Building pathways of pro-poor energy access: PV-powered electricity services in Kenya

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Paper for session: Governing the transition to sustainable and inclusive energy systems
PEGNet Conference 2013
How to Shape Environmentally and Socially Sustainable Economies in the Developing World – Global, Regional, and Local Solutions
University of Copenhagen
17-18 October 2013

Draft for discussion – please do not cite

Introduction

Access to modern energy services is a critical human development priority and can be transformative to the livelihoods of poor people and their economic potential. A tension is sometimes perceived between increasing energy access and pursuing low carbon development. High carbon, conventional energy options are often viewed as cheaper and hence easier for poor countries to pursue. However, multiple synergies potentially exist between human and economic development priorities and access to low carbon energy technologies. Renewable energy can facilitate access in areas where grid-based provision is prohibitively expensive and unreliable, energy efficient technologies can improve availability of energy services, such as lighting and heat, and a combination of the two can increase local and national energy security and economic resilience by reducing exposure to the price fluctuations and political constraints of fossil fuel imports. Access to low carbon energy technologies is therefore potentially critical to meeting the Millennium Development Goals – MDGs (Modi et al 2006).

At 18%, the grid-based electricity access rate in Kenya remains well below the average for sub-Saharan Africa, despite significantly intensified efforts over the past decade to increase grid-penetration. Alongside these efforts, there are several large generator projects intended to address the shortages and vulnerabilities in current energy supply that result in frequent brown and black-outs for those who are connected to the grid. Some of these generator projects involve low carbon energy technologies, which form part of the Kenyan government's recently published climate resilient development plans. However, although the rhetoric of these plans promotes the deployment of a range of low carbon technologies at different scales, there is still little in the way of practical support for off-grid low carbon electrical services and so little policy attention to the role of rural household energy access in pro-poor development. Instead, much of the attention to the pro-poor agenda is being paid by donors, who have tended to adopt the 'bottom-of-the-pyramid' (BOP) rhetoric that claims poor people can participate in energy technology markets and so the private sector can deliver pro-poor energy services. Within this rhetoric, the challenge is said to be one of

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creating an enabling environment within which private actors can compete freely to service the energy demands of the poor.

Insights from innovation studies and socio-technical transitions theory suggest that this largely technocratic view of enabling free markets to deliver energy services is misguided at best. The innovation studies literature tells us that an enabling environment is certainly important but it is not sufficient. We also need to be concerned with what drives innovation – both as process and outcome – and that markets are replete with failures that weaken innovation processes and so deter potentially desirable innovation outcomes. In the context of developing countries, these studies also tell us that the development benefits associated with innovation can only be fully exploited if local innovative capabilities are built, including innovation systems. It is not enough simply to adopt innovations. For productive innovations, the economic benefits are likely to be short-lived as the global 'frontier' of those productive innovations moves on and, in any case, the value-added available to innovators will be appropriated elsewhere. Consumption-based innovations can be helpful for improving the quality of life – such as enhancing access to energy services – but, as with productive innovations, much of the value-added will be unavailable to the consumers and to the local economy. But further, a socio-technical understanding of innovation tells us that context matters and that innovation processes are shaped interactively with political, social and environmental forces, as well as with those actors who possess economic and institutional power. Combining these insights, we can understand that innovation is not a uni-dimensional process, driven by inalienable economic logic and measureable only in terms of rate of change. Rather, innovation processes can be multiple and proceed simultaneously in different directions (and different rates), each favoured by sympathetic actors who do political work to persuade others to bring their support to any particular trajectory of development. In such a landscape of possible pathways, we can expect that actors who possess significant economic and institutional power will be more likely to see their favoured pathway realised; that there will be dominant pathways of development alongside smaller ones, and that some potential pathways will not get started.

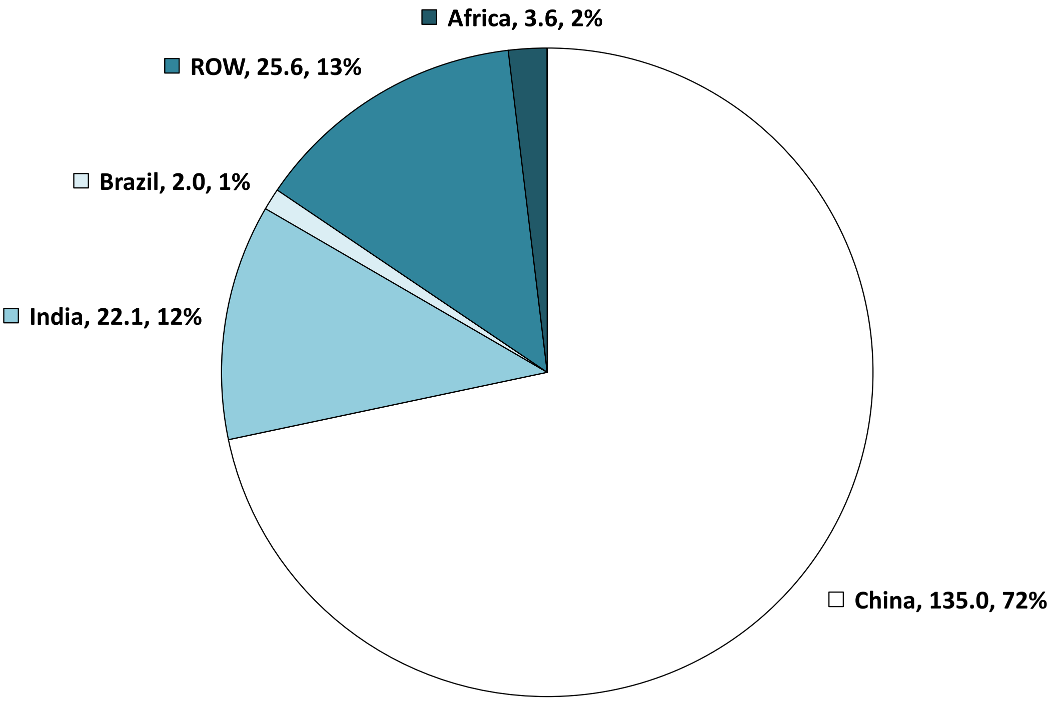
The solar home system (SHS) market in Kenya provides a case with which to examine these ideas. There are estimated to be in excess of 300,000 SHSs in Kenya, sold through a vibrant private market that is considered one of the most dynamic per capita solar markets historically. Recent years have also seen the growth of a market for pico-solar products – essentially, solar lanterns that in some products also have provision for charging a mobile phone and powering a radio. For many years, the rhetoric used to describe the SHS market's evolution has sustained the notion that it has been private sector led, and the rise of the pico-solar market is similarly described but uses BOP rhetoric. However, closer inspection of the evolution of these markets reveals that neither has been simply private sector led and that neither success is simply down to an enabling environment. Instead, important innovations have been driven or facilitated by donor involvement throughout the local supply chain, along with detailed understanding of user needs and desires. Moreover, the Kenyan policy environment has at times been hostile to the promotion of photovoltaic (PV) technology and policy support remains somewhat ambivalent. There is also some evidence that innovation in the Kenyan market is moving beyond the selling of imported technologies towards the development of an innovation system around PV. Several donors are supporting the implementation of a Climate Innovation Centre, and a PV module assembly plant – also involving donor support – began operations in September 2012.

Analysing the evidence in the Kenyan SHS case as a whole suggests that interventions to widen, deepen and enhance low carbon energy access need to be sophisticated and systemic. They should attend to the entire local supply chain; find, understand and raise demand for low carbon energy innovations; build capabilities that support development towards local innovation systems, including at the policy level; and do so in ways that are reflexive to the local (evolving) context. Furthermore, considering that an important contribution to the success of the Kenya SHS market has been detailed understanding of the needs and desires of users, much closer attention to those in poor and marginalised groups could yield effective low carbon energy innovations that are more likely to be pro-poor. To achieve this closer attention, we would argue, it is better to include the poor and marginalised pro-actively in innovation processes, including those processes that engage political and social forces. In other words, the case gives us useful clues for working towards effective and just governance of the transition to sustainable and inclusive energy systems.

The paper is organised as follows. The next section provides a brief critique of existing low carbon development policy. That is followed by a conceptual discussion covering development pathways, technology and innovation systems, and the building of low carbon innovation systems. We then provide an account of the evolution of the Kenyan solar home system market in order to illustrate some of the ideas presented in the conceptual discussion. The paper ends with a discussion of the case, including a brief analysis based on the critical factors for inclusive governance suggested in the parent paper for this session by Johnson and Vidican (2013).

International low carbon development policy

Existing international policy mechanisms for low carbon development have had mixed results, with little impact on poor developing countries, particularly Least Developed Countries (LDCs). For example, only 0.2% of certified emissions reductions under the Clean Development Mechanism (CDM) are expected to come from LDCs (De Lopez et al 2009). We have argued elsewhere that this problem is in part due to a tendency to frame low carbon energy access in developing countries around the notion of low carbon 'technology transfer', where technology is understood narrowly as simply consisting of hardware (Byrne, Smith et al 2012). This narrow understanding steers policy towards financing incremental costs of low carbon hardware, such as via credits for investing in low carbon projects under the CDM. Whilst hardware is clearly important, these financing mechanisms have led to an uneven distribution of investment, both technologically and geographically, with the poorest nations benefiting least, if at all. The majority of support is concentrated towards rapidly emerging economies, where financing and deployment environments are already attractive. The technologies funded tend to be low risk or mature, and mostly relate to large project based initiatives that are less likely to attend to the needs of poorer groups.



Key: Country or Region, USD billion, percentage of CDM total accumulated investment

Figure 1: Accumulated investment through the CDM in USD billion by selected countries and regions as at end of October 2012

Source: Authors' analysis of CDM pipeline, available from http://www.cdmpipeline.org

Furthermore, as the CDM in particular is based on private sector investment in individual projects, it is concerned primarily with generating profit from emissions reductions, not with building local innovation systems and the capabilities within them to foster innovative development of technologies. Indeed, we could argue that the incentive is to reduce the potential for building local innovative capabilities so that project developers maintain control over technologies (e.g. see Douthwaite 2002 for a discussion on the protection of knowledge hindering innovative activity). Where the CDM has been used to build innovation systems it has been done through the strategic intervention of the state, as is the case in China (Watson et al 2011). For poor developing countries, where capabilities for policy implementation are generally weak and the potential to generate emissions reductions now is low, the CDM or similar policy instruments are unlikely to be of any benefit in regard to low carbon innovation system building.

If we accept this analysis then it is clear that a different approach is necessary in LDCs and other poor developing countries. In the next section, we sketch a promising approach that arises from the literature on socio-technical transitions, but develop this on the basis of insights from innovation studies. We then illustrate the approach briefly with an example of the evolution of the solar home system (SHS) market in Kenya.

Low carbon development pathways

This paper is concerned with the role of policy in fostering low carbon technology uptake as part of development pathways that serve the needs of poor and marginalised people. As such it makes inherent normative assumptions, viewing poverty reduction and climate change mitigation as priority development commitments that might be simultaneously achieved. Such normative commitments cannot be taken as given. Each can be contested, and the particular solutions to any commitment – even if not contested – are the subject of sometimes fierce debate. These contestations and debates have material consequences for the choice of action undertaken and so it is important that we include attention to these politics in both our analysis of potential interventions and the way we conduct those interventions. Therefore, we begin our discussion of low carbon development pathways by considering the notion of framing and its implications.

Societal services or functions (e.g. energy production via low carbon technologies to serve the needs of poor rural communities) are realised dynamically out of the interplay of various co-evolving complex systems (social, technological, environmental) and any particular unfolding of these dynamics constitutes a specific development pathway amongst multiple possible pathways (Leach et al 2007). Each of these complex systems themselves, and their combination, can be framed in different ways. And each framing informs – and is informed by – a narrative that interprets the world in a particular way, reflecting and reinforcing the perspective of the narrator. As understood here, a narrative is used to "suggest and justify particular kinds of action, strategy and intervention" (Leach et al 2010: 3) and so attempts to enrol actors and their resources into particular ways of achieving development goals. If this enrolment is successful then a particular direction of development is privileged, the result of which is an unfolding pathway co-evolving contingently and uncertainly in the interplay between these privileging forces and the various complex systems noted above.

Implicit in this description is the notion that multiple framings, narratives and pathways are possible. Different groups of actors will interpret the world in different ways; arising from their own experiences, situations, understandings, values and interests. Favouring certain framings over others, they will seek to promote narratives that would help to create their preferred development pathways. Some narratives will be more dominant than others, perhaps because they are promoted by powerful actors, and are likely to become manifested in interventions. Other narratives remain marginalised, perhaps because they are promoted by groups who are themselves marginalised or powerless (Byrne, Smith et al 2012).

But this is not to argue that dominant narratives and pathways are immune to influences from the margins. As evidenced in the literature on socio-technical transitions, dominant socio-technical practices come under pressure from external dynamics, and experience internal tensions between the many dimensions (social, cultural, political, technical) that constitute those practices (e.g. see Geels 2002; Raven 2005; Smith 2007). Climate change, for example, is creating increasing pressure on the dominant fossil-fuel based development pathway. And the climate change narrative has enrolled increasing numbers of actors and their resources; spawned the United Nations Framework Convention on Climate Change (UNFCCC) and instruments of climate governance such as the Kyoto Protocol; promoted certain strategies such as investment in renewable energy technologies; and argued for interventions such as carbon pricing. Of course, the fossil-fuel based development pathway remains dominant but it is clearly under mounting pressure and we could argue that its dominance is beginning to erode.

In trying to analyse how dominant practices come to be eroded, or how new practices come to be accepted, we can draw from the socio-technical transitions literature. Here we see that there are various ways in which marginal, experimental or sometimes radical socio-technical practices can come to influence mainstream practices and even thoroughly transform them over time (Geels and Schot 2007). Technology can play a central role in such transformations by affording opportunities for entirely new practices that create demands for widespread institutional change (Deuten 2003). But if we are to make use of these transformational possibilities to realise normative goals, such as pro-poor low carbon development, then we need to be careful how we understand technology itself (Watson et al 2011). Our argument here is that an inadequate conception of technology will likely produce – at best – inadequate technology policy, such as with many 'technology transfer' efforts and instruments such as the CDM. Worse, such policy could be ineffective or even counterproductive (Byrne et al 2011). For instance, inadequately conceived low carbon technology transfer to developing countries could see the failure of those technologies, resulting in pressure to turn to carbon-intensive options instead, locking development pathways into high carbon directions. For insights on the nature of technology, and its role in helping to realise pro-poor, self-determined, development pathways we can turn to the innovation studies literature.

Technology and innovation systems

An important insight in the literature is that technology is not simply hardware. Embedded in the hardware is a reflection of the knowledge required to create it; and knowledge and skills are needed to adopt, use and adapt it – sometimes referred to as the software – (Bell and Pavitt 1993; Ockwell et al 2010). Extending this idea, some authors demonstrate that hardware is also embedded with social or cultural assumptions (Agarwal 1986; Pacey 1983; Wynne 1995). An essential characteristic of this 'software' is tacit knowledge – a fundamental aspect of knowledge and skills that is difficult or impossible to articulate but can be cultivated through practice (Polanyi 1966). Combining these ideas, we begin to form the notion of socio-technology, echoing the language of socio-technical transitions thinking discussed above. Flowing from these ideas, and demonstrated in the literature, we see that technologies are created, adopted and adapted within a systemic environment. This idea has long been studied in regard to innovation systems, with particular attention to the linkages between firms and other actors, and the institutional setting of policies, laws, regulations and norms (e.g. see Bell 1990, 1997, 2009; Bell and Pavitt 1993; Freeman 1992; Hobday 1995a, 1995b; Katz 1987; Kim et al 1989; Lundvall 1992; Ockwell et al 2008; Radošević 1999; Watson et al 2011).

One way to understand the significance of some of these ideas is depicted in Figure 1, especially in regard to innovation systems and the ways in which the knowledge and skills required for self-directed development can be accumulated. Based on Bell (1990), the diagram shows three types of possible technology flow (A, B and C) during transfer projects into a local innovation system. Flow 'A' includes hardware, as well as the engineering and managerial services that are required for implementing such transfer projects. Flows of type 'B' consist of information about production equipment – operating procedures, routines, etc. – and training in how to operate and maintain such hardware. Bell (1990: 77) describes these flows as "paper-embodied technology" and "people-embodied knowledge and expertise". Both flows 'A' and 'B' add to or improve the production capacity of a firm or economy, but do little or nothing for developing the skills needed for generating new technology. Flows of type 'C', however, are those that help to create the capability to generate new technology. In other words, they help to build innovation capabilities (see Bell 2009).

Within the context of a concern with low carbon development, this idea of technology flows building local capabilities to generate broader technological change is of central importance – in this case building capabilities to generate technological changes that facilitate lower carbon social and economic practices. The existing technological capabilities in the local context are sometimes referred to as absorptive capacity, defined originally by Cohen and Levinthal (1990: 128) as the ability of a firm to "recognize the value of new information, assimilate it, and apply it to commercial ends". However, it has also been used to demonstrate the impact of individual firms' absorptive capacity on the ability of clusters of firms to adopt and adapt new technologies (Giuliani and Bell 2005), and – within the low carbon context and of particular relevance to us here – to explain the ability of countries to achieve technological learning through the CDM (Doranova 2009).

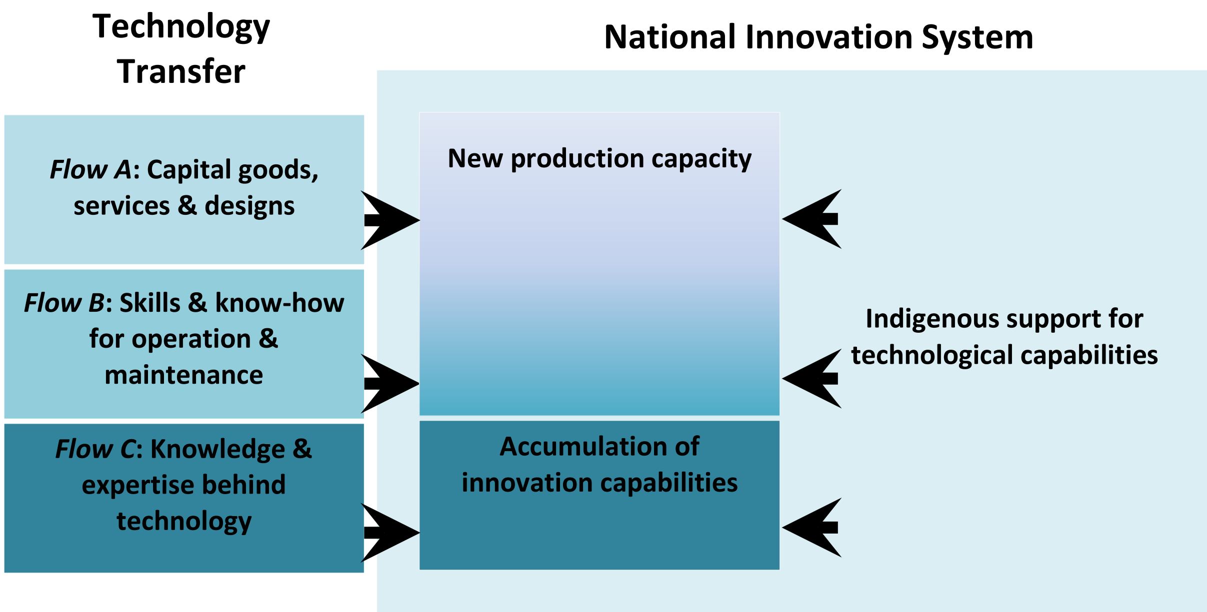


Figure 2: Technology transfer and indigenous innovation

Source: Adapted from Watson et al (2011: 16) based on Bell (1990)

The diagram in Figure 2 does not show explicitly the importance of the institutional environment, although the innovation literature does so, especially with regard to formal national and international policies. These can help to enhance existing industrial activity – to raise the level of capabilities to increase competitiveness, for example – but are also important for fostering new industrial activity that would otherwise not be pursued (e.g. see Cimoli et al 2009). In the case of low carbon technologies – and a concern with broader processes of low carbon technological change – this latter point is particularly relevant (Ockwell et al 2010). Many existing low carbon alternatives are not yet competitive with carbon-intensive technology options and so market demand for many low carbon technologies tends to be weak or marginal. But it is likely that we will need a range of low carbon technologies, and the need is becoming increasingly urgent. In principle, appropriate policies could foster the improvement of low carbon technologies, and the local capabilities and innovation systems that can sustain and develop them. The result could be a multiplicity of co-existing pathways, each appropriate to its context, promoting more equitable human development (Stirling 2009).

Building low carbon innovation systems

More recently, the broader dimensions of the systemic environment in which innovation and development takes place (social, cultural, political together with the economic, institutional and technical) have received attention in the socio-technical transitions literature (e.g. see Berkhout et al 2004; Byrne 2011; Geels 2002; Geels and Schot 2007; Raven 2005; Rip and Kemp 1998; Smith 2007; Smith et al 2010). And, this socio-technical approach has begun to be applied in the context of developing countries. For example, see the special edition of *Environmental Science & Policy* introduced by Berkhout et al (2010) for the application of these ideas to developing Asia, and see Byrne (2011) for their application in Kenya and Tanzania. Specifically, these papers focus on the use of strategic niche management (SNM, or 'niche theory') to understand the dynamics of how novel technologies were tested in real-world settings, and whether or not they resulted in wider use and further development. In the case of Byrne (2011), the evolution of solar home system (SHS) markets in Kenya and Tanzania is traced over several decades from their beginning (in Kenya) in the mid 1980s. We will summarise some of the findings in the next section.

A key feature of niche theory is that it directs our attention to the co-evolution of actors' expectations about a technology in the future, their learning as they experiment with that technology in real-world settings, the networks of other actors they develop, and the societal embedding of various socio-technical practices relevant to that particular technology. These co-evolutionary dynamics are assumed to happen in what amounts to a protective space – or niche – in which the normal pressures of market forces and technical performance are weakened, enabling essential learning to take place (Smith et al in press). Of course, these dynamics unfold within a broader context, which is conceived as consisting of various 'regimes' (mainstream, normal or dominant ways of doing things) and a wider 'landscape' (difficult to influence changes such as demographics, events such as wars, etc.) (Romijn et al 2010). Some niches come to influence regimes over time, and can even replace them entirely.

Understanding the processes of how and where niches have been successful and unsuccessful in influencing regimes therefore raises the potential to understand where policy might deliberately intervene to nurture low carbon niches. A policy aim might be, for example, to widen and deepen access to low carbon energy technologies to benefit poor and marginalised groups and do this by creating new – or nurturing existing – niches of low carbon energy technology applications amongst poor communities and households. Importantly, niche theory emphasises the role that key actors, known as "cosmopolitan actors" (Deuten 2003) or "innovation system builders", can play in developing a niche, raising potential for policy makers and other actors (e.g. NGOs or private companies) to emulate the actions of past successful innovation system builders to achieve wider impacts and broader uptake of low carbon energy technologies. It is here that an account of the evolution of the Kenyan SHS niche can illustrate these ideas.

Evolution of the Kenyan SHS niche

This section draws heavily on Byrne (2011), supplemented with information from on-going research[2] into the Kenyan PV market. Consequently, some of the more recent information might contain factual errors. Still, even at this stage, there are potentially useful insights to draw from what must be assumed tentative results.

Early innovation system builders

Photovoltaic technology was already in use to some degree in Kenya in the late 1970s and early 1980s, where it was used to power commercial and community applications such as telecommunications facilities and health centres. The first recorded experience with SHSs was in the mid 1980s, where an ex-Peace Corps volunteer, Harold Burris, used PV for his home. Burris had worked in the nascent US solar industry before coming to Kenya. In 1985, Burris teamed up with another Peace Corps volunteer, Mark Hankins, to install PV lighting in a rural Kenyan school. Following this installation, the headmaster and teachers wanted PV for their homes. From this point, Burris began to market these 'solar home systems' in the area around the school; a relatively rich part of Kenya due to the production of cash crops. Within a few years, Burris and his technicians were busy installing SHSs and the PV suppliers in Nairobi soon entered the market once they began to hear about its growing success.

Hankins, having also learned of this success, returned to Kenya and began to get involved in solar training after starting his own company, Energy Alternatives Africa (EAA), through which he started to win project funding to help experiment with ideas for further developing the SHS market. Over the next decade or so, EAA became an important player in the Kenyan SHS market by implementing many donor-funded projects. Some of the projects installed PV systems in community buildings, such as schools and hospitals, alongside training of local technicians. Others involved developing and testing various products or balance-of-system components, such as solar lanterns or charge regulators. Some projects were implemented to help build local manufacturing capability for solar batteries. And some projects tested different financing mechanisms, such as micro-credit through local Savings and Credit Cooperatives (SACCOs).

Building on the ideas above, an SHS niche can be understood to have developed in Kenya, together with key aspects of a relevant innovation system, facilitated in large part by the strategic activities of certain key actors, particularly EAA. Over time, EAA worked with a wide variety of actors in the SHS niche in Kenya, and on a range of dimensions of the niche – some technical, some financial, and some managerial. While doing so, Hankins wrote extensively about the various experiences, sometimes as a reporting requirement of the donors, and sometimes for his own publication record. The effect was to help build the actor-networks that niche theory identifies as important; create many opportunities for learning in real-world settings, and share this learning widely; build detailed market information, especially in articulating consumer preferences; and help to embed new socio-

[2] See http://steps-centre.org/project/low_carbon_development/ for more information.

technical practices, not least through the solar training courses. Furthermore, Hankins, in particular, became an opinion leader in the solar field in Kenya (and beyond), persistently promoting the technology locally and internationally. In short, EAA can be seen as an innovation system builder in the Kenyan SHS niche.

Attempts to scale-up: market transformation

In 1998, the International Finance Corporation (IFC) began implementing a project in Kenya that was intended to transform the market by addressing a perceived finance constraint. The Photovoltaic Market Transformation Initiative (PVMTI) made USD 5 million finance available on both the demand and supply sides of the Kenyan PV market, which would be disbursed in loans to consumers and suppliers over the ten-year life of the project (Gunning 2003: 81). Finance for customers would enable them to overcome the high initial cost of PV systems and therefore release pent-up demand. Finance for companies would allow them to purchase in bulk and so reduce their costs, hence lowering prices to consumers. The project was to be implemented in three countries simultaneously: Kenya, Morocco and India. Kenya was "viewed as a true free market for PV products" (IFC 1998: 12). With a total investment across the three countries of USD 25 million, the project was expected to have a discernible impact on sales in the world market: specifically, the impact was expected to be about a 5% increase in world PV sales within five years (IFC 1998: 14).

A request for proposals was issued in September 1998 (Gunning 2003: 85). As the terms of lending were leverage of 1:1 and a minimum PVMTI investment of USD 0.5 million, companies in Kenya were forced to come together as consortiums because no single company could risk such an amount of money (Ngigi 2008; Bresson 2001: 5). One of the first consortiums to submit a proposal involved the Cooperative Bank of Kenya (CBK) together with battery manufacturer Chloride Exide and EAA. This received "first-track" status, meaning that it was acceptable in principle and ready for implementation (Ngigi 2008). However, the IFC had issues with investing in CBK because of their non-performing assets, and decided the proposal was not bankable. Soon after this, according to Ngigi (2008), disparaging articles began appearing in the local media and EAA became one of PVMTI's biggest critics. Certainly, by 2001, there was evident disquiet and impatience expressed in the SolarNet[3] newsletter by some actors (Muchiri 2001: 4; de Bakker 2001: 4-5; Bresson 2001: 5-6).

Other proposals were received (Hankins and van der Plas 2000; Ngigi 2008), and a long process of negotiations ensued: negotiations between the consortiums and the IFC; and, when these failed to produce deals, local financial institutions were persuaded to engage with the project, these deals collapsing after more protracted negotiations (Ngigi 2008). Eventually, it appeared that most of the available finance would finally be disbursed. Three deals were agreed: one with Barclays Bank, Kenya; one with Equity Building Society; and one with Muramati Tea Growers SACCO (Hankins and van der Plas 2000: 29). But these fell apart for various reasons, and the disquiet amongst stakeholders mentioned above turned to resentment.

This stimulated some actors to begin discussing ways in which PVMTI might be changed in order to provide some tangible benefit to the market (van der Vleuten 2008), and approached PVMTI in 2003 requesting help with capacity-building (Magambo 2006: 1). In 2004, PVMTI went through a

[3] SolarNet was a network for renewable energy promotion in the region and was publishing a widely read newsletter a few times per year. It was formally closed down in 2010 (Kilonzo 2013).

restructuring (IFC 2007: 42). As a result of meetings with PV actors in Kenya and the frustrations felt within the PVMTI hierarchy itself (Ngigi 2008), together with the evidence for training and quality needs (Jacobson 2002a, b), and the availability of some technical assistance[4] grant money, PVMTI began a capacity-building project in Kenya in 2006 (IFC 2007: 42; PVMTI 2009). The grant of USD 350,000, together with "in-kind contributions and co-financing" of USD 115,000, was used to support the Kenya Renewable Energy Association (KEREA), the development of a PV curriculum, PV training courses, the production of three manuals (user, seller, and installer manuals), and a quality assurance programme (IFC 2007: 42; PVMTI 2009; Nyaga 2007; Magambo 2006). PVMTI was then extended to 2011, and local actors began to take a more favourable view of the project (Ngigi 2008). But, in terms of the project's main goal – to make a discernible impact on the Kenyan PV market – it was a failure, having helped to finance only 170 SHSs (IFC 2007: 42).

Targeting the bottom of the pyramid: Lighting Africa

In September 2007, the IFC launched Lighting Africa with a global call for project proposals aimed at developing new lighting products and delivery models for Africa's large un-electrified rural off-grid lighting market. The hope was that recent advances in performance of key technologies – especially light-emitting diodes (LEDs) – could be harnessed to provide cheaper and better lighting for the BOP. Grants of up to USD 200,000 were available for each successful proposal, and 16 were selected from the more than 400 proposals received, four of them to be implemented in Kenya (WBG 2008: 6-7). Since then, Lighting Africa conferences were held in 2010 (Nairobi) and 2012 (Dakar) during which awards were given for a selection of "outstanding" lighting products on the market.

But the Lighting Africa programme soon began implementing a wider range of activities after its launch in 2007. By the time of its second-year progress report, these included: market research in several countries; product testing and the development of quality assurance methodologies; identification of financing needs throughout the value chain; knowledge-sharing and self-evaluation; and moves to identify policy constraints by researching the policy environments in several countries (WBG 2009). For Kenya, by the end of 2008, there were already highly detailed qualitative and quantitative market assessments (IFC 2008a, b). And much more research followed including on products available in Kenya, product-testing, and a review of the policy environment and policy actors (see the Lighting Africa website[5] for these reports).

In 2009, Lighting Africa became much more active in Kenya in terms of interventions. Over the next few years – up to the official completion of its pilot phase in late 2013 – the programme engaged in an aggressive and roaming awareness-raising campaign, quality-assurance labelling of products, setting-up of a product-quality testing facility, training of technicians, capacity-building for business development and for finance institutions, lobbying of policy makers on regulations, and building of networks of actors to encourage the flow of information. Whilst it is difficult to determine the extent to which outcomes can be attributed directly to these efforts, the programme does make a series of claims (see Figure 3). And a recent updated survey in three towns in Kenya tends to support the

[4] Ten percent of PVMTI money was already available for grants for exactly the kinds of activities the stakeholders wanted funded (IFC 1998). It is unclear why it took so long for the money to be made available in-country. But, additional grant money was made available after the grant component was increased to 20 percent (Ngigi 2008; IFC 2007).

[5] http://www.lightingafrica.org/

notion that the market for small off-grid lighting products has expanded rapidly in the past four years (Harper et al 2013).

Overall impact	
6,900,000[1]	**People in Africa now with clean lighting** and better access to energy due to solar lanterns
1,386,000	**Off-grid lighting products** that passed Lighting Global quality standards **sold in Africa**
138,600	**Tons of GHG emission avoided;** CO_2–equivalent of taking 26,000 cars off the road
120%	**Growth in sales of good quality lighting products in 2012** (over 2011)
20	**Number of countries** now selling products that have passed Lighting Global quality tests
Quality assurance	
2	**Test methods,** developed by Lighting Global**, for off-grid lighting products;** tests currently used in four laboratories worldwide: Kenya, Germany, and two in the USA
150+	**Lighting products tested** using the Lighting Global Quality Test Methodology (LG-QTM)
49	**Products passed the Lighting Global minimum quality standards**. Most of them have also met the recommended performance targets
12	**Technical Briefing Notes published**, providing manufacturers with information to help them design and improve their lighting products
2	**Eco Design Briefing Notes published**, focusing on health and safety issues for consumers, distributors and manufacturers
Market intelligence	
16	**In-depth market insight reports** that the industry has used to develop products, enter the markets, or mobilize investors
Consumer education	
22,000,000	**People reached** by the consumer education campaigns in Kenya and Ghana
1,500+	**Village forums** in Kenya and Ghana organized to educate rural families about the benefits of solar lighting over kerosene
Access to finance	
7	**MFIs providing micro-loans for consumers** to purchase quality-assured modern off-grid lighting products
Business development support	
30	**Manufacturers whose products** have passed Lighting Global minimum quality standards
15	**Manufacturers/Distributors** receiving advisory services from Lighting Africa **(Associates)**
Policy	
1	**Institutions referencing Lighting Africa's test methods**: the UNFCCC harmonized with Lighting Africa Quality Testing Methodology for carbon finance (CDM) compliance
8	**Country studies identifying key policy barriers** to the adoption of modern lighting products and services published. The studies cover Cameroon, Democratic Republic of the Congo (DRC), Ethiopia, Ghana, Kenya, Rwanda, Senegal, and Tanzania.

[1] The access to clean light computation is based on the assumption that one solar lantern serves one household, and that each household has five people. This calculation is currently under review to accommodate new market data.

Figure 3: Lighting Africa claimed impacts and outcomes up to end of December 2012

Source: http://www.lightingafrica.org/resources/annual-reports.html (accessed 16/10/13)

Discussion and conclusions

It should be clear from the preceding account that the PV market in Kenya has a long history and has benefited from extensive donor involvement. The extent of this donor involvement is seriously downplayed in most analyses of the market's evolution and growth but it continues to be critical to its apparent success. This is not to argue that the private sector has been unimportant. Rather, it is clear that both the private sector and donor community have played complementary roles in helping to service the electricity needs of those in rural areas of the country. What is less clear is whether the Kenyan policy environment has been as constructive. Policy action has been patchy and sometimes even hostile, although recent years have seen a more sympathetic approach.

The SHS market in Kenya is now worth about USD 6 million annually and there are more than 300,000 SHSs installed (Ondraczek 2013). It is not yet clear how many small lighting products – particularly PV-powered lights – have been sold but it is likely to be in the tens of thousands. This is still a relatively small fraction of the population with access to small quantities of electricity from PV, and so it would be premature to say that the niche has replaced the dominant view that electricity should be provided through the grid. Nevertheless, significant advances have subsequently been observed in relation to SHSs in Kenya. For example, the Kenyan government recently implemented a large project to install PV systems in schools; a project worth about a third of the annual SHS market. And Kenya now has a feed-in tariff for PV (MOE 2012). Furthermore, there have been recent developments to begin manufacturing solar modules in Kenya through a Dutch-Kenyan joint venture[6]. Before this, there had been interest from a Chinese company to manufacture modules in Kenya (Disenyana 2009) but the deal fell apart following the post-election violence in 2008.

Little – if any – of the success can be attributed to PVMTI, which could be characterised as a hardware-financing project. But the IFC may have learned important lessons from the PVMTI experience that informed the design of the Lighting Africa programme. This programme has taken a more systemic approach to developing the market, albeit a different segment of the market than the target of PVMTI. Lighting Africa has focussed more on building capabilities throughout the value chain, building actor-networks, influencing policy and other institutions, raising demand and – crucially from our perspective here – building detailed understanding of the electricity needs and desires of the poor.

This brings us to a discussion of the critical factors for the governance of the inclusive and sustainable energy transition as posited in Johnson and Vidican (2013: 15). The first of these factors is coalition strength. The Lighting Africa programme seems to have worked hard to build a strong coalition of actors in Kenya and internationally. Indeed, the actions of Hankins and EAA could be similarly described. But PVMTI was much less successful in this regard; any goodwill it enjoyed early in the project evaporated, only beginning to return once the project engaged in activities broader than hardware-financing. For implementation capacity, again, Lighting Africa seems to have targeted its resources to continued strengthening of capabilities throughout the value and supply chains. PVMTI, in contrast, continually struggled to develop its own implementation capacity and had to be persuaded that capacity-building in the market would be a better use of its resources. Whilst it did eventually devote more resources to capacity-building, it was a relatively small amount of money, even though the activities may have been helpful. In terms of learning capacity, Lighting Africa

[6] See http://www.ubbink.co.ke/

seems to have been stronger than PVMTI again. Much of the learning in Lighting Africa was focussed on market intelligence but there also seems to have been on-going efforts to act on feedback from stakeholders. PVMTI did learn, and may have informed the design of Lighting Africa, but it does not appear that there was any integrated form of continuous learning in the initiative.

The other critical factor is regime type. It is not at all clear how much influence this factor has had in the Kenyan PV market. Throughout the late 1980s and up to the early 2000s the Kenyan government displayed variously hostile and lukewarm stances towards the PV market. Even so, the market was considered to be successful during this period, especially when compared with off-grid PV markets in other developing countries. It is possible that there will be important influences from what is beginning to look like a much more constructive approach from the Kenya government in recent years but it is too soon to tell.

One clear lesson from the evolution of the Kenya PV market is that its success – whether for SHSs or pico-solar lighting products – is explained by a combination of interventions that has addressed several dimensions of a nascent innovation system. An interesting aspect of these interventions has been the effort to understand the detail of consumer preferences and constraints. This has enabled much better designs of SHSs and lighting products that address the context-specific nature of electricity services in rural areas. This suggests that governance of inclusive energy transitions would be improved by taking a systemic approach and that, within this approach, working more closely with consumers of energy services to understand their needs more deeply would raise the chances of providing more appropriate solutions. Indeed, these kinds of strategies may lead to governance that achieves extensive inclusiveness in line with the dimensions outlined in Johnson and Vidican (2013: 4).

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