Energy Policy 114 (2018) 89–97

Contents lists available at ScienceDirect

Energy Policy

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

Spatial transfer of innovations: South-South learning on village-scale solar power supply between India and Kenya☆

Kirsten Ulsrud[a], Harald Rohracher[b,*], Charles Muchunku[c]

[a] University of Oslo, Department of Sociology and Human Geography, Postboks 1096, Blindern, 0317 Oslo, Norway
[b] Linköping University, Department of Thematic Studies – Technology and Social Change, Campus Valla, 58183 Linköping, Sweden
[c] Independent RE Consultant, P. O. Box 76406-00508, Nairobi, Kenya

ARTICLE INFO

Keywords:
Technology transfer
Socio-technical systems
Energy access
Solar energy
Energy transition
Development

ABSTRACT

This article presents research on the transfer of sustainable energy innovations between countries of the global South from a socio-technical perspective. The analysis identifies factors important for how a deliberate transfer process may unfold. It is based on monitoring a case of South-South transfer of experiences with village-level solar power supply models from India to Kenya. This research shows that it is not so much stable technical solutions which travel between different spatial and cultural contexts, but that experiences with sustainable technologies in one country can provide important inspiration and knowledge for the development of new socio-technical designs based on local needs in a new socio-spatial context in a different country. Such learning processes can be especially effective between countries with similar problem situations, such as poverty and lacking access to electricity in rural areas. To achieve a successful transfer, strong emphasis must be put on mutual learning and exchange of knowledge, socio-technical experimentation, adaptation and social embedding. Learning from promising, innovative infrastructures in other geographical areas needs to capture the micro-level interactions between people, technology and socio-cultural contexts, while also taking into account larger processes of system innovation and emerging transitions.

1. Introduction

Existing examples of social and technological changes, whether successful or not, are valuable sources of learning for those who seek societal improvement (Hoogma et al., 2002; Kalleberg, 2009; Raven et al., 2008). Many pioneering and innovative activities are currently taking place globally in order to develop a greener and more equitable society. In the field of electricity supply for instance, attempts to develop solutions that can reach all parts of the population in sustainable ways can be found in many countries, not least within off-grid use of renewable energy technologies in the Global South. There is geographical diversity in the details of such experimentation at the same time as they are addressing similar problems. This creates a potential for transferring practical experience and knowledge between these activities in countries of the Global South.

However, technologies and their configurations are parts of wider socio-technical systems developed and embedded in specific geographical and cultural contexts, thus they are not likely to be directly transferable to different places (Raven et al., 2008). Technologies are closely interwoven with social practices, actors and institutions involved in their production and use (Berkhout et al., 2010). Although institutions shape the framework conditions for involved actors, it is difficult to reproduce institutional conditions that govern the field of energy in other places. Moreover, it has been pointed out that donors and funders of technology projects in developing countries do not always put sufficient effort into understanding the recipient society, the actual needs of people and the details of what fits to a specific social context (Murphy, 2001; Ockwell and Byrne, 2017). The dynamic relations between the social and technical dimensions in different geographical contexts have been widely recognized (Bridge et al., 2013; Metz et al., 2000; Romijn and Caniëls, 2011).

Although some kind of translation is clearly necessary, spatial and contextual aspects of technology transfer have received little attention in research, policy and practice so far. Technology transfer was earlier mostly understood as a unidirectional, linear process of delivering technology, expertise and financing to a country from the outside, especially from the Global North to the Global South (Maskus, 2004). Such an understanding has long been questioned (Metz et al., 2000), but is still typical for the way technology transfer is considered today, for instance in relation to climate change (Ockwell and Byrne, 2017).

☆ *"This article is part of a Virtual Special Issue entitled 'South-South Technology Transfer and Cooperation for Low Carbon Energy Technologies'."*

* Corresponding author.
E-mail addresses: kirsten.ulsrud@sosgeo.uio.no (K. Ulsrud), harald.rohracher@liu.se (H. Rohracher), muchunku@yahoo.com (C. Muchunku).

https://doi.org/10.1016/j.enpol.2017.11.064
Received 4 August 2017; Received in revised form 1 November 2017; Accepted 27 November 2017

The transfer of social and technological innovations between different socio-cultural contexts and national settings remains poorly understood. This includes how an adaptation or translation of innovations to different social contexts may take place, and which kinds of factors influence such processes.

This article discusses insights from a socio-technical transfer process where processes of learning through "trying, failing and trying again" were explored as a mechanism for the gradual adaptation to contextual conditions. Drawing on experiences with the transfer of solar mini-grids from India to Kenya, the paper investigates how a spatial transfer strategy can combine different kinds of knowledge, including local knowledge and experience, to facilitate a creative learning process. Village-level solar power systems, like solar mini-grids are a good example of how decentralized, small-scale renewable energy models can potentially contribute to an equitable and sustainable transition of energy systems. Our analysis of the effects of an ongoing system innovation in Kenya highlights how a planned South-South transfer of innovations can offer deliberate, stepwise transfer strategies that can potentially link energy transition processes in different countries facing similar problems.

In the following Section 2 we present the theoretical approach to this analysis followed by a description of the case and how it was studied in Section 3. The results are analyzed in Sections 4 and 5, and conclusions are suggested in Section 6.

2. Theoretical approach

Two bodies of literature particularly discuss the spatial transfer of technology or socio-technical systems. The first is the literature on technology transfer to countries in the global South, and the other analyses concepts of inter-local learning in the growth of socio-technical niches. Even if the second one has mainly been developed in a European context, we find it relevant for understanding strategic efforts for transferring socio-technical innovations between local initiatives in the South.

2.1. Literature on technology transfer to countries in the South

A large part of the literature on international technology transfer to countries in the South has focused on how developing countries can catch up with industrialized countries in technological advancement, industrial production and production of their own capital goods, as well as large-scale energy and water supply (Maskus, 2004). Channels for technology transfer between countries identified in this literature include trade in products, trade in knowledge, direct foreign investment, and international movement of people. The transfer has traditionally been assumed to go from North to South. Central issues discussed are the policies of technology exporting countries, spillover effects from foreign direct investment, protection of infant industries and competition issues. Authors also focus on norms and standards set by multilateral organizations, trade terms and intellectual property rights (Bell and Albu, 1999; Grübler and Nakićenović, 1991; Hoekman et al., 2004; Reddy and Zhao, 1990; Soete, 1985). Such literature on technology transfer only provides limited insights on the transfer of knowledge, experience and equipment relevant for implementation and use of technology in local communities, which is the focus here.

More specific literature in this field relates to the transfer of "clean technologies" to combat climate change and at the same time create economic and social development in the South. Some of this literature has developed a more integrated view on social and technical dimensions (Halsnæs et al., 2007; Martinot et al., 1997). A special report from IPCC (Metz et al., 2000) conceives of technology transfer as a broad set of processes covering the flows of know-how, experience and equipment. It also comprises processes of learning to utilize and replicate technology, including the capacity to adapt it to local conditions and integrate it with indigenous technologies. Participatory approaches and strengthening of networks are suggested elements, and it is recommended not to ignore late stages of the transfer process. The report emphasizes the sustainable development perspective of technology transfer, i.e. the importance of creating social and economic development at the same time as addressing climate change and other environmental problems, which is also pointed out by Román et al. (2012).

Barriers to technology transfer mentioned in this literature are especially related to the characteristics of the "recipient" or "host country", including human and institutional capacity and science and educational infrastructure. A lack of ability to develop and replicate innovations is addressed. So-called "active technological behavior" by technology importing firms is called for to avoid technological dependence and stagnation. Emphasis is put on the characteristics of the "recipient", including ability to absorb and use new technology efficiently (Halsnæs et al., 2007; Metz et al., 2000).

Some of this literature has come as a reaction to the way technology transfer is seen in practice within international mechanisms for technology transfer, such as the Clean Development Mechanism (CDM). Byrne et al. (2011) and Ockwell and Byrne (2017) argue that the current form of CDM seems to be influenced by an understanding of technology as "hardware", with some understanding of the need for "software", mainly in terms of cooperation and maintenance skills. A range of societal problems are assumed to get solved through such mechanisms for transfer of low-carbon technologies, including problems of energy access, equity, security, and environment. However, considerations of social conditions and economic realities of the people who could benefit from the technological change are often insufficient (Murphy, 2001).

2.2. "Inter-local learning" – technology transfer as learning between projects

The concept of "inter-local learning" is used to address learning between projects both within and between countries. The concept is relevant for our analysis of technology transfer, even though it is not focusing explicitly on international technology transfer to developing countries. According to Raven et al. (2008), inter-local learning means learning between specific socio-technical experiments in different geographical contexts – practical projects where new technologies or new ways of using technologies are tried out in real-life settings. The work on inter-local learning is part of a broader effort to understand the formation of socio-technical niches, their accumulation and impact on transitions towards more environmentally sustainable systems. Local experiments contribute to the formation of niches which often are radically different from existing mainstream systems or regimes, such as the conventional energy system (Raven et al., 2008; Schot & Geels, 2008).

Such experiments draw on experiences from similar projects, and represent local variations of the emerging structures or rules of a socio-technical niche. An important aspect is local *re-invention* in order to embed the project in the social context. Such embeddedness is created through establishing continuity with existing physical, social and cognitive structures and by providing local benefits. Locally appropriate communication and participation procedures are also suggested (Raven et al., 2008, p. 469). Local benefits may include energy independence or creation of a new marketable product, local employment, and improvement of community services (Raven et al., 2008; Späth and Rohracher, 2012). This is relevant for direct learning between projects, which is important here.

Fig. 1 below shows learning processes between the local socio-technical experiments (projects) and the aggregate niche level as well as between local projects (Coenen et al., 2010, p. 297; Geels and Raven, 2006). The mechanisms shown in the figure represent processes of building up socio-technical systems in niches, of which inter-local learning is just one element. This article is particularly interested in the potential for systematic knowledge sharing and learning between