

Using Blockchain to incentivize small scale power trading and mini-grid creation

Michele Velenderić

Green Power Brains, Munich, Germany
Sebastian Finke, Bochum University of Applied Science, Bochum, Germany
Oleg Pankov, INDETAIL Co., Ltd, Sapporo, Japan
Albert-Roßhaupter-Str. 1, 81369, Munich, Germany
Phone: +49 179 487 5400
E-mail: michele.velenderic@greenpowerbrains.com
Website: www.greenpowerbrains.com

Keywords: Blockchain, Distributed Ledger Technologies, Mini-Grid

It is estimated that about 12% of the world's population, more than 840 million people, have no access to electricity. In Sub-Saharan Africa this figure rises to roughly 55% of the population.¹ This electricity shortage has a negative impact on the economies of the area and on the welfare of the people affected.²

In addition to the electricity production itself, a big challenge is the distribution over vast, often scarcely-populated areas. High capital and operational expenditures and a lack of capacity for maintenance and operation, as well as undeveloped markets, are some of the problems that have to be faced when considering electrification in developing countries.

A decentralised energy production of mutually-independent off-grid, or grid-failover, hybrid power systems based on renewable energy sources bears various advantages. These are, among others, lower capital costs, less-complex installations and lower maintenance efforts that can be handled by local staff, as well as higher resilience in terms of technical failure.

In terms of service security however, independent renewable-energy-based power systems lack the advantages of a well-developed grid, overcapacities having to be installed in order to cover higher power demands during times of low renewable energy resources availability.

¹ The World Bank, <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS>, accessed on Oct. 5th, 2019

² Electric Power and Natural Gas - Brighter Africa, Antonio Castellano et. al., McKinsey & Company, Feb. 2015

Connecting independent power systems into a mini-grid could solve this issue and is often technically feasible. When the connected systems have the same owner the only barrier might be of technical nature. Connecting power systems with different owners opens the same possibility for isolated power systems to evolve into interconnected mini-grids, where different power systems support each other. However, open questions on fair usage and the lack of tangible financial incentives prevent this kind of connections from becoming common practice.

The goal of this paper is to examine the potential of connecting autonomous, decentralised power systems based on peer-to-peer energy trading in developing countries. This approach combines the advantages of decentralized power systems with the service security of a power grid by connecting together single off-grid or grid-failover renewable-energy-based power systems. A promising technical approach is the introduction of a blockchain-based solution that facilitates a fully autonomous electricity trade between single users and owners of the power systems within the mini-grid by using smart contracts. Automatic payment, confirmation of operation status, dynamic pricing as well as flexible incentives for services are some of the advantages of a blockchain-based solution.

Most importantly, the low transaction costs enable even the smallest systems to be integrated into publicly-owned mini-grids, which strongly increases the value of each individual system.

This approach will highly incentivize private investments into power systems and will boost efforts to provide electricity to communities in developing countries.