Electrification of Sub-Saharan Africa through PV/hybrid mini-grids: Reducing the gap between current business models and on-site experience

The absence of publicly available up-to-date costs breakdown data on photovoltaic (PV)/hybrid mini-grids in Sub-Saharan Africa (SSA) is a barrier that needs to be resolved in order to overcome challenges in rural electrification planning, regulation, life-cycle operation, financing, and funding. The primary aim of this research is to provide better understanding of the cost structures of PV/hybrid mini-grid projects in Sub-Saharan Africa. The review on existing literature reveals significant lack of transparency and inconsistencies in PV/hybrid mini-grid costs. This paper aims to support the fact that there still remains a strong need to reduce the gap between current business model concepts and successfully implemented scale-up electrification models. Based on the experience of PV/hybrid mini-grids projects implemented in various rural communities of SSA, we propose a multi-dimensional cost analysis with a standardised breakdown of the real costs of installed projects. Subsequently, we assess the main social and environmental implications and we identify barriers that appear to hinder successful PV mini-grid planning and subsequent implementation in SSA. Africa has the unique opportunity to utilize renewable energy as a primary energy source. Indeed, the continent has the potential to bring electricity especially to its rural population by means of PV/hybrid mini-grids. However, the capability of public and private sector investors to pre-evaluate projects is limited by the lack of locally available information on PV/hybrid mini-grid costs or the reliability of data (when available). Multi-dimensional cost analysis of social and environmental impacts from this study highlight that PV/hybrid mini-grids offer a unique opportunity to create a standardised framework for quantifying costs of PV/hybrid mini-grids in SSA, that can support decision-making processes for designing viable business models. Findings show that there is a strong need to minimise the data quality gap between current business model and that of successfully implemented PV/hybrid mini-grids electrification projects. This gap could be mitigated through studying the issues that influence mini-grid costs (both hardware and software). In addition to understanding other factors that can influence project costs such as the market maturity and remoteness of the site, organisation capability, development approach, and level of community involvement. Regarding policy considerations, stronger political will coupled with proactive rural electrification strategies and targeted renewable energy regulatory framework would be essential in order to establish viable dynamic domestic market for off grid renewables. In the presented benchmarking analysis, the experiences of public and private development organisations are synchronized to contribute to the furthest extent possible to facilitate the assessment. Those include the disaggregation of component costs according to their unit in order to make comparison more accurate and include site-specific parameters in the discussion of costs.

General information
Publication status: Published
Organisations: Department of Management Engineering, UNEP DTU Partnership, European Commission Joint Research Centre Institute, Trama TecnoAmbiental
Number of pages: 14
Pages: 1148-1161
Publication date: 2018
Peer-reviewed: Yes

Publication Information
Journal: Renewable and Sustainable Energy Reviews
Volume: 91
ISSN (Print): 1364-0321
Ratings:
BFI (2018): BFI-level 2
Scopus rating (2018): CiteScore 12.21 SJR 3.288 SNIP 3.694
Web of Science (2018): Impact factor 10.556
Web of Science (2018): Indexed yes
Original language: English
Keywords: Business model, Cost data harmonization, Energy Development policy, Hybrid mini-grid, LCOE, Photovoltaic (PV), Rural electrification, Sub-Saharan Africa(SSA), Technology learning
Electronic versions:
filestore_8_.pdf
DOIs:
10.1016/j.rser.2018.04.018

Bibliographical note
© 2018 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/BY/4.0/).
Source: FindIt
Source-ID: 2434851715
Research output: Contribution to journal › Journal article – Annual report year: 2018 › Research › peer-review