumption by behaviour	28.68	53.49	9.30	5.43	3.10
Insulating and air sealing home to reduce heat loss and draughts	11.90	29.37	27.78	16.67	14.29
I turn off all relevant appliances at the switch (reducing standby power)	34.13	56.35	3.97	3.97	1.59
I turn off my lights when they are not needed	45.52	47.01	1.49	4.48	1.49
I keep my windows and doors closed when the heating system is on	16.80	34.40	16.00	17.60	15.20
I keep radiators free of obstructions.	15.49	16.90	21.13	22.54	23.94
I use blinds to control a room temperature (open them when it's cold and sunny, close them when it's hot and sunny)	14.68	18.35	36.70	10.09	20.18

Table 6. Potential EE measures at the household level.

3.8 Perceptions and Attitudes towards Energy Efficiency

The study sought to understand some of the perceptions and attitudes of the respondents towards EE. Participants were asked to state how much they (dis)agreed with seven predetermined statements.

Their responses are captured in Table 7. Key point to note here is that whereas the majority agreed on the importance and need for practicing energy efficiency measures such as saving energy, energy-efficient appliances and installations of renewable energy, most were either neutral or resisted the thought of spending more money to do any of these. This signifies that most would rather, albeit hesitantly, continue with old energy inefficient ways/appliances than spend more money on new energy-efficient ones.

ENERGY EFFICIENCY ATTITUDE QUESTIONS	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
It is important to practice energy efficiency during all human activities.	51	75	2	5	1
Saving energy is important to me	67	56	11	1	1
When I buy a new appliance energy efficiency is the most important decision-making factor.	36	45	37	16	1
I am willing to invest in installing renewable energy in my home.	33	59	26	9	8
I am willing to spend more money to have renewable energy installed in my home.	25	28	51	18	12
I am willing to spend more to have renewable energy supplied to my home from an energy supply company.	27	9	59	22	14
There is a culture of efficiency in my region.	13	12	25	62	15

Table 7. Respondent energy efficiency attitudes

This was despite the possible benefits of adopting energy efficiency practices, to which most respondents agreed as shown in Table 8.

PRACTICING EE MEASURES AT THE HOUSEHOLD LEVEL CAN:	STRONGLY AGREE	AGREE	I DON'T KNOW	DISAGREE	STRONGLY DISAGREE
Save/reduce the money spent on energy	70	60	3	2	2
Reduce energy wastage	75	59	3	0	0
Ensure longer energy use	56	47	11	17	4
Increase energy availability	49	55	17	10	3
Energy transition into other forms	18	30	73	11	2

Table 8. Potential benefits of EE practices

But still, some people would be motivated to reduce their energy consumption by a number of things. The survey findings show that the potential savings on energy bills was the greatest motivation for energy efficiency – see Chart 10. This is a critical point for stakeholders seeking to promote energy efficiency to consider subsidies and incentives in monetary terms and frame the energy efficiency (campaign/promotion) in the same way.

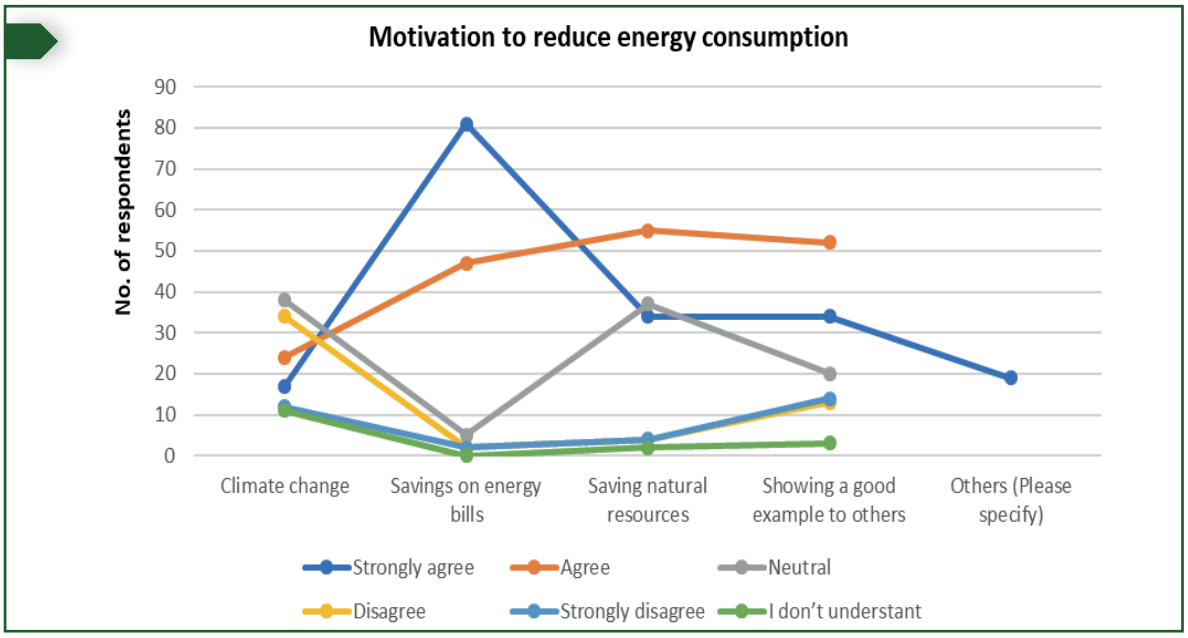

Table 10. Respondent energy efficiency attitudes

3.9 Sources of Information on Energy Efficiency

Access to information regarding energy efficiency is important. Majority of the respondents (64%) had information on energy efficiency, which was mainly through radios, television, social media, newspaper, word of mouth and schools. Other sources of information included local authority websites, national websites, energy efficiency public spaces, magazines and workshops/training. In terms of preferences on how they would like to receive energy efficiency information, Chart 11 illustrates the respondent rankings.

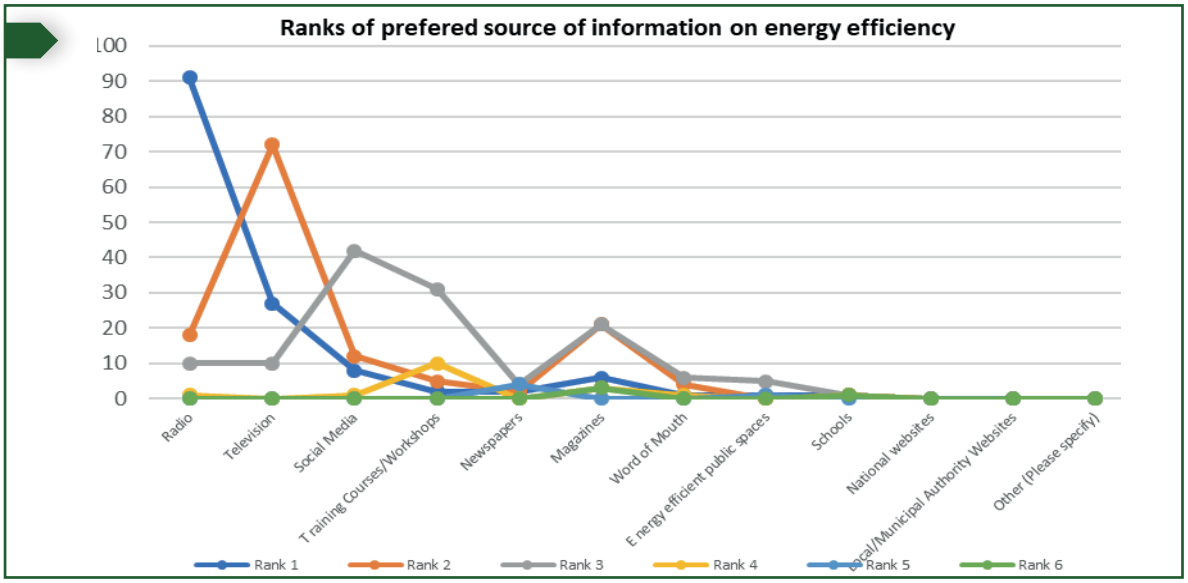

Chart 11. Preferred energy efficiency sources of information.

3.10 Obstacles for implementing EE measures in Kenya

Despite the various efforts to support energy efficiency as described in section 3.2 above, the uptake of these technologies and practices remain low. Some of the challenges identified during the interviews with some stakeholders are:

- *EE technologies are expensive compared to the inefficient ones therefore due to the hierarchy of needs and the weak purchasing power, consumers tend to choose the cheaper appliances to be able to purchase all the other products that they need.*
- *There is low awareness on energy efficiency for both the distributors and the consumers where the distributors cannot articulate to the consumers exactly what the different star ratings mean, and the consumers do not know what the stars mean. Thus, consumers mostly consider only the price of a product to make a purchasing decision therefore low adoption.*
- *Technology dumping is rampant in many Africa countries including Kenya where inefficient technologies are imported into the country at cheap prices therefore undermining the governments' efforts promoting energy efficient technologies.*
- *Inadequate financial incentives/loans (green bonds) to promote adoption of these technologies as they are very expensive compared to the inefficient ones*
- *There is also inadequate capacity to implement activities that aim at promoting energy efficiency. An example is the lack of testing laboratories in Kenya as testing of these gadgets is done outside the country by manufacturers in the countries of origin.*
- *The lack of enforcement of existing policies and regulations by authorities mandated to support energy efficiency activities is common and this is mainly due to corruption.*
- *The existing legislations are not holistic as they capture general aspects of energy efficiency yet leaving important aspects such as capacity building and awareness campaign plans that could ensure enhanced uptake of these technologies and practices.*
- *Lack of coordination by the various agencies central to the implementation of EE such as ERC, National Construction Authority, Kenya Bureau of Standards among others. They mostly work in silos and therefore suffer a greater risk of either duplicating efforts and/or engaging in counterproductive ventures.*
- *Retrofitting is a main challenge especially in residential places where they had previously installed inefficient gadgets therefore house owners are reluctant to switch these gadgets with the efficient ones as it is an expensive undertaking for them.*

3.11 Opportunities for implementing EE measures in Kenya

However, there are several opportunities that can be tapped into to scale up the uptake of these energy efficient technologies. At the policy front, the energy management regulation of 2012 provides a baseline upon which EE initiatives and activities can be based. Moreover, the new Energy Act of 2019 will also play a critical role in supporting EE activities. Despite these policies, more need to be done to

ensure that the various standards capture all the aspects of a technology because the missing aspects such as lifespan of a product, quality of service among others determine or undermine whether a consumer will purchase a product or not.

In terms of initiatives and programs, there are future efforts aimed at increasing the uptake of EE technologies. For example, the government of Kenya through the Central Bank of Kenya intends to roll out green bonds to accelerate financing opportunities for EE activities therefore removing the finance barrier that hinder adoption of EE technologies. The Energy Regulatory Commission in partnership with the Ministry of Energy and Collaborative Labelling and Standards Program (CLASP) are also in the process of rolling out the second phase of the Minimum Energy Performance Standards (MEPS) campaign aimed at creating awareness among appliances distributors on the meaning of the various EE star labels on appliances that they are retailing.

Moreover, there are several ongoing projects that can be tapped into such as the rapid modern homes projects being carried out by private developers. This provides an opportunity for the private developers to install EE appliances and equipment in these new housing units. Furthermore, the Government of Kenya has identified housing as one of the big four agendas. This offers an opportunity for such ventures to adopt these technologies as they provide modern housing facilities for the citizens hence upscaling up their uptake.

In addition, there are other training opportunities by various stakeholders interested in EE matters that can be optimised. This can also be cascaded down to academic institutional level as part of the curriculum.

Lastly, the current high electricity costs call for efficient utilization of energy by the various energy users. This creates an opportunity where households with EE appliances use less energy therefore reducing household consumption, therefore reducing the financial burden related to energy consumption.

4. CONCLUSION AND RECOMMENDATIONS

4.1 Overall conclusions

It is evident that Kenya has made significant efforts in supporting energy efficiency initiatives and programmes. At the policy level, the government has formulated policies and regulatory frameworks aimed at fostering energy efficiency in the country. State agencies and non-state players such as development agencies and the private sector have also supported various initiatives that target scaling up the adoption of EE practices at various levels. However, more efforts in terms of ensuring that the existing policies and regulatory frameworks capture all aspects of EE, capacity building of personnel in the different institutions, EE infrastructure development such as laboratories and awareness creation for consumers and suppliers are needed to maximize on the benefits associated with EE practices and inventions.

Although secondary literature indicate that the government of Kenya has done so much to turn around energy use practices in the country, and the take up of these is increasing, most citizens still use crude energy sources basically wood, charcoal and crude fuels. There also seems to be a disconnect between the reported government efforts and achievements vis-à-vis actual public energy use practices pointing to both a communication gap and inability of the citizens to quickly take up these projects.

Also, there seems to be several confusing policy tools that can confuse stakeholders. More work remains in harmonizing all these tools and coming up with one general instrument that all stakeholders can refer to about the country's energy use and EE concerns. The responsible agencies also need to be more proactive in implementing and/or enforcing existing policies already and documenting the process and outcomes. Data from such initiatives need to be readily-available for scrutiny and action to further improve EE in the country.

4.2 Recommendations on the findings

To tap into the above opportunities and also address the various challenges identified above, several recommendations need to be taken into consideration.

- *There is need for carrying out a national-wide baseline study on the level of adoption of EE technologies and the impacts of EE on the various sectors. Cost benefits analysis could be prioritized in the impact analysis as it will give the consumers a clear picture of what adoption of EE technologies will mean in financial terms.*
- *This study establishes that most Kenyans remain oblivious of what is happening in the EE world despite the existence of several EE measures and initiatives in the country. There is need to enlighten the households on not only the importance of the concept and practice of EE, but also on the existing EE policies and initiatives. This would likely increase the demand for and access to EE measures. As it is, the supply*

segment of the energy value chain is not met by any significant demand to make a transformative change in EE promotion.

- *More financial resources should be allocated to support EE research and development activities at the local academic institutions and development of local testing laboratories to support in R&D activities in Kenya. Moreover, support for public-private partnerships would enhance R&D activities being implemented.*
- *There is need for developing standards that capture all the aspects of a product to ensure that the products are of acceptable quality therefore protecting the consumer from sub-standard products in the market. This can be for both existing and new household appliances and equipment.*
- *There is need for building capacity of the various actors in the EE field through trainings and awareness campaigns. In academic institutions such as technical colleges and universities, a curriculum that tackles EE is important in developing qualified personnel with knowledge and expertise in EE matters in the country.*
- *Establishment of an institution that coordinates all the EE activities by the various stakeholders would be more effective in reducing duplication of efforts. This will also enhance the level of activities being carried out and the impacts of these activities as they are able to target a larger proposition of consumers unlike the isolated activities.*
- *Support for mandatory energy audits especially for large residential projects and strengthening the mandate of MEPS enforcement agencies will be key in ensuring that various actors adhere to the laid down standards.*
- *The phasing out of inefficient energy technologies such as inefficient bulbs beyond the large electric appliances will play a significant role in promoting energy efficiency and conservation at the consumer level.*
- *Government support through tax rebates for EE products would play a significant role in scaling up the adoption of these technologies as they will be more affordable to the consumers therefore their wider adoption and use.*

4.3 Limitations and challenges

This study focused on household/domestic energy use only. This is one of the main 'sectors' where energy is used. However, this excluded other critical sectors, including industrial and transport sectors among others. In addition, the quantitative data collected capture important aspects on awareness levels of energy efficiency technologies and practices at the household level that can be used as a baseline for future EE interventions. Sampling was done to ensure the data were as geographically representative of Kenya as possible. However, due to limited financial resource, the study did not include the mountainous/forested, coastal and northern parts of Kenya, where energy use might be different due to the relatively 'extreme' whether conditions. Thus, there may be some technicalities in generalising the conclusions as national.

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APPENDICES

The following appendices associated with this study are available and can be availed on request.

Appendix 1: Terms of reference

Appendix 2: Survey questionnaire

Appendix 3: List of interviewed institutional stakeholders

About Heinrich Böll Stiftung (hbs)

The Heinrich Böll Stiftung (hbs) is a think tank for policy reform, a catalyst for green visions and projects, and an international network of about 160 project partners working in over 60 countries. With 30 international offices, hbs provides a space for critical and informative political debates, creating evidence for policy advice, enabling national, regional and global networking and building capacities for political advocacy. Affiliated with, but intellectually independent from, the German Green Party, hbs shares the same ideas as the green political movement, and works in the core areas of ecology, sustainable development, democracy, human rights and justice. The hbs Afrique du Nord-Rabat office commenced its operations in 2014, and is working to promote the same non-violent, proactive and sustainable policies as the parent organisation. Its mandate is in the promotion of civic and political education, and is working on ecology and sustainability, democracy and human rights, with a predominant focus on "gender equality" for social emancipation and equal rights for all.

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