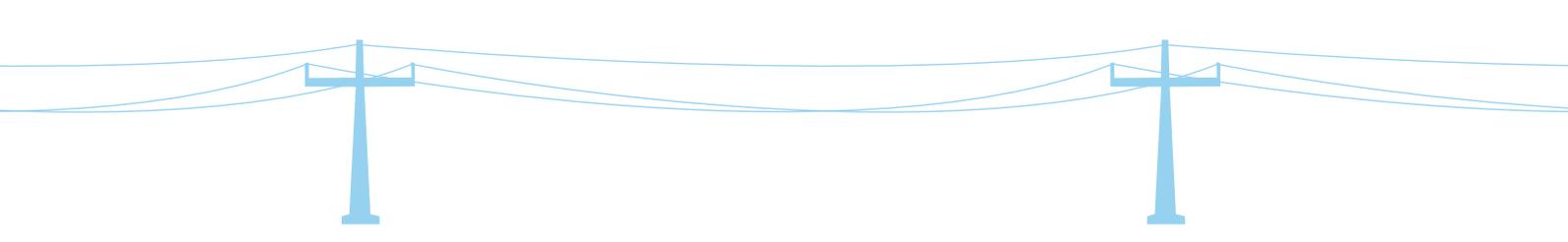




Productive Use of Energy – PRODUSE
Measuring Impacts of Electrification on Small and Micro-Enterprises
in Sub-Saharan Africa

Executive Summary



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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 Small and Micro-Enterprises in Sub-Saharan Africa* set out to improve the understanding of this issue. PRODUSE pursued two main 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 the impact evaluation of electrification programmes.¹

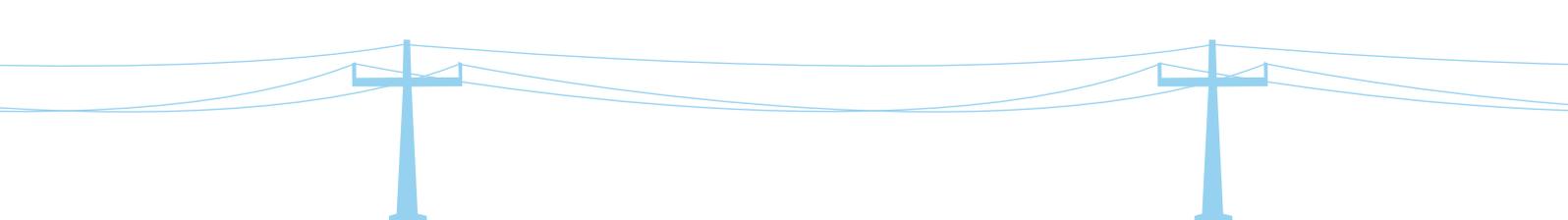
PRODUSE has shown that proper usage of statistical techniques is required for deriving solid findings on these impacts and has demonstrated that methodological rigour is possible even if available project evaluation budgets are small. The study has confirmed that the ex-ante differences between firms that get connected to electricity 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). Methods have to be used which account for observable and also for non-observable heterogeneity between connected and non-connected firms.

With regards to objective (a) i.e. gaining insight 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 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 in 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.² In one country case, 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. generally no clear indication for positive effects of electricity access on firm performance) 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

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- 1) Regarding objective (b), our aim was to demonstrate evaluation methods which would (i) allow for more robust results than most electrification evaluations to date, and at the same time (ii) be readily applicable in real-life implementation contexts – which often face limitations in terms of costs and/or timing. The impact evaluation methods we propose could be applied with relatively modest additional effort to most electrification programmes. As an example, we provide a ‘next best’ method to treat project implementation cases in which no baseline has been established by the time an evaluation starts (which should obviously be avoided wherever possible, but all too often happens in practice).
 - 2) 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 that 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.



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 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 a solid 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 of electrification on micro-enterprises. Furthermore, the ex-ante cross-sectional approach generates insights into firm characteristics and behaviour in a comparable, 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.

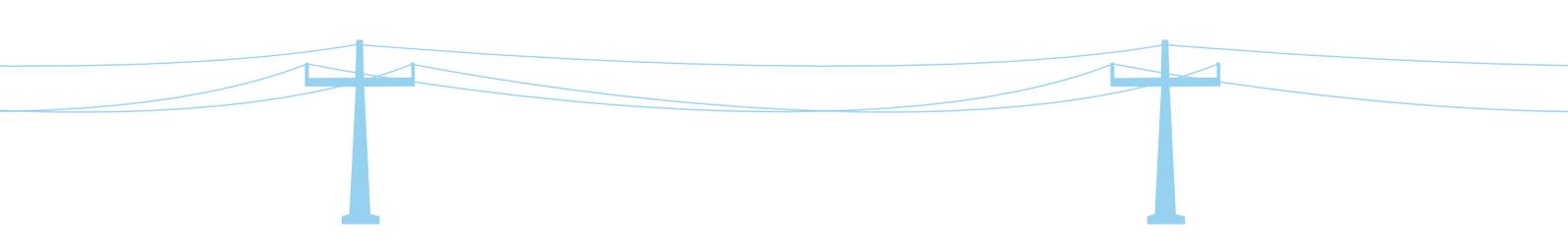
Nonetheless, it would be desirable to also collect over-time data in order to allow the application of difference-in-differences analysis. In contrast to cross-sectional data, this accounts for unobservable heterogeneity between connected and non-connected firms, which in turn increases the robustness of results. Furthermore, it would be desirable to have bigger sample sizes in future studies, because the heterogeneity of firms and their responses is so high that small sample sizes are often not able to grasp potentially existing differences in a statistically significant way (even if the survey is focused on specific industries). 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.

We strongly encourage development practitioners and policy makers to make use of rigorous evaluation methodologies such as the one used for PRODUSE³ 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 2*) 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.⁴

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 (measurable) economic impact of electrification projects, especially on firms. If substantial productive take-up is specifically 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. picking those areas first that appear to be most promising for productive uses – for example because of better access to external markets). However, this may be in direct contrast to other selection criteria (such as poverty targeting).

3) See *Chapter 3* (methodology) and the PRODUSE Impact M&E Guide in the annex.

4) The PRODUSE website (www.produse.org) is available as a platform for making available studies that fulfill these requirements.



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 projects 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 development⁵ 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, as appeared to have happened in the case study from Benin ('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.

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 can be moderate in the short term, as our country cases show. 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. In the same vein, the UN has recently included electricity access explicitly as a direct indicator of their new Multi-dimensional Poverty Indicator (MPI).⁶

5) 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.

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

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The full text and further information on productive use of energy is available at <http://www.produce.org>

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