

IMPACT OF DECENTRALIZED

Jean-Claude Berthelemy, Université Paris 1 Panthéon Sorbonne, Phone, jean-claude.berthelemy@univ-paris1.fr
Arnaud Millien, Université Paris 1 Panthéon Sorbonne, 331652763217, arnaud.millien@univ-paris1.fr

Supprimé: ¶

Overview

Decentralized Electrification Projects (DEPs) are booming in developing countries as a response to the deficiencies of on-grid electrification in many parts of the developing world, particularly in rural areas, and due to the new possibilities offered by technological progress in renewable sources of energy. This process is potentially promising for sustainable development in developing countries, but it may be curbed by a lack of visibility on what works and what does not work, which may in turn become an obstacle to financing such projects.

This paper is part of a project to build a collaborative database on decentralized electrification, named CoSMMA (Collaborative Smart Mapping of Mini-grid Action), with the objective of identifying best practices from the point of view of sustainable development.

Methods

Using evaluations of 421 projects from published research papers, we built a pilot of CoSMMA which proves its feasibility. Its relevance is demonstrated by a meta-analysis, which reveals the principal characteristics of decentralized electrification projects that have positive impacts on sustainable development.

Four main characteristics were considered : technology (source of energy), system size (power), decision level (from local to country level), geographic location. When searching for best practices, technology and system size must be considered together, because the chosen technology may constrain the power which is provided by the system.

Our principal tool is a multi-probit meta-regression, which shows which factors led to which effects of DEPs on sustainable development. We also attempted to break down the analysis by type of effects, but at this stage the available information limits our analysis.

Results

We find that the most popular projects, which are based on Solar Home Systems (SHS) are not the most effective. The problem with SHS is not the use of solar energy, but the small system size often chosen for SHS.

Mini-grids, of larger size, especially those which use hybrid renewable sources of energy, have more positive impacts, because these systems combine the benefits of sustainability and flexibility.

In terms of decision level, we find that both top-down and bottom-up approaches have advantages, with the observation of a U-shaped curve for the influence of the decision level on the probability of obtaining positive impacts.

Geographical location matters, as it is very often the key to system feasibility. We find that DEPs are more effective in Latin America than in Asia, and more effective in Asia than in Africa.

Conclusions

The results of our meta-regression highlight the roles of energy source and system size. There is clearly a trade-off between the choice of new sources of renewable energy, especially solar energy, and system size. Solutions

relying on solar energy alone bring positive impacts, but those impacts are reduced because solar electricity is mainly delivered by nano systems, whose positive impacts are much less frequent than positive impacts of larger systems such as mini-grids.

Hybrid systems may provide an interesting compromise, because they can be larger than SHSs, and also help solve other technical issues such as intermittence. Our results also suggest an important role for the organizational characteristics, as evidenced by the U-shaped curve describing the influence of the decision level.

Presenting best practices of decentralized electrification may both encourage better sizing of projects and also provide first indications for the measurement of latent demand for decentralized electricity.

Using CoSMMA, electrification project developers could quantify the need for power given socio-economic conditions of the targeted off-grid area, and thus project sizing could be optimized, thus increasing the survival probability of projects.

Our meta-analysis of DEPs effects also gives a preliminary contribution to the measurement of latent demand for electricity, as positive impacts of electrification may be considered as proxies of electricity uses in developing countries. Measuring the latent demand is important because the development path of electrical appliances that was followed by households in advanced countries cannot be replicated today in developing countries. It is thus crucial to further analyze what will be the households preferences for electrical appliances.

References

References would need two pages, which is above the allowed size for this abstract. The complete bibliography can be found in the working paper, [here](#).