Energy Policy 56 (2013) 407–417

Contents lists available at SciVerse ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

The sun rises in the east (of Africa): A comparison of the development and status of solar energy markets in Kenya and Tanzania

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HIGHLIGHTS

- Paper analyses development and status of Kenya's and Tanzania's solar power markets.
- 10 MWp (4 MWp) and 300,000 SHS (40,000 SHS) currently installed in Kenya (Tanzania).
- Geographic, socio-economic, political and other reasons for development of solar power markets are analysed.
- Awareness, availability and affordability are needed for spread of solar technologies.

ARTICLE INFO

Article history:
Received 16 December 2011
Accepted 2 January 2013
Available online 9 February 2013

Keywords:
Solar power market development
Off-grid electricity supply
East Africa

ABSTRACT

This paper describes, compares and analyses the historical development and current status of Kenya's and Tanzania's emerging solar energy markets. The analysis is based on an extensive literature survey and 25 in-depth personal interviews with experts on the East African solar power market. Kenya's solar market is found to be one of the world's leading markets for off-grid solar uses, with a current installed capacity of over 10 MWp and more than 320,000 solar home systems. Having developed much later than the Kenyan market, Tanzania's market still remains smaller than its neighbour's, with an installed capacity of around 4 MWp and at least 40,000 solar home systems, but is in the process of catching up. In addition to solar home systems, other applications of solar energy technologies, such as in social institutions, telecoms and tourism, are covered. Major differences and similarities between the Kenyan and Tanzanian solar markets are identified and reasons for these are analysed. Initial policy implications regarding the regulation and promotion of solar energy in East Africa suggest that awareness, availability and affordability are major drivers that all need to be present to enable the widespread adoption of off-grid solar technologies in emerging markets.

1. Introduction

Africa, probably more than any other continent, faces the double challenge of improving the living conditions of its population by dramatically increasing access to modern energy services, while simultaneously developing its energy sector in a way that is sustainable. The East African nations of Kenya and Tanzania are two examples of countries that face these challenges most acutely: Both countries have quickly-growing populations and rising prosperity that lead to increased energy demand. Yet, in both countries the electrification rates are among the lowest in the world, with 14% and 11% respectively in 2005 (IEA, 2006). At the same time, both Kenya and Tanzania continue to rely heavily on traditional biomass for most of their primary energy needs, while undergoing structural changes in power sectors that used to be dominated by clean and abundant hydro power as the primary source of electricity. The two countries therefore serve as good examples for economies that face the energy challenge and where solar energy, already exploited since the 1970s, might be part of the solution.[1]

This paper combines data and information from a broad range of sources to give an overview of the historical development and current status of the solar energy markets in Kenya and Tanzania. The paper is based on an extensive literature survey that takes account of academic as well as grey literature. The literature review has been complemented by 25 in-depth personal

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0301-4215/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2013.01.007

[1] Both Kenya and Tanzania are among the "Sunbelt" countries identified by EPIA (2011) that are located between the latitudes of 35°N and 35°S. Of the 66 countries analysed by EPIA, Kenya ranked 14th based on the installed capacity in 2009 (2010: 19th) and Tanzania 38th (2010: 36th), as estimated by Werner et al. (2011). Ranking Sunbelt countries by the share of solar PV in overall electricity generation capacities yields somewhat different results, with Kenya attaining the 8th rank and Tanzania the 18th in 2010 (2009 figures not available).

interviews with leading experts on the East African solar energy market that were conducted in September 2010. The paper provides an overview that focuses on two of the biggest economies in the region, which are also two of its biggest markets for solar energy applications. Given the current market structure, the paper focuses on the market for off-grid solar photovoltaic (PV) systems, but also makes reference to other solar energy applications.[2]

In addition to presenting an up-to-date overview of the solar energy markets in both countries, this paper serves a second purpose by analysing and explaining the observed differences and similarities between Kenya's and Tanzania's solar markets. Both the up-to-date overview and the comparative analysis fill major gaps in current knowledge. The aim of this paper is therefore to contribute to the body of scientific literature on the diffusion of solar energy technologies and to provide academics, industry participants and policy-makers with a useful reference work that should facilitate the formulation of renewable energy policies in East Africa and beyond.

The remainder of this paper is structured as follows: Sections 2 and 3 present a concise overview of the development and current status of solar energy markets in Kenya and Tanzania, respectively. Section 4 describes major similarities and differences between both markets. Section 5 puts forward and analyses a number of possible explanations for the observed differences between Kenya and Tanzania. Finally, Section 6 provides a short summary and concludes with some policy implications that emerge from the previous analysis.

2. Kenya's solar energy market

2.1. Market development

The origins of the Kenyan solar market date back to the 1970s. During that decade the Kenyan government started to use solar energy as a means to power signalling and broadcasting installations in remote areas. From the early 1980s, the government, international donors and development agencies began to include solar energy in their projects for the provision of electricity for various social uses in off-grid environments, such as school lighting, water pumping and vaccine refrigeration. Their demand for solar power systems fostered the emergence of a national PV supply chain. At the same time, donors supported the first training workshops for solar technicians as well as demonstration projects. While donor and government procurement led to growing demand for solar power systems, some early pioneers started solar companies that specifically targeted the energy needs of off-grid consumers in rural Kenya. In the 1980s, a private market segment thus slowly started to emerge alongside the donor market segment (Acker and Kammen, 1996; Hankins, 2000; Jacobson, 2004).

Throughout the 1980s and 1990s the private solar market grew dynamically, as falling system prices and the introduction of smaller, more affordable solar power systems combined with rising incomes in rural areas during the agricultural "boom period" (GTZ, 2009a, p. 5) of the early and mid-1990s. It is the spread of radio and TV signals, however, that is most widely credited with inducing the rapid expansion of Kenya's solar home systems (SHS) market. As broadcasting signals reached more and more parts of the country, consumers were eager to own TVs and radios, but lacked grid electricity to power them. A lot of these households therefore turned toward so-called battery-based systems for their electricity needs, which many subsequently complemented with solar panels and wiring for the recharging of the batteries (Acker and Kammen, 1996; ESDA, 2003; GTZ, 2009a; Hankins, 2000, 2010; Jacobson, 2007).

In the early 1990s the overall installed PV capacity was estimated at around 1.5 MW peak (MWp), with approximately two-thirds installed in institutional systems (Acker and Kammen, 1996). By 2000, the Kenyan market had more than doubled to approximately 3.9 MWp and it was estimated that some 75% of the installed capacity was used in households (ESDA, 2003; Moner-Girona et al., 2006). One decade on, the overall market had reached between 8 and 10 MWp of installed capacity (GTZ, 2009b).[3] Annual sales of solar PV systems have recently reached 1–2 MWp and the annual growth rate has been around 10–15% since the 1990s, with much of the market dynamic stemming from demand for residential SHS (e.g. Hankins, 2010).

2.2. Market structure

Today's solar PV market can be divided into three broad segments. The biggest segment is comprised of the large number of residential SHS and some small-scale commercial PV applications (such as kiosk lighting and mobile-phone charging). These systems are usually smaller than 100 W peak (Wp) and typically around 14–20 Wp (ESDA, 2003; Ondraczek, 2011). This segment constitutes around three-quarters of the total installed capacity, or an estimated 6–8 MWp (GTZ, 2009b). The second segment consists of systems that provide electricity to off-grid schools, health centres, missions and other social institutions in rural areas, with a system capacity that can sometimes exceed 100 Wp (ESDA, 2003). This segment used to dominate the Kenyan market in its early years, but was overtaken in the 1990s by the emerging SHS segment. However, increased procurement by the Kenyan government and development agencies has resulted in a limited revival of the role of institutional systems in recent years (MoE, 2010d; Ondraczek, 2011). Nonetheless, this segment still constitutes only around 20–25% of the market, or a total installed capacity of approximately 2 MWp (GTZ, 2009b; Moner-Girona et al., 2006).

While the use of solar energy in telecoms and broadcasting was among the earliest uses of solar energy in Kenya (ESDA, 2003), newer applications such as solar-powered base stations in mobile-phone networks and PV in tourism establishments are only slowly emerging as the third current market segment, which still remains very small (GTZ, 2009b). Likewise, the use of solar energy in isolated mini-grids in rural Kenya so far remains very limited, and only tentative steps have been taken with respect to regulation that would enable PV systems to feed into the national electricity grid (Chloride Exide, 2010; GTZ, 2009a; MoE, 2010a). So far, only two on-grid solar projects have been installed in the country with a combined capacity of 575 kW peak (kWp) (BMWi, 2011; Enkhardt, 2011; Hankins, 2011). Table 1 provides more details on the overall PV market and its segments in the year 2009.

[2] For a more detailed description of the Kenyan and Tanzanian solar markets as well as a comparative analysis of both countries refer to Ondraczek (2011). The more extensive working paper version of this paper also contains further information on the literature reviewed and the interviews conducted.

[3] This figure might still understate the true size of the market. As Hankins (2010) pointed out, this is only a very rough estimate as no reliable statistics on the overall installed capacity are available. Some observers have remarked that there exists a strong incentive for both importers and dealers to underreport their turnover vis-à-vis authorities and researchers (e.g. Mumbi, 2010). While the Ministry of Energy (MoE) officially put the installed capacity in 2010 at 4 MWp, ministry officials confirmed that the actual market was probably much bigger (MoE, 2010d).