

Lessons from deploying large scale solar electrification in Bangladesh. Can the Last-Mile Become the First?

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Overview

With over four million solar home systems (SHSs) deployed under the national electrification program ran by IDCOL, the Infrastructure Development Company Limited, Bangladesh stands out in the development of decentralized, bottom-up off-grid electrification (International Monetary Fund 2018). The large scale solar program is widely recognized for its effective industry policy combined with its unique last-mile distribution and end-user financing model. Khandker et al. (2014) as well as Bertsch and Marro (2015) among others, have largely discussed the program and identified principal success factors. However, an overall critical discussion with regard to the organizational model deployed is missing, including the limited ability of the program to respond to recent challenges facing a considerable slowdown of SHS installation rates (Tyabji and Chase 2016). The objective of this paper is to summarize two decades of solar electrification in Bangladesh and to provide insights on the economics and regulation in the context of institutional modelling. The critical analysis leads to the discussion on how effective decentral SHS electrification can be further developed by exploring the potential of swarm electrification, i.e. the achievement of “grid-like” infrastructure through the bottom-up (r)evolution of the off-grid SHS infrastructure by interconnecting the decentralized existing and new electricity usages, storages and generators, enabling a peer-to-peer economy based on prosumerism and local value creation.

Methods

First, we focus on the historic and contextual component. Among others, our analysis includes extensive findings from the World Bank (Martinot, Cabraal, and Mathur 2001; World Bank 2002; Sadeque, Zubair et al. 2014) as well as dedicated policy research papers (Asaduzzaman et al. 2013; Tiedemann 2015) to explore the evolution of the program since its inception in 2002. Special attention is paid to the perspectives of the four principal stakeholders: end-user, distributor, supplier and government/public sector. While the literature on the business model of the SHS program, its effective distribution and success factors, is vast, the institutional perspective has received much less attention. Thus, as a second step, we explore the program according to the organizational models deployed. Distinguishing between the two fundamental dimensions of production and financing, we create a framework which leads to the determination of the underlying organizational models and its generic potential for enhancements and replication. Lastly, we introduce swarm electrification as one solution to the recent challenges of the program. Bottom-up grid infrastructure by interconnecting solar home systems may present the next level of sustainable off-grid electrification.

Preliminary Results

Our analysis provides a consistent and historic overview of the Bangladesh solar electrification program. IDCOL, the public entity in charge of the coordination and implementation, has been proven to be highly effective as a single aggregator for financing, standardizing and deploying SHSs on large scale in rural Bangladesh. Based on their policies, the key challenges of last mile distribution - financing as well as delivery of affordable, but high-quality SHSs combined with effective customer service - could be solved. The program’s policies combine an attractive ownership model of the SHS for the end-user, affordable consumer loans as well as a highly enforced and developed local distribution and domestic supply side which is incentivized by subsidies and soft loans. A local solar industry has emerged which employs more than 133,000 people nowadays (IRENA 2018). Our institutional analysis identifies a well-structured division of the dimensions production/distribution and financing between the multiple stakeholders. The public sector, represented by the infrastructure agency IDCOL, is coordinating the policy level and managing the financial dimension of the program, while the execution, the production, deployment and maintenance of the SHSs was given in the hands of private sector players. However, especially the distribution side is mostly characterized by non-profit operations. NGOs and charitable foundations are often responsible for the last-mile distribution, which contributes to the overall finding, that the complexities of rural solar electrification asks for a dynamic and hybrid public private partnership model (PPP). In regards to swarm electrification, research on the installed SHS load curves in Bangladesh suggests that more than 30% of the generated electricity is not effectively used (Kirchhoff 2015).

Deploying SHSs provides only limited electricity Tier 1/Tier 2 access according to the World Bank Multi-Tier Framework (MTF) for measuring energy access (Bhatia and Angelou 2015). But using smart ICT technology and a DC Nano grid approach may drive the SHS infrastructure in Bangladesh to the next level (Walsh, Groh, and Chowdhury 2015). The concept of swarm electrification, networking solar infrastructure on a peer-to-peer level, has the potential to provide efficient and effective grid-like infrastructure (Groh and Koepke 2014). A recent study of Narayan et al. (2019) confirms that interconnected SHSs lead to a definite increase of electricity access. Swarm electrification supports the end-user in growing towards the grid-like energy infrastructure, leading to Tier 4/Tier 5 electricity access.

Conclusion

The Bangladesh case confirms that large scale solar electrification can be efficiently managed and successfully implemented. IDCOL, as the single aggregator of the program, has put into action an effective and hybrid PPP enabling high installation rates as well as a consistent growth of the local solar industry itself. The program has turned into an industry policy over time, and its success is catalysed by a close collaboration of the various actors. The critical institutional dimensions of financing and distribution/production are well organized. However, a new regulatory framework which addresses recent challenges and facilitates the adoption of swarm electrification is suggested.

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