Sustainable Renewable Energy Financing: Case Study of Kenya

Tabitha A. Olang and Miguel Esteban

Abstract The present work examines the views of renewable energy stakeholders with regard to what they deem as sustainable methods of renewable energy financing in the Kenyan market. It also touches on the preferred source of renewable energy and the factors that need to be considered for their successful implementation. The study made use of online surveys, key informant interviews and site visits to collect data. The findings are intended to be used to inform decisions regarding sustainable financing solutions that are suitable for the Kenyan market. The key finding is that although the Kenyan government has taken a rather hands-off approach to the solar energy market, this market has been able to thrive in the private sector in the recent years.

Keywords Feed-in tariffs • Political risk • Power purchase agreement

1 Introduction

Sustainable development is defined as development that satisfies the needs of the present without compromising the ability of future generations to satisfy theirs [1]. Electricity generation is clearly crucial to the sustainable development of emerging economies as it plays a major role in the alleviation of poverty and constitutes the engine of socio-economic development. Moreover, energy is one of the most important aspects to be considered when establishing the interaction between the technological, economical and political landscape of a given country or region.

Excluding South Africa, sub-Saharan Africa has 37 gigawatts (GW) total installed electricity capacity, which is less than half of that in the United Kingdom, as of 2012 [2]. Moreover, the lack of plant maintenance and skilled personnel and weaknesses in transmission and distribution systems are some of the reasons why most of the installed capacity is not even available for generation. Hence, the region has the world's lowest electricity penetration rate (32 % overall), with rural areas

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having an energy access rate of only 16 % [3]. The region therefore needs to install approximately 7 GW of new-generation capacity annually in order to meet the increasing energy demand and support rapid economic growth [4]. In particular this need to increase installed capacity is particularly important to countries with rapid growing economies, such as Kenya, which has recorded a steady economic growth of 5.7 % in 2013 and a projected 6.5 % in 2015 [5]. Hence, this country will be used as a case study of the problems facing the sustainable financing of renewable energy in emerging economies.

Kenya is rich in potential sources of renewable energy, namely, wind, biomass, hydro, geothermal, biogas and solar resources [6]. However, according to The World Bank, only 23 % of the Kenyan population have access to electricity as of 2010 [7]. In 2008 Kenya identified energy as one of the enablers to its long-term development programme, known as Kenya Vision 2030 [8]. Kenya ratified a new constitution in August 2010, which started a process of regional devolution where there are now two levels of government, namely, those at the national and county levels. The Ministry of Energy and Petroleum (MOEP) anticipated a sharp rise in electricity demand as the new county governments operationalised, implying that various economic activities would spring up at the county levels. Specifically, energy-intensive industries, such as mining, production of iron and steel, irrigation schemes, agro-based industry, operation of petroleum pipelines and electrification of designated railway lines, were some of the activities that will likely result in a sharp increase in energy demand.

The Kenyan Government through the MOEP [9] therefore proposed a roadmap known as the 5000+ MW programme in 2013 to increase the country's generation capacity from 1664.1 to 6700 MW by 2016. This aggressive 5000+ MW programme aims to mainly achieve its target by a sharp increase in four types of electricity production, namely, geothermal (1646 MW), natural gas (1050 MW), wind 630 MW and coal 1920 MW. New capacity will be developed by government power utilities (KENGEN) and independent power producers (IPPs) under a private-public partnership framework. The necessary transmission will be developed by the Kenyan government (KETRACO). The project is mainly financed by the World Bank, which has invested over $650 million in the Kenyan energy sector in recent years [10]. The programme's focus is on reducing the cost of electric power by over 40 % for all end users [9]. As of November 2014, Kenya's installed capacity was 2294.82 MW, as shown in Fig. 1 [11].

The energy sector institutional structure previously had all its functions concentrated between the MOEP and Kenya Power and Lightening Company (KPLC). However, reforms in the sector led to the unbundling of functions, specifically generation (KENGEN), transmission (KETRACO), distribution (KPLC) and oversight and policy functions (ERC). Other key stakeholders in the Kenyan renewable energy sector include Kenya Renewable Energy Association (KEREA) and one emergency power producer known as Aggreko (which currently have an installed capacity of 30 MW). KEREA is made up of 29 private sector members who are dedicated to facilitating the growth and development of renewable energy business in Kenya [12]. Currently, six IPPs are operating in Kenya, accounting for a total

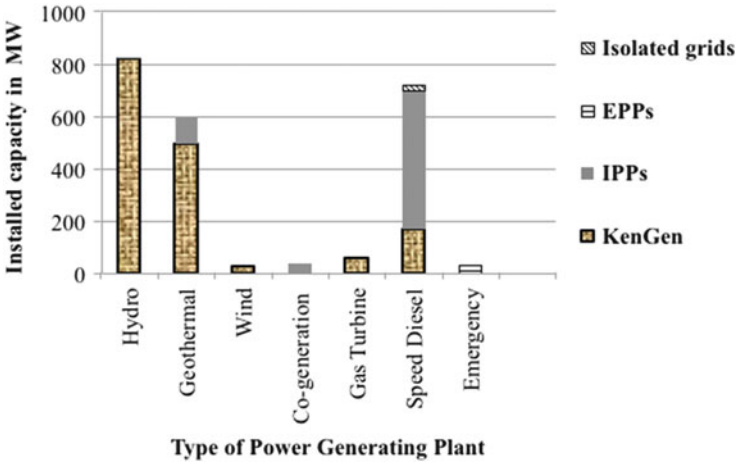

Fig. 1 Kenya's installed capacity as of November 2014

installed capacity of 725.32 MW, which is 31.63 % of the country's installed capacity (see Fig. 1).

The National Energy Policy (2004) was the first Kenyan policy to mandate the promotion of private sector investments in renewable energy. The Energy Act (2006) established the Energy Regulatory Commission (ERC), which promotes development and use of renewable energy technologies. One way of promoting the development of renewable energy technologies was by encouraging potential IPPs to carry out feasibility studies on renewable energy sources. In a bid to safeguard the time and resource investments made by private investors while undertaking feasibility studies and to boost renewable energy development in general, the MOEP proposed to set feed-in tariffs (FITs) for electricity generated from renewable energy sources. This led to the enactment of the feed-in-tariffs Policy (2008). This policy has undergone two revisions and currently the feed-in-tariffs policy (2012) is in operation. As a result of it, large geothermal power plants have been built, and it is significant to note that Kenya ranks eighth with regard to countries with the highest geothermal energy-installed capacity [13]. For example, the Olkaria 1 Power Plant is situated in the Rift Valley in Kenya and has an installed capacity of 185 MW.

However, despite the government enthusiasm for geothermal energy, this form of energy is one of the many available to the country. Despite this, to the authors' knowledge, no research has been carried out on the actual perception of private sector practitioners with regard to renewable energy financing in Kenya. Hence, the present work attempts to investigate how appropriate Kenyan government policy is from the point of view of the private sector in Kenya. The reason for doing so is that it is clear that a better understanding of various stakeholder perceptions with regard to the future of renewable energy in Kenya would help to ensure that equity in the consultation processes can be achieved. When mismatches are identified,

consultation can help to build consensus, increasing the chances of successful deployment by making sure that effective policies are put in place.

2 Methodology

2.1 Data Collection

The study used three methods of data collection, namely, structured online surveys, key informant interviews and site visits. Structured online surveys were distributed via email to 43 energy experts and practitioners in Kenya in the month of February 2015. The initial contact list was obtained through the KEREA members' website [12]. Subsequent respondents were obtained via a snowballing sampling technique. Respondents' roles in the Kenya RE market are shown in Fig. 2. Findings from the survey were used to inform questions that were to be used in the key informant interviews.

Key informant interviews were carried out in March 2015. The study interviewed six respondents who had various roles in the Kenyan renewable energy market, namely, a government official, consultant, international lender, consumer/capacity builder, solar water heater consumer and a RE local investor. Findings from these interviews were used to triangulate the outcomes of the questionnaire survey and further the understanding of the responses.

After the key informant interviews, two site visits were carried out to Green Park Estate (Fig. 3a), namely, Athi River and Olkaria 1 Geothermal Plant [13]. Green Park Estate [14] is a gated community with 1550 house units along Mombasa Road, Nairobi, Kenya, which use solar water heating systems to supplement the grid power supplied by KPLC. Olkaria 1 Geothermal Power Station (Fig. 3b) was the first geothermal power plant in Africa, commissioned in June 1981. Since its commissioning, the plant has an availability factor of 95 % [15]. The visit to these two sites was important for the research as it provided some perspective on the responses obtained from the online survey and the key informant interviews.

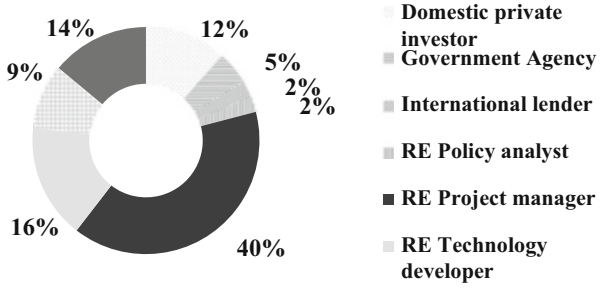

Fig. 2 Respondents renewable energy roles

Fig. 3 (**a**) Green Park Estate with solar water heating systems on rooftops and (**b**) Olkaria Power Plant

2.2 Data Analysis

The study undertook two levels of data analysis, namely, summary statistics and regression analysis, both using Microsoft Excel analytical functions. The summary statistics established the main findings, after which a regression analysis was performed, though the authors will only discuss those results significant at the 99 % confidence level. Feedback from the key informant interviews was used to explain findings from the two levels of analysis.

3 Results

3.1 Key Findings from Summary Statistics

3.1.1 Preferred Technology

Out of all respondents ($n = 43$), 74 % stated that solar PV will be the favoured technology in sub-Saharan Africa over the next 5 years. Only 7 % of the respondents preferred geothermal, 5 % biomass, 5 % wind, 2 % hydro and 7 % other technologies. Of those who stated a preference for solar PV ($n = 32$), 56 % thought that it was suitable for rural, off-grid applications, and 28 % of them stated that the technology matches Africa's renewable resources (Fig. 4).

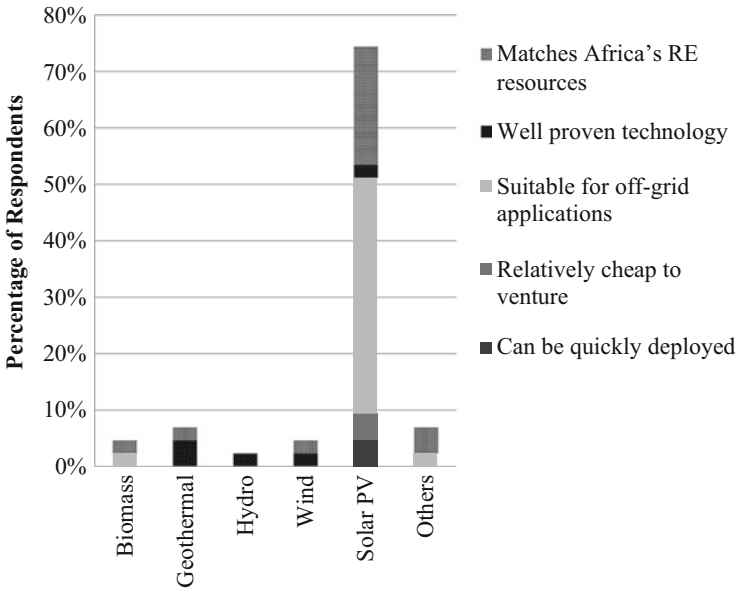

Fig. 4 Renewable energy technology and reasons for preference

3.1.2 Political Stability

All respondents stated that political stability was important for the viability of renewable energy investment in Kenya. Moreover, among a list of other possible risks experienced in the Kenyan renewable energy market, 42 % of the respondents stated that political risk is the most prominent risks that must be considered when financing sub-Saharan Africa renewable energy projects (Fig. 5). The second most important source of risk was regulatory risk, which is also partly tied with political risk, as the government has the capacity to quickly modify the regulatory regime, greatly changing the outlook of renewable energy.

For instance, the value-added tax (VAT) regimes of solar products have substantially changed over the past 5 years. In 2009, the solar products were zero rated (taxable, but at 0 % tax rate of tax on their input supplies). Subsequently in 2013 the incoming government made solar products taxable (at 16 % tax rate) in a bid to increase government revenue. However, the Kenyan government then once again decided to dismiss this tax on solar products in 2014 in a move to cut costs of renewable energy products by making them tax exempt [16].

3.1.3 Multilateral Lenders

All respondents stated that multilateral financial and development institutions (such as World Bank, Japan International Cooperation Agency, European Investment

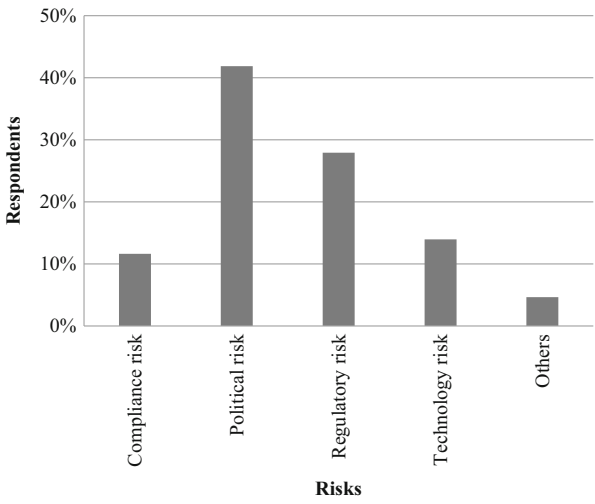

Fig. 5 Perceived risks in the Kenyan renewable energy market

Bank, etc.) will have a vital role to play in financing African renewable energy projects over the next 5 years. Moreover, 53 % of respondents stated that multilateral lenders will be the most important source of debt financing over the next 5 years (see Fig. 6). Nongovernment lenders (such as private banks, micro finance facilities, cooperative societies etc.) were selected as the second most important source of debt financing for renewable energy projects (26 % of respondents).

3.1.4 Feed-in Tariffs (FITs)

Forty-six percent of respondents ($n = 43$) stated that FITs are the most effective mechanism that should be used to attract private sector investment to RE technologies in Kenya (See Fig. 7). Of those who stated FITs were the most effective policy mechanism ($n = 20$), 85 % of them thought that solar PV is the most preferred renewable energy technology. This might imply that FITs could be the most suitable type of financing for solar PV technology in Kenya. Public-private partnerships were selected as the second most effective policy mechanism to attract private investment (35 % of respondents).

3.2 Key Findings from Regression Analysis

The key findings from summary statistics were subjected to a regression analysis by treating them as dependent variables and the rest of the responses as independent variables. A series of regressions were carried out between dependent variables (solar photovoltaic, multilateral lenders, political stability and feed-in tariffs) and

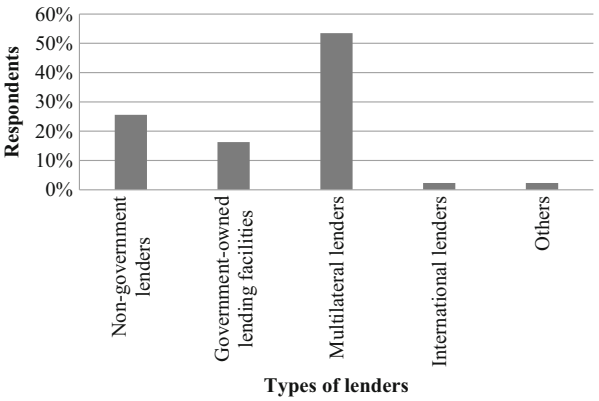

Fig. 6 Sources of debt financing for renewable energy projects

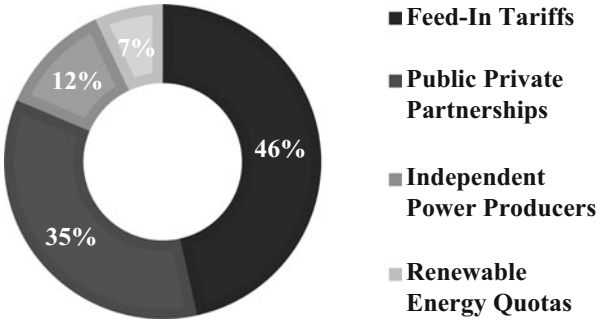

Fig. 7 Perceived as most effective policy tools available in the Kenyan RE market

each category of independent variables (RE market roles, reason for technology preference, sources of funds, risks, barriers and drivers of RE projects and mechanisms to promote RE technology). The only findings that will be discussed are those that were significant at the 99 % level of confidence, given the small number of respondents.

Two significant findings were obtained (Table 1). The first finding is that the preference for solar PV has a negative correlation with the technology being well proven. This implies that the reason solar PV is preferred is not necessarily because the technology is well proven but because it is suitable for rural, off-grid applications (as discussed in the summary statistics). The choice of feed-in tariffs as the most effective policy tool in attracting private investments in the Kenyan renewable energy market has a positive correlation with the source of equity for renewable energy projects being government investments and grants. This means that respondents who stated FITs as an effective mechanism to attract private sector investment also believe that an important source of equity is government investments and grants.

Table 1 P-values of significant regressions

Dependent variable	Independent variable	Coefficient	P-value
Solar PV	Technology is well proven	−0.80	1.93 %
Feed-in tariff	Government investments and grants	0.57	4.97 %

3.3 Key Findings from Key Informant Interviews

The results of the key informant interviews added a number of insights into the renewable energy market in Kenya, with the most significant of these outlined below.

3.3.1 Ignorance of Renewable Energy Policy Provisions

Most small-scale end users, especially those with solar PV panels installed in their houses, were not aware that the feed-in-tariff policy (2012) provides tariffs for both on-grid and off-grid solar PV systems. Moreover, informants who were aware of the energy policy provisions also stated that the transaction costs associated with the negotiation process when entering into power purchase agreement were high, especially for small-scale power producers. However, the feed-in-tariff policy (2012) provides standardised power purchase agreements (PPAs) templates to be used as a basis for negotiations as well as the various feed-in-tariff levels. Although the Kenyan government has attempted to increase the appeal of the renewable energy market, such feedback implies that many more improvements are still needed to ensure that all stakeholders—whether operating on a large or on small scale—are provided with equitable policy provisions.

3.3.2 Technology Challenges

The informants also highlighted how for small-scale solar PV, batteries have a much smaller lifespan (approximately 2 years) than solar panels. An option that could possibly counteract this would be feeding any excess power during the day directly the grid. However, some respondents claimed that KPLC is not always ready to sign a power purchase agreement with small-scale power producers.

3.3.3 Renewable Energy Financing Complexity

Much thinking is done at the level of international partners as well as African entrepreneurs and financiers. Moreover, there are many different market segments and business models currently being deployed, which greatly differ in characteristics and requirements. For instance, when comparing solar lighting ($<$10 MW) with large-scale solar utility scale power generation ($>$20 MW), the only thing they have

in common is that electricity is produced and consumed and that the technology is based on solar PV, everything else is different. Hence to "establish" one viable financing mechanism might be too ambitious.

4 Results

4.1 Mismatch Between Ministry of Energy and Petroleum and Other Renewable Energy Stakeholders

Findings from the present study show that the renewable energy sector prefers solar PV technology mainly because it is suitable for off-grid, rural applications. The Kenyan government has largely taken a hands-off approach in the photovoltaic market. Moreover, it has also liberalised foreign exchange and import regimes, and this has allowed private entrepreneurship in the photovoltaic market to flourish. Hence, over the years, this market has grown gradually both technologically and commercially, making it accessible to lower-income users [17]. In terms of technology, the photovoltaic units have become cheaper and smaller in size. Commercially, innovative technologies such as MKOPA solar systems, which make use of mobile payments that allow people to buy these products on credit, have revolutionised asset financing of solar products in Kenya [18].

However, the Kenyan government is trying to meet its Vision 2030 development goals and increase the availability of electricity, with all efforts to reach the target of 5000 MW by 2030 mainly being done through the promotion of geothermal energy. Although geothermal resources in Kenya have an estimated potential of between 7000 and 10,000 MW [13], there is need to establish why the renewable energy practitioners are insisting that solar PV should also be promoted. In this sense it is important to note how the World Bank mainly funds geothermal projects in Kenya and that the power generated is fed into the national grid. This implies that the population not connected to the grid would not be able to benefit from the increased electricity generation and reduced charges (KPLC is the only corporate body mandated to distribute on-grid electricity in Kenya). According to KPLC's Annual Report as at June 2014, electricity is currently accessible to 35 % of the Kenyan population [19]. From an economic point of view, it would appear paradoxical how, given that less than 50 % of the population have access to electricity, having the national grid produce a surplus could mean huge wastage of electricity given the lack of connections of those in the more remote areas of the country.

4.2 The Issue of Storage and Smart Grids

The main components of solar home systems include solar cell modules, lead-acid batteries, charge controllers, low-voltage direct current (DC) appliances and other accessories such as switches, module mounts, etc. For the purpose of the urban and more developed parts of Kenya, it is clear that the issue of how to store electricity from PV panels will become crucial in the future. As the installed PV capacity increases, the life of batteries will become a fundamental problem for the financial sustainability of such a system. New technologies that produce batteries that can store energy in the presence of the sun and when utilities rates are low, as well as provide backup electricity supply, can go a long way in making solar home systems and even industries independent of the national grid (e.g. the proposed Powerwall by Tesla Motors [20]). However, cost implications should also be put into consideration when looking at such possibilities.

4.3 The Issue of Off-Grid Access to Electricity in Kenya

When talking about electricity in Kenya, it is important to remember that at present 65 % of the country is still not connected to the grid. Though the government is spending considerable amounts of money (for instance, KPLC government-funded projects comprising construction of substations and lines at various locations, amounting to US$ 23.38 million [16]) to increase electricity penetration, by 2020 it is expected that 70 % of the country would be connected, still leaving 30 % without access to grid electricity.

However, it is important to note that electricity is important for economic development and poverty alleviation, especially in rural areas. Without electricity, access to education is limited as students are not able to study at night, commerce would be crippled, businesses and hospitals dependent on electricity would not be able to operate, and people would end up using kerosene and charcoal to cook, which have serious associated health hazards. Moreover, mobile phone banking, by use of the M-PESA service, is a core source of small-scale financial services in Kenya, with money transfer and credit systems having 17 million active and registered users in the country as of 2013 (over 30 % of Kenyan population) [21]. M-PESA has led to local economic expansion, security, capital accumulation and increased levels of employment [22]. To have access to this service, the subscribers need mobile phones, which clearly need electricity to operate.

Thus, the issue of off-grid access to electricity in Kenya will be important for many years to come. In order to promote the sustainable development of the more remote parts of the country, the government should not only concentrate on increasing the on-grid installed capacity but also consider promoting off-grid projects to ensure a larger energy access in the country. Increasing on-grid capacity should also be coupled with an equal investment in transmission lines and increased

number of electricity connections at affordable costs to various groups of consumers (industrial versus residential, urban versus rural, etc.). The feed-in-tariffs policy would go a long way in encouraging private investments in the sector. Initiatives by the government such as introducing a standardised power purchase agreement for small-scale power producers are a step in the right direction as it enables a less complicated and less costly negotiation process between the power producer and KPLC.

5 Summary

The authors conducted questionnaire surveys and interviews with key informants that showed how there is a discrepancy between the energy policy followed by the government and the views of many energy experts. Although the Kenyan government has exempted solar products from value-added tax and set specific feed-in tariffs for the various sources of renewables, a policy support regime has only been set for geothermal energy (+5000 MW programme) and not for other renewable energy sources of energy such as solar energy, which is readily available.

The solar market in Kenya has been able to thrive without direct government intervention. However, instead of the government taking a hands-off approach, it should facilitate solar energy market growth with more incentives and specific targets to ensure an increase in the solar energy uptake, especially in rural areas that are disconnected from the grid.

Finally, the FIT policy seems to be effective in the renewable energy market in Kenya. The policy also gives provision for revisions every 3 years. The government should use this opportunity to create a more robust market by putting in place provisions that promote the coexistence of both the public and private renewable energy markets for the benefit of the entire Kenyan population.

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