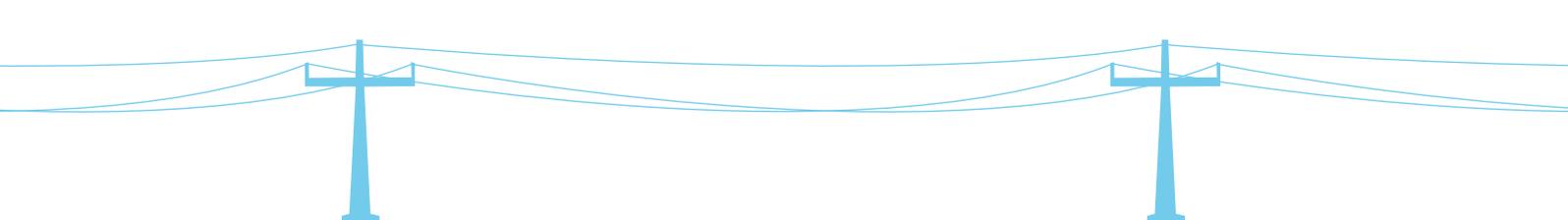




Productive Use of Energy – PRODUSE
Measuring Impacts of Electrification on Small and Micro-Enterprises
in Sub-Saharan Africa

Conclusions



PRODUSE is a joint initiative of the Energy Sector Management Assistance Program (ESMAP), the Africa Electrification Initiative (AEI), the EUEI Partnership Dialogue Facility (EUEI PDF) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). Further information on www.produce.org.

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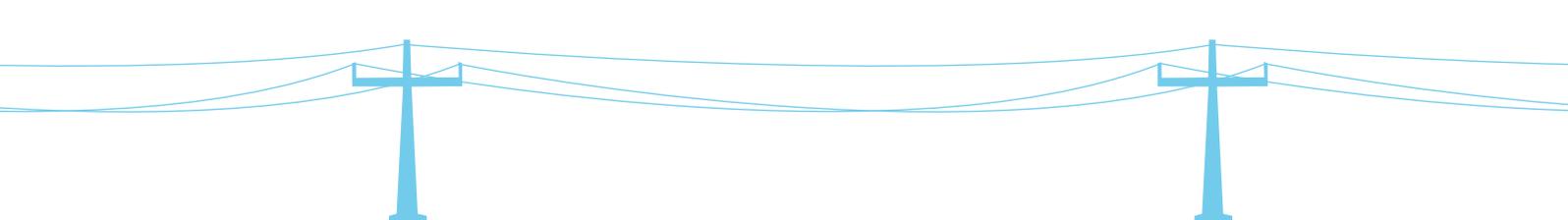
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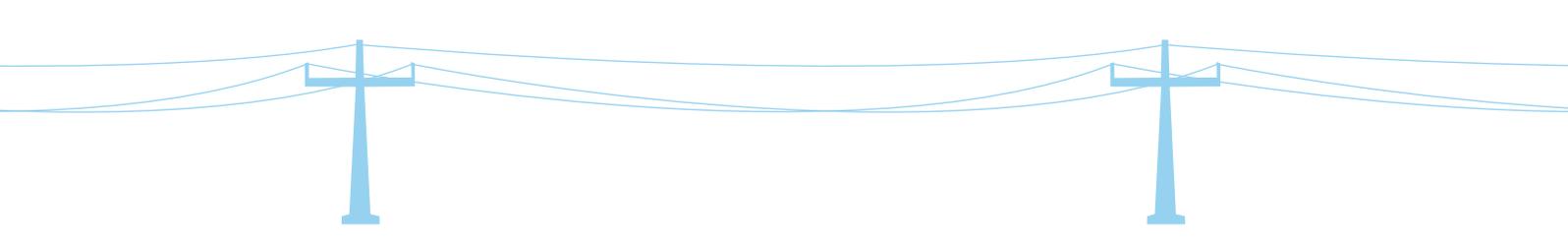
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By Kilian Reiche, Jörg Peters and Lucius Mayer-Tasch



Conclusion

While the interest of policy makers in the nexus between electrification, productive electricity usage and development impacts has been increasing steadily over the last decade, the lack of robust evidence on causal effects of electrification is striking. The joint GIZ-ESMAP study *Productive Use of Energy (PRODUSE) – Measuring Impacts of Electrification on Micro-enterprises in Sub-Saharan Africa* is dedicated to improve the understanding of this issue. In detail, the PRODUSE study pursued two overall objectives: (a) gaining insights on the interaction between electrification and productive electricity usage by examining *the impact of electrification on micro-enterprises* and (b) improving the available toolkit for (robust yet cost efficient) impact evaluation of electrification projects and programmes with a particular focus on productive usage.

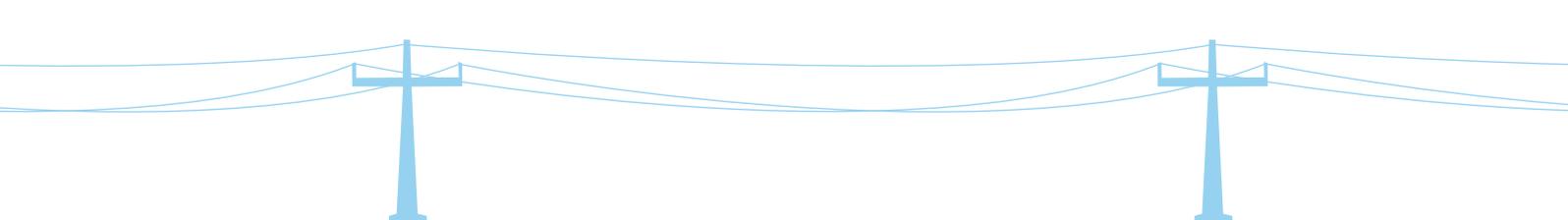
PRODUSE has shown that proper usage of statistical techniques is required for deriving solid findings on these impacts and has demonstrated that methodological rigour is possible, even if available project evaluation budgets are small. The study has confirmed that the ex-ante differences between firms that get connected and those that do not get connected are substantial – which invalidates any determination of impacts by simply comparing these groups using descriptive statistics (as is all too often done in literature on electrification impacts). The true causal relations between electrification and firm performance may remain veiled and the importance of other factors may be neglected. Methods have to be used that account for observable and also for non-observable heterogeneity between connected and non-connected firms.

With regards to the first objective, i.e. gaining insights on the interaction between electricity access, productive electricity usage, income generation and additional services, valuable and partly surprising findings could be provided based on field surveys carried out in Benin, Ghana and Uganda, in spite of the modest budget of the surveys. Stark differences between industries show up: while service firms tend to get connected to the grid, take-up rates in the manufacturing sector of rural areas were low in the countries that have been studied. Connected firms in rural areas both the manufacturing and the service sectors use electricity mostly for lighting and phone charging. Some rural manufacturing firms also use electric appliances if it is essential for their production process (such as welders). In general, however, take-up of electric appliances remains modest. In the service sector more appliances are used, mostly refrigerators and entertainment devices. A slightly different picture prevails in the peri-urban set-up studied in Ghana. Here, grid connected firms employ much more electric machinery.

Altogether, in the three studies electricity usage did hardly translate into higher firm profits in a measurable way.⁴⁸ In one country case study, Benin, it seems that the financial burden resulting from the investment in the connection and subsequent electricity bills can even reduce the profitability of firms, indicating that from a pure business perspective getting connected is not always a rational option.

These rather sobering results (i.e. the fact that we found no measurable positive effects of electricity access on firm performance in our three cases) were contrasted by some evidence indicating that electrification can lead to the creation of new firms, which generate additional income and, hence, impacts on the target population in the project regions. Small service and manufacturing firms are created offering goods and services that have previously been imported from other regions or simply not been offered in the area heretofore. In addition, individual cases could be observed, in which larger firms were attracted to the region by the availability of electricity. While such direct investments could contribute substantially to income generation in the region, it is premature to claim that such firm creation occurs systematically. More research in other regions and with larger sample sizes is needed to further understand this potential process of electricity-induced firm creation and investments. This particularly includes studies that survey project target regions before and after electrification and compare firm creation at these two points in time, respectively. Furthermore, crowding out

48) One can think of a whole series of possible explanations for this result of our three case studies, such as lack of access to external markets, lack of business skills, etc. One possible explanation, which has repeatedly been brought forth by this study's peer reviewers, is the low reliability of the electricity grid. However, none of our three case studies allows for clear conclusions regarding these explanations. For example, the grid in the surveyed region in Northern Benin, was stable with short outages occurring only once every few days. In Ghana and Uganda, both announced and unannounced outages occurred somewhat more frequently but even here only a small number of entrepreneurs complained about reliability issues. Also, only few non-connected firms declared reliability as a major reason for not connecting.



effects (i.e. people have to reduce their expenditures for the *old* product in order to buy the *new* one) have to be taken into account in order to assess the net benefit for a region.

Methodologically, PRODUSE has developed and applied an approach for gaining insight on how micro-enterprises use electricity and the extent to which this changes their production process. In spite of this innovative contribution, PRODUSE cannot be more than a kick-off to further and broader investigations of the complex relationship between electricity access and productive processes and, eventually, economic development and poverty alleviation. It can be concluded that cross-sectional methods – if properly implemented – are a valid approach to identify causal effects. Furthermore, the ex-ante cross-sectional approach generates insights into firm characteristics and behaviour in a comparably, already electrified non-project region *as well as in the project region* that can inform the design and implementation of the planned electrification project. For example, the baseline data from the already electrified control group can be used during project implementation for developing realistic business plans together with firms in the project area.

Nonetheless, it would be desirable to also collect over-time data in order to allow the application of difference-in-differences analysis. In contrast to cross-sectional data, this accounts for unobservable heterogeneity between connected and non-connected firms, which in turn increases the robustness of results. Furthermore, it would be desirable to have bigger sample sizes in future studies, because even if the survey is focused on specific industries, the heterogeneity of firms and their responses is high so that small sample sizes are often not able to grasp potentially existing treatment effects in a statistically significant way. In addition, the scope of research might be extended to all sectors in one region and also neighbouring communities in order to capture demand movements and, hence, crowding out effects.

In particular, the fact that PRODUSE could not find much evidence on positive impacts on micro-enterprises in the three project cases in this report does by no means imply that there is no positive impact in other countries and project set-ups.⁴⁹

We strongly encourage development practitioners and policy makers to make use of rigorous evaluation methodologies such as the one used for PRODUSE⁵⁰, when planning new energy interventions to i) improve project results and ii) contribute to a more solid overall understanding of the nexus between electrification, productive use and development impacts. As the literature review ([Chapter 1](#)) has shown, there are very few solid studies on this topic to date. Once a critical mass of robust evaluation studies has been conducted in a sufficiently broad variety of country, market and project contexts, it will be possible to draw more general conclusions about this nexus.⁵¹

One of the conclusions that can be drawn from the research efforts presented in this report is that project managers should be realistic in their expectations with regard to the economic impact of electrification projects. If substantial productive take-up is intended by an electrification project, a typical strategy would be to include the major determinants for productive uptake in the programme's geographic area targeting process (i.e. pick those areas first that look most promising for productive uses, because they are, for example, exhibiting some sort of export potentials). However, this may be in direct contrast to other selection criteria (such as poverty targeting).

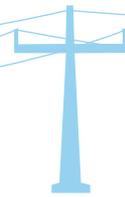
The PRODUSE manual, which has been developed in parallel to this study, provides guidance on how to design and implement activities promoting productive use that can be integrated into broader electrification pro-

49) In addition, the size of the specific effect that electrification might have on firm performance in each of our three case studies might have been too small to be detected with the relatively small sample sizes we have employed. In addition, we have deliberately focused on MSME only, so that we cannot draw any conclusions on the possibility of significant positive impacts of productive uses of electricity in home businesses.

50) See [Chapter 2](#) (methodology) and the PRODUSE Impact M&E Guide in the annex.

51) The PRODUSE website is available as a platform for making available studies that fulfill these requirements.

52) See [modules 5.3](#) and [5.4](#) of the PRODUSE manual Productive Use of Energy (PRODUSE) – A Manual for Electrification Practitioners, which has been developed by GIZ and EUEI PDF. It can be accessed at www.produce.org/manual.



jects and enhance the impact of electrification projects and programmes on local economic development in general and firm productivity in specific. However, the results of our study show that productive use is not automatically associated with positive impacts on firm performance and other parameters. Promotion activities should therefore include support for proper business plan development⁵² for the targeted firms (i.e. the potential commercial electricity customers) in order to ensure the profitability of their investment into grid connections and electric appliances. Such promotion activities have to be open towards the results: connecting to the grid should not be promoted at all costs. The decision should rather be based on the business plan implying that the recommendation for an individual firm can as well be to abstain from a connection if the projected additional revenue is insufficient to recover the investment. This is essential in order to avoid predictable misallocations, which might drive some firms into financial problems ('electrification trap'). Furthermore, the creation of promising new enterprises as observed in Benin and Uganda could be facilitated by accompanying activities that support potential external investors in collecting the required information to prepare firm creation in the region. This could be done in cooperation with industry chambers or regional development programmes.

The three country studies also explored the provision of additional services: it could be observed that access to both finance and Business Development Services (BDS) was generally given in most of the surveyed areas. While firms in peri-urban Ghana use credits quite systematically, uptake of credits in rural areas is low. At the same time, many firms claim (in qualitative questions) that access to more equipment would help their business. Procedural difficulties are the most frequently stated reason for not applying for credits. The survey instrument did not allow to further analyse this stated reason – i.e. if there is simply too much red tape in the investigated financial sectors or if actual formal requirements (such as a lack of collaterals) pose factual problems. Yet, we observed that most firms that decide to apply for a credit also receive one.

This leads to the recommendation to complement electrification projects by examining in a first step, if information about credit availability and terms is sufficient and accurate among entrepreneurs. If a knowledge gap exists, information campaigns might help to close it in order to increase usage of external finance in a profitable way.

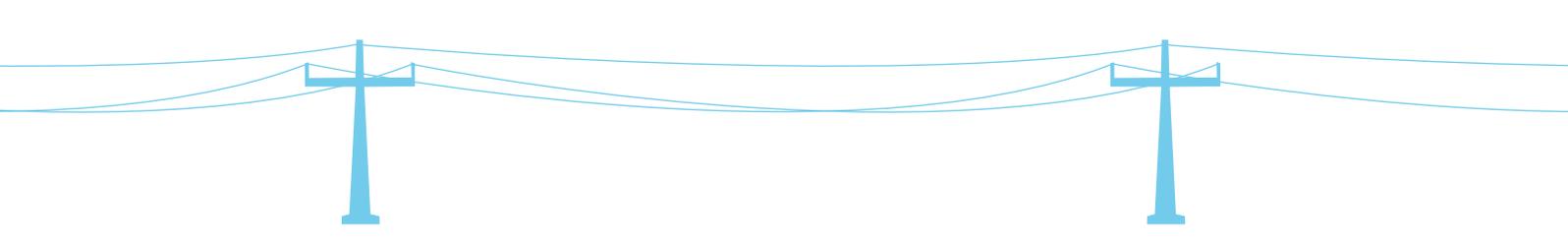
BDS, on the other hand, were available in most but not all surveyed regions. If they are available, their quality differs substantially. This makes it very difficult to investigate their impact – in particular in interaction with another treatment such as electrification. In order to account for the heterogeneity in different BDS one would need a much larger sample size and several regions – covered and not covered by the respective service. While this was clearly beyond the scope of the PRODUSE study, further research should probe into the effect of BDS and its interaction with electrification.

On a more general note, the findings of the PRODUSE study suggest that (rural) electrification should not be reduced to its potential contribution to 'productive uses' and, hence, to economic growth in a narrower sense. Firstly, this poses the risk that claimed objectives are not achieved, as productive uptake seems to be moderate in the short term. Secondly and more importantly, this would neglect the 'non-productive' significance that electricity arguably has to people in rural areas. From the perspective of rural dwellers, electric lighting, television and mobile phone charging revolutionise their lives. In this context, it should not be forgotten that 'productive use' in specific and economic growth in general are only proxies to measure improvements in people's well-being. Electricity and modern energy services at large, however, directly affect the well-being of rural people – beyond any potential income generation.⁵³ In the same vein, the UN has just included electricity access in the new Multidimensional Poverty Indicator (MPI).⁵⁴ This general nexus between electrification and well-being is also in need of more robust evidence and might be addressed in future research using appropriate methods such as contingent valuation or experiments.

53) Fouquet and Pearson (2006) highlight the psychological effects that improved lighting potentially has on people and also establish a connection to economic development in the long run. See also Bensch, Kluge and Peters (2010).

54) The MPI is based on the Human Development Index (HDI) and formulates ten dimensions that capture poverty. See UNDP (2010).





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