Energy Research & Social Science 42 (2018) 1–10

Contents lists available at ScienceDirect

Energy Research & Social Science

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

Original research article

From technical innovations towards social practices and socio-technical transition? Re-thinking the transition to decentralised solar PV electrification in Africa

Festus Boamah*, Eberhard Rothfuß

Chair of Social and Population Geography, University of Bayreuth, Bayreuth, Germany

ARTICLE INFO

Keywords:
Solar home systems
Socio-technical transitions
Social practices
Energy transition
Energy visions
Ghana

ABSTRACT

Technical innovations feature prominently in the current 'energy transition' debate in Africa but societal adaptation issues seldom receive a thorough airing. The mediating role of 'societal conditionings' in the adaptation to new energy technologies and the outcomes of such energy-society interrelations can offer some important insights. A study in Ghana shows a recent enthusiasm for Solar Home Systems (SHS) as power back-ups in residential facilities due to high/convoluted tariffs, perceived corruption and inefficiencies in the state-driven/centralised provision of electricity. A new class of "energy-elites" whose livelihoods and lifestyles require uninterrupted access to electricity sought to gain some autonomy in electricity provision and consumption by investing in power storage devices (e.g. power inverters and batteries) or fuel-powered Generator-Sets for use during unexpected frequent power outages. These infrastructures supported self-organised electrification initiatives only on ad hoc basis but SHS provided avenues to sustain that societal quest for autonomy. Achieving this autonomy, nonetheless, required SHS users to restrict their practices to energy services easily enabled by SHS alone, or adjust social practices according to the extent to which they intended to depend on the state-driven provision of electricity. The vision of energy autonomy and resultant societal practices are indeed realised through the use of SHS technology; the overarching driving force is the dynamics of energy-society interrelations. We therefore hypothesize that the adaptation to decentralised solar PV systems in Africa cannot be reduced solely to technical innovations nor even financial considerations but is instead dependent on how these factors intersect with social practices, the quality of the state's electricity services, etc. to shape societal energy visions.

1. Energy-society interface and our argument

You have your own Akosombo [power generation] when you go solar (Ghanaian solar energy expert/user, Fieldwork 2017)

Modern capitalist societies urgently need electricity to drive its activities. Recent debates in energy studies emphasise that energy is constituted and constitutive of social practices [1,2]. Shove and Walker [1] emphasise the energy-society interface by drawing attention to a fundamental question in social science research: what kind of work is done by energy or how does a particular need for energy evolve in society? Producing, supplying and consuming energy in particular ways certainly triggers societal change and vice-versa. Socio-technical transitions – dynamics of changes in the co-evolution of society and technological relationships – and its relations to practice-based approach is rarely employed to theorise how innovations in energy generate societal change in Africa. Energy access literature in Africa, for example, has been criticised for its failure to theorise social change due to its over-emphasis on finance and technology as the *sine qua non* for achieving sustainable energy access [3,4]. A socio-technical transitions perspective offers promising avenues for theorising societal change by drawing attention to the importance of focusing on social practices that energy access facilitates, rather than representing technologies as driving these social practices [3,4], and simultaneously emphasising the co-evolution of technological change and changes in social practices [4]. There has therefore been a recent focus on socio-technical designs, socio-cultural contexts, challenge of users, operators and managers for ensuring sustainable access to energy services [5], with a special interest in addressing particular energy needs and visions of local communities contrary to the usual over-emphasis on technical and financial considerations [6]. Ockwell and Byrne made a path-breaking contribution by using "Socio-Technical Innovation System Building"

* Corresponding author.
E-mail address: festus.boamah@uni-bayreuth.de (F. Boamah).

https://doi.org/10.1016/j.erss.2018.02.019
Received 17 July 2017; Received in revised form 21 February 2018; Accepted 26 February 2018

framing to emphasise on one hand the need for a systemic understanding of how policy interventions can nurture innovation and technological change and on the other hand to underline the importance of attending to the social practices through which sustainable energy technologies intersect, the co-evolution of innovation and socio-technical change, as well as the existing socio-technical regimes that sustainable energy technologies must compete with [7]. A holistic examination of how social practices, forms of energy governance, the slogans of energy service providers and technical innovations simultaneously intersect with societal knowledge and energy visions to shape outcomes of energy-society interrelations is thus required in energy transition studies in Africa. That said, 'sectoral systems of innovations' predominantly focus on knowledge development (or the creation of a technology) and firms involved in the innovation, but pays limited attention to its diffusion, utilisation, societal impacts and transformations [8]. Transitioning from dominant energy systems to newer or cleaner energy systems (such as renewable energy) requires shifts not only in technology but also in political regulations, tariffs and pricing regimes and the behaviour of users and adopters [9]. Innovations in solar energy have involved improving the voltage available from solar cells, developing efficient inverters, durable and low self-discharge batteries and firms improvising to adopt cost-effective alternatives (relative to fossil energy, for example) and forming cross-national alliances to develop and market their products, but societal adaptation issues have been considered the least.

The recent energy transition in Africa coincides with a switch from passive energy consumers to consumers seeking to understand, organise and control their energy consumption and expenditure patterns in self-empowering ways [10,11].

Furthermore, the transition process involves technologies and discourses controlled by the west and emerging economies under the assumption that the availability of the technology in Africa or the global south translate into adoption and utilisation – demand is assumed to be automatic and societal adaptation issues slip out of view (see Africa Renewable Energy Initiative; UNDP SE4ALL Action Plan,[1] for example). It is also noteworthy here that across Africa the state exercises a strong centralised control over electricity supply, planning and the development of electricity infrastructure [12,13], hence the transition to decentralised electrification options has implications for national energy governance. Some of the questions that arise include the following: Which knowledge systems inform the adaptation to decentralised/self-organised renewable energy technologies? How do particular practices emerge around new energy technologies? Or how and why do decentralised electrification systems condition/enable the use of particular appliances to transform or perpetuate existing social practices? What are the implications of the resultant social practices for energy policy, the design of energy systems and energy transition studies? To answer these questions, conceptualising the structural conditions that mediate adaptation to new energy technologies in Africa is crucial.

Solar energy is currently gaining prominence in Africa compared with other renewable energy technologies. The high cost of fossil fuels and hydro-power investments, the increasing electricity access gap-between urban areas and remote/rural locations, the recent fall in prices of solar Photovoltaic (PV) panels and the existence of 320 days of bright sunlight and irradiance levels of about 2000–2500 kW h/m^2 per annum in Africa, among others aspects, are driving interest in the technology [14]. Ghana and Tanzania lag behind Kenya, South Africa and Zimbabwe in the uptake of decentralised solar PV electrification in Africa. In Kenya and Zimbabwe, for example, donor funding and government initiatives directed towards reducing the high upfront costs and hence improving electricity access, especially in rural areas, contributed to a higher uptake of decentralised solar PV systems particularly during the 1960s–1990s, whereas a reverse situation occurred in Ghana were greater efforts and much funding had been already directed towards a fair spatial extension of grid-based electricity [15]. For this reason, a common conclusion reached is that *affordability* and *availability* issues constitute essential conditions for the adoption of the technology [15,16], while *societal adaptation* issues slip out of view. The recent enthusiasm for decentralised solar PV systems in a late-adopter country like Ghana – which has registered an enviable national electricity access rate in sub-Saharan Africa – offers an opportunity to rethink factors considered decisive in the transition to such technologies in Africa. When used as power back-ups, decentralised solar PV systems do not overly depend on state-built energy infrastructure and state regulations compared with other forms of electricity production (e.g. hydro-power systems, wind energy, geothermal energy, etc.). These characteristics provide avenues for self-organised electrification initiatives by individuals, solar energy investor companies, civil society and private actors to effectively control the diffusion and direction of the technology and it is here that energy-society interrelations become particularly crucial.

Ghana developed its first ever hydro-power project from an artificial dam built in 1965 in a small town called Akosombo. An erratic electricity supply over the years led to the introduction of emergency and expensive diesel/gas-fired thermal plants to complement Ghana's power generation capacity – leading to higher electricity tariffs. The signing of controversial power-purchasing agreements with Independent Power Producers (IPPs) and impacts on tariffs generated public perceptions of corruption in the energy sector. A credit/post-based metering system, used by Ghana's Electricity Company (ECG), created difficulties in the estimating of monthly-based electricity tariffs and often provided a leeway for customers to default, delay tariff payments and/or illegally adjust electricity meters to record lower levels of power consumption. These challenges affected electricity supply and revenue collection. The massive implementation of a pre-paid metering system[2] in 2016 to replace the post-paid system to ensure the efficient delivery of electricity services, however, coincided with further increases in tariffs, anomalies in tariff estimation, etc. and consequently reinforced public frustration and deepened mistrust towards the state regarding centralised electricity provision. The societal ethos thus called for self-organised decentralised electrification initiatives that would ensure not only cheaper power alternatives but also provide 'uninterrupted' electricity access and avenues for energy-saving practices. Rooftop solar energy systems in residential facilities (henceforth called Solar Home Systems) became an important solution to this structural power crisis and are hence the focus in this paper. The solar PV industry in Ghana grew slowly from the 1990s but by 2015 the Energy Commission had licensed 105 solar energy providers/companies. In fact, Ghana experienced a power crisis in 2006 due to its low electricity generation capacity [17] and even in the late 1990s but one may wonder why the transition to Solar Home Systems (SHS) took so long until recently.

The habits of watching TV programmes, frequent cold storage of food and drinks, providing illumination or lighting in rooms for hours, etc. among electricity users in Ghana create situations whereby appliances are left 'switched on' for long periods – either consciously or unconsciously – even when users leave their homes or unproductively because tariffs could be easily defaulted or at least temporarily shifted to the state, especially with the post-paid metering system. Governments have often sought to encourage and institutionalise

[1] In 2013 the government launched the Renewable Energy Master Plan and The Ghana Sustainable Energy for All (SE4ALL) Action Plan with technical support from the United Nations Development Programme to harness its renewable energy resources. Ghana also launched the China-Ghana South–South Cooperation on Renewable Energy Technology Transfer for the period 2014–2018 to facilitate the exchange of expertise on renewable energy and provide an enabling environment for the local absorption of these technologies.

[2] The prepaid metering system in Ghana involves advance payment of electricity tariffs on electronic cards which are uploaded onto special meters before use.