POLICY BRIEF

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Need to Accelerate Uptake of Solar PV in Kenya towards Vision 2030

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Introduction

Kenya's installed electricity capacity as of 2023 stood at 3,321MW, a significant growth from 1,800MW in 2014, but still low for a country with a population of over 50 million. Most of the installed capacity is from renewable energy resources as evidenced by its energy mix, which consists of five main types of Renewable Energy Sources (RES) that contribute a total of 90 % of the installed energy generated in Kenya (Figure 1). These are namely: Hydropower (with 800MW installed capacity or 22.5%, Geothermal with installed capacity of 985 MW (44.5%), Solar PV energy with installed capacity of 367.5 megawatts (3.5%), Wind Energy with installed capacity of 436 megawatts (14.3%). Fossil fuels from petroleum products contribute about 15%. About a third of Kenya's installed capacity is owned and operated by independent power producers (IPP) across several plants, including small-scale hydro, geothermal, biomass, wind, solar, and heavy fuel oil plants. The remaining capacity is owned and operated by Kenya Electricity Generating Company (KenGen), which is 70% government owned. The country's electricity generation is currently based on large-scale hydro power and geothermal while other renewable energy sources such as solar, only a minor role (GoK 2015).

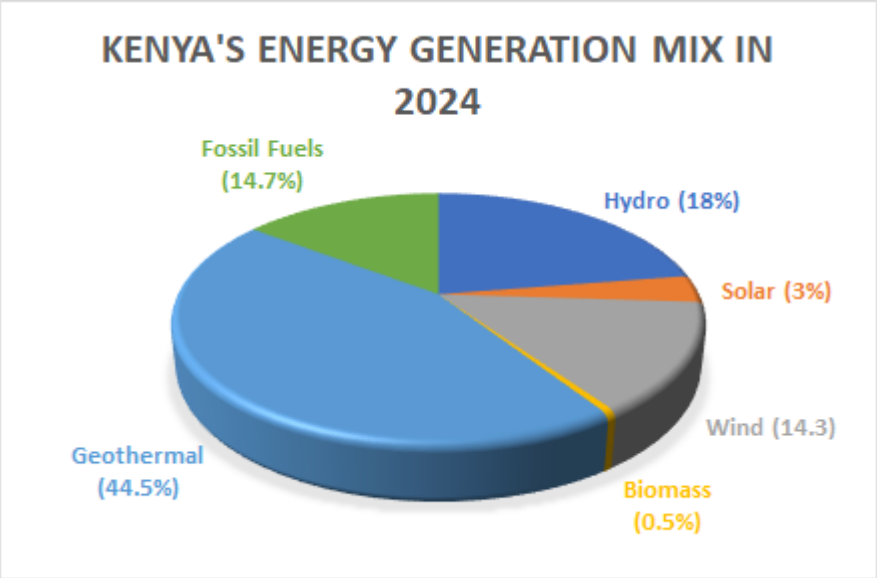

Figure 1. Kenya's Energy generation mix as of December 2024. (Source KIPRA)

Kenya vision 2023 aims to transform Kenya into a newly industrialising, "middle-income country providing a high quality life to all its citizens by the year 2030". There is therefore need for increased energy supply. Kenya must, therefore, generate more energy at a lower cost and increase efficiency in energy consumption. This calls for exploitation of renewable energy sources such as wind and Solar PV. Over the last few years, Kenya has had an aggressive electrification program and today, the national electricity access stands at 84%, having grown from 32% in 2013. The country aims to achieve universal access by the year 2030 by largely focusing on expanding in rural access to increase power demand and supply and lower the cost of electricity by injecting cheaper renewable energy sources, such as geothermal, wind, and solar, into the energy mix, while weaning off the more expensive heavy fuel oil (HFO) plants. It is expected that power generation will reach 5,000MW by the year 2030 with the bulk of it coming from clean energy sources.

Despite the advantages that increased use of such 'new' renewable resources, such as wind and solar (as opposed to Kenyan well-established hydro power and geothermal), could potentially bring to the country in terms of energy access to spur rural development, the uptake of renewable energy continues to be low. Currently, solar energy accounts for a very small portion (3%) of the country's renewable energy generation despite the high potential for solar power given irradiation levels available in Kenya throughout the year. There is huge untapped demand for off-grid solar that can supply communities located far from existing transmission infrastructure. As such, solar PV deployment has mainly been driven by stand-alone (i.e., off-grid) systems that are not connected to national grid mostly for Solar Home Systems due to the following challenges.

Given these problems and the fact that Kenya has a significant yet underexploited potential for photo voltaic (PV)-based power generation, the limited—although growing—exploitation of solar PV in Kenya is explored in this policy as a means of diversifying and stabilising electricity supply. The potential for integration of PV into the Kenyan electricity generation mix is analysed together with the sociotechnical, economic, political, and institutional policy barriers, which limit PV integration. We argue that these barriers can be overcome with improved and more robust policy regulations, additional investments in research and development, and improved coordination of the use of different renewable energy sources. Most noticeably, storage solutions and other elements of flexibility need to be incorporated to balance the intermittent character of electricity generation based on solar PV.

Challenges for integrating renewable energy sources into the national energy mix in Kenya

These challenges can be categorized into three: **technological, economic and institutional**

(a) Technological Barriers

There are still several technical barriers to the adoption of PV technology. This includes

- Lack of adequate knowledge leading to improper usage and inability to maintain the systems. This also creates negative perception towards adopting PV technology.
- Lack of energy storage systems since battery storage solutions are still expensive hence the need for hybrid systems (combining solar PV with hydropower as a viable alternative)

(b) Economic Barriers

- The main economic barrier for PV integration has been the high upfront cost of grid-connected solar PV systems as well as for off-grid systems. However, currently, solar PV has been highly incentivized and prices have dropped significantly thus making it a viable option compared to diesel-fuel generators that are expensive to run.

(c) Institutional Barriers

- These include include: (i) grid access monopoly, (ii) lack of research and development programmes in government institutions, (iii) policy issues and (iv) Political barriers.

    (i) Grid Access: Kenya has an interconnected national electricity grid operated and run by the monopoly Kenya Power and Lighting Company Limited (Nairobi, Kenya). Unfortunately, the process of grid connection for new PV systems is

long and complicated (that requires up to fourteen licensing steps) which discourages potential investment in PV power generation.

(ii) **Lack of Training, Research and Development Programmes:** There is minimal research and development within Government firms since most of them rarely devote a portion of their annual budget towards capability trainning in PV technology.

(iii) **Policy issues:**.Lack of a government regulatory (conducive) environment to support rapid integration of PV into the energy mix. Experience from Rwanda and Morocco could be used to inspire policies in Kenya to help foster increased integration of solar PV in the country.

(iv) **Political Barriers:** As early as 2008, Kenya developed a feed-in tariff policy meant to ensure market stability for investors in PV by making it . The feed-in tariff made it possible for independent power producers to deliver power from wind and hydro sources to the national grid. In 2012, the feed-in tariff policy was revised to also include solar power. However, these policies have not translated to higher installed grid-connected PV capacity largely because the policies have not been implemented. Corporate lobbying, political pressure, and inherent dependence on fossil fuels remain as challenges in shifting to the renewable energy industry from the age-old fossil fuel industry. The dangers of climate change have started affecting human lives to a great extent.

Opportunities for integrating renewable energy sources into the national energy mix

Geographical Location of Kenya: Kenya has a large potential for PV since it is located near the equator with relatively 5-7 peak sunshine hours. Among all the renewables for providing energy access, solar energy holds a big promise. growing renewable power technology worldwide (OECD/IEA 2011). Rural electrification using solar PV has been emerging as a viable option for the developing countries. PV systems not only provide reliable, clean, and environment-friendly energy but also create employment opportunities in the vicinity of its operation (UNEP 2014). The Kenyan solar energy market is one of the most advanced in Eastern Africa, and indeed in Africa. Traced back through the 1980s, it is one of the classic examples of a market driven largely by the private sector. It is estimated that the overall solar market has increased by more than 100 per cent in Kenya within the past decade with the current size of the market now in the range of approximately 8–10 MWp (GoK 2015; Hankins et al. 2009). Solar market development in Kenya has also been aided by the global fall in the solar PV prices over the last decade (Figure 1).

Cost: The decreasing module costs combined with increasing efficiencies have resulted in a compound decrease in the cost of electricity from PV modules. Similar to solar PV, distributed electricity storage is also getting cheaper largely due to mass production of batteries and introduction of new technologies (Figure 2). Kenya having high grid electricity connection cost, solar PV and batteries joining forces (both for solar micro-grid or stand-alone systems) has the potential to make the electric grid optional for many customers -without compromising reliability and possibly at prices cheaper than utility retail electricity.

Transmission:
While Kenya Power & Lighting Company (KPLC) is currently the sole distribution company in the country, and operates Kenya's interconnected grid, as well as several off-grid stations in

the northern regions of the country, it has been assisted in this effort by the Rural Electrification and Renewable Energy Corporation (REREC). Founded in 2006, REREC's mandate has been to accelerate the pace of rural electrification across Kenya. Since its inception, REREC helped move rural electrification from 4% to 32% of rural households, largely through its efforts to connect 60,000 public facilities (mostly primary schools) around the country and all household consumers within 600 meters of those facilities. REREC is focused on connecting major town centers, schools, and hospitals to the grid, as well as looking at off-grid solutions such as hybrid solar Photovoltaic (PV) plants. Opportunities also exist for solar mini-grid providers to solve power needs for households and provide other socio-economic benefits such as education, health, water, and food preservation in the off-grid areas of Kenya.

Policies: Kenya has instituted policies meant to increase the integration of PV such as the Kenya Rural Electrification Master Plan, Feed-in Tariff policy and the Vision 2030. Need for an Enabling Solar Policy for Enhancing Electricity Access Despite the high potential of energy generation through solar and market growth over the years, the country is still not sufficiently exploiting its solar energy resources for the benefit of its people. A number of barriers have been mentioned as responsible, which include but are not limited to awareness about the technology, capacity (both technical and end users) and end user, and value chain financing (Makokha 2015). All these issues are directly or indirectly related to policy framework. In all countries such as Germany, Spain, Bangladesh, India, and Japan, the market success has been driven by policy support, which has grown considerably in the last decade. Policies continue to evolve to address market developments and reduce costs (OECD/IEA 2011).

The Kenya government has been intensifying efforts to tackle the numerous regulatory and political barriers that are holding back investment in domestic energy supply. The earlier efforts started with Electric Power in 1997, and this was followed by the Sessional Paper number 4 of 2004 and Energy Act of 2006, which has liberalized the electricity production. The latter two documents set the agenda for renewable energy production in Kenya. They were also instrumental in creating various institutions. For example, the Act provided the legal framework for the establishment of the Energy Regulatory Commission (ERC) as the single energy sector regulatory agency with responsibility for economic and technical regulation of the electric power, renewable energy, and petroleum sub-sectors. Since 2010, when the new constitution was adopted, the country has been revising the energy policy to align with the new constitution. The latest version is Energy Bill (2015) which is in parliament for debate and adoption. The draft Bill borrows a great deal from the Sessional Paper of 2004 in addition to introducing nuclear energy into the mix, establishing institutions for energy efficiency, renewable energy, and energy research among others. Table 1 shows the current targets set by the government.

Suffice to mention that the government also Suffice to mention that the government also published the Solar Regulation 2012 for licensing solar dealers and technicians. The Solar Photovoltaics System Regulations, gazetted by the Kenya ERC in September 2012, requires technical capacities/training for designing and installation of solar PV systems. The three different classes recognized are Class T1: for single PV module or single battery DC system of up to 100 Wp; Class T2: for medium size PV systems, that is, multiple modules of up to 300 Wp or multiple batteries that may include an inverter; and Class T3: for advanced, including grid connected and hybrid solar PV systems. Another important instrument in the solar market is the publication of Feed-in-Tarrifs (FiTs) policy of 2012, which is a revision of 2008 and 2010 versions. The policy was intended to attract investment in renewable energy and standardized power purchase agreements for embedded power for solar, biogas, biomass, wind, and small hydro and geothermal technologies. The potential introduction of net metering,

which is currently under active discussion, is another initiative that is expected to increase the investment on solar PV and other technologies further.

The Department of Physics at the University of Nairobi has been at the forefront of research and training in renewable energy through collaborations with industry and government stakeholders to develop training programs that equip students with the skills needed for careers in renewable energy and sustainable development. It pioneered the Solar PV T1, T2, and T3 training programs in Kenya in 2013, with a mission to boost solar PV adoption through high-quality training and installations that positively impact communities. To date, the department has conducted 37 training sessions, equipping over 700 trainees with essential skills in solar energy.

Recommendations

Photovoltaic technology, as a key renewable energy source, has immense potential to meet a substantial portion of Kenya's energy needs. The primary beneficiaries of this advancement will be rural communities and dispersed settlements, where extending national grid connections is often prohibitively expensive and impractical. Additionally, with the implementation of net metering systems, urban populations will also gain by storing surplus energy within the electricity grid, further enhancing energy accessibility and efficiency. Accelerating clean energy access for households, businesses, and institutions across Kenya will foster climate resilience and economic growth. Moreover, integrating renewable energy into agriculture—through agrovoltaics, water pumping, and food preservation technologies—will enhance land efficiency, improve crop and livestock yields, and promote farmer sustainability.

This policy therefore calls for storage solutions and other elements of flexibility that need to be incorporated to balance the intermittent nature of electricity generation in Kenya based on solar PV. This is particularly eminent for large-scale deployment of PV technology in Kenya. A complement between hydro and solar PV to address the storage challenge is proposed. Such a hybrid system represents a complete transformation from the current scenario. A variety of technical, economic, institutional, political barriers have been pointed out which currently restrict further increase of PV technology. Some of the technological barriers identified include lack of adequate knowledge of PV technology and lack of energy storage systems or energy system flexibility to integrate PV. An important economic barrier identified is the high upfront costs and unwillingness of banks to fund PV investments. Some of the institutional and policy barriers identified are lack of stability incentives for adoption of PV and the long and complicated grid connection process. These barriers can be overcome with robust policy regulations, additional investments in education, training, research and development, better regulation of the electricity sector and improved coordination between key actors. While this analysis focused on the barriers for solar PV in the Kenyan grid system, the results may be applicable to other sub-Saharan African countries, many of whom are faced with the same challenges:

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