Productive Use of Energy – PRODUSE

Impact Monitoring and Evaluation of Productive Electricity Use – An Implementation Guide for Project Managers

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

On behalf of BMZ Federal Ministry for Economic Cooperation and Development

ESMAP Energy Sector Management Assistance Program

THE AFRICA ELECTRIFICATION INITIATIVE

L'INITIATIVE D'ELECTRIFICATION DE L'AFRIQUE

Photos
© GIZ / Marco Hüls

Layout
creative republic
Thomas Maxeiner Visual Communications
Frankfurt, Germany
www.creativerepublic.net

Language Editor
Sina Mabwa

This paper has also been published as an *annex* of the study *Productive Use of Energy (PRODUSE) - Measuring Impacts of Electrification on Micro-Enterprises in Sub-Saharan Africa.*

If information from this guide or parts of the addenda are used, please cite as: Peters, J., Bensch, G. and Schmidt, C.M. (2013): *Impact Monitoring and Evaluation of Productive Electricity Use – An Implementation Guide for Project Managers.* In: Mayer-Tasch, L., Mukherjee, M., Reiche, K. (eds.), *Productive Use of Energy (PRODUSE): Measuring Impacts of Electrification on Micro-Enterprises in Sub-Saharan Africa.* Eschborn.

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.produse.org*.

Productive Use of Energy – PRODUSE

Impact Monitoring and Evaluation of Productive Electricity Use – An Implementation Guide for Project Managers

By Jörg Peters, Gunther Bensch and Christoph M. Schmidt[56]

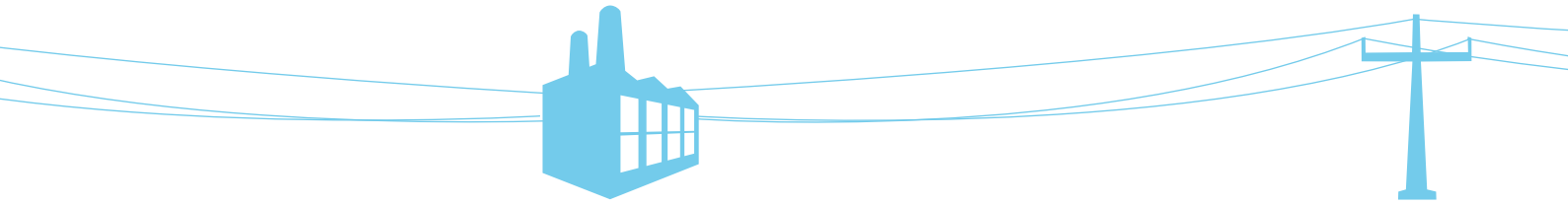


Table of Contents

1. Introduction

The existing literature on the methodology of impact evaluations targets academic evaluation researchers or practitioners with a high affinity to becoming acquainted with evaluation methods.[57] Practitioners who are rather interested in setting up a hands-on monitoring and evaluation (M&E) scheme to obtain robust insights into the impacts of concrete interventions, however, can hardly be expected to familiarise themselves with these methodological issues at the level of highbrow econometric research.

Intending to close this gap, the guide provides assistance on how to design an impact M&E system or an impact evaluation study for productive electricity use in elec¬trification interventions (PUE impact M&E system in the following) and is tailored to examine electricity take-up and income generation in small and micro-enterprises (SMEs).

It is targeting managers of electrification projects who are particularly interested in monitoring and evaluating the impacts of electrification on SMEs (whom we – for simplicity – hereafter call 'project managers')[58]. Still, it is in the same way geared towards researchers or practitioners in charge of the evaluation itself, the 'researchers'.

The education of this audience with respect to methodological issues is not the focus of this discussion. Rather, its major aim is raising awareness for important parameters in the design of a PUE impact M&E system and the provision of project managers with an accessible menu of requisite steps, also intended to encourage the further development of local evaluation capacities. While this guide focuses on evaluating the impacts of electrification on SMEs, the principal steps of the proposed PUE impact M&E system are interchangeable and can be transferred to other development projects.

Three different modules are presented, representing the spectrum of potential approaches and their respective advantages and limitations. Depending on the methodological approach, the PUE impact M&E system can either be implemented by project staff or external consultants or researchers with special evaluation skills have to be contracted. For the case in which such researchers are contracted, the present chapter guides the project manager on how to effectively steer and backstop the assignment.

In order to stress the demarcation between classical M&E and impact M&E, the guide reviews briefly the different results of an intervention: outcomes, impacts and highly-aggregated impacts. Classical M&E systems typically monitor project activities and sometimes outcomes, but not impacts (ADB 2006). This is elaborated in *Section 2* – also by discussing the problems and pitfalls that one encounters when the impacts of electrification on SMEs are to be evaluated.

Section 3 first introduces principal strategies to assess the impact of an intervention. Subsequently, three modules are presented: one simpler module based on a short SME survey (*Module a*), one module based on an extended and profound SME survey (*Module b*) and one module based on anecdotal case studies (*Module c*). *Module (a)* and *(b)* deliver data that can be analysed statistically. All modules have been applied during the PRODUSE study and within other projects.[59] A discussion of their respective opportunities and limitations complements the proposal of the modules.

55) If information from this annex or parts of the addenda are used, please cite as: Peters, J., G. Bensch and C.M. Schmidt (2013) Impact Monitoring and Evaluation of Productive Electricity Use – An Implementation Guide for Project Managers. In: Mayer-Tasch, L., Mukherjee, M., Reiche, K. (eds.), Productive Use of Energy (PRODUSE): Measuring Impacts of Electrification on Small and Micro-Enterprises in Sub-Saharan Africa.

56) The authors are grateful for valuable comments by Anna Brüderle, Nadja Kabierski-Chakrabarti, Lucius Mayer-Tasch, Kilian Reiche and Colin Vance.

57) See Ravallion (2008) and Gertler et al. (2010) for examples of handbooks that comprehensively introduce the methodology of impact evaluations.

58) The guide is not meant to replace existing handbooks and guides on impact M&E (see above and refer to *Addendum 1*) or, more specifically, on evaluation or survey methodology (see for example Ravallion 2008, Iarossi 2007 and Warwick and Lininger 1975).

59) The impact M&E approaches presented here were applied as part of the PRODUSE study in Benin, Ghana and Uganda. Comparable M&E studies were also implemented in Burkina Faso, Benin, Indonesia, Rwanda, Senegal and Mozambique. In addition to the PRODUSE report, published reports are Bensch and Peters (2010), Bensch, Peters and Schraml (2010) and Harsdorff and Peters (2010). Methodologically more elaborated methods are used, for example, in Bensch, Kluve and Peters (2011) or Peters, Vance and Harsdorff (2011).

Section 4 is the core of the guide and presents the process of designing a PUE impact study step by step. *Step 1*, 'Getting Started', pays particular attention to outlining the decision process, *Step 2* describes the process of designing the study, *Step 3* the survey preparation, *Step 4* the implementation of the survey and *Step 5* the data analysis and reporting. To facilitate its practical applicability, an addendum section contains references to further readings and, most importantly, sample questionnaires that have been used in the PRODUSE study and other evaluations.

2. Classical M&E vs. Impact M&E

2.1. Outcomes, Impacts and Highly-Aggregated Impacts

Any programme implemented in practice aims at making a genuine difference to the state of well-being in the target population. To this end, the programme directly influences the state of outcome variables that are intended to trigger intermediate impacts and, eventually, highly-aggregated impacts on income, nutrition or other variables of fundamental importance. In the case of productive electricity usage, one might consider the example of a programme that subsidises the extension or densification of the national grid. Here, a results chain which connects the intervention's inputs and activities to its outcomes and impacts in generic terms, would, for example, consist of the following links: the desired outcome with regards to productive use is that SMEs get connected. An intermediate impact then is that the firm uses electricity productively for example by employing a machine or by extending its operating hours. The next step in the results chain then is the effect that this electricity usage has on the firm's production process (increased productivity), while the highly-aggregated impact occurs at the level of the firm owner or the firm's employees in the form of higher incomes (see *Aid 1* for a simple visualisation of a PUE results chain).

Outcomes are typically clearly attributable to the project's intervention. Both intermediate and highly-aggregated impacts, in contrast, might be caused by a combination of different factors. Apart from the project's intervention, such other factors may be the firm's development along its secular growth path, rising or falling demand for the firm's products as a result of general economic development or changes in market prices of the firm's products. In the project's results chain, this insight is expressed as the so-called attribution gap between outcomes and impacts. Before attempting any quantification of either of them, the careful enumeration of what the outcomes and impacts are and what the project could achieve in principle should be the starting point of every evaluation effort.

The results chain also shows the difficulty of an impact evaluation: on the one hand, only the highly-aggregated impact variables are of ultimate interest when gauging the effectiveness and success of a programme. The intermediate impact variables, higher profitability, for example, are no means to the end. On the other hand, the more aggregated the impact indicator is, the more difficult and costly it is to isolate the net effects of the intervention on the impact indicators. Taking our example, these are the effects of the electrification project alone. Gross effects, in contrast, also include influences due to external factors that would also have taken place in the absence of the project. Disentangling the electrification impact from these other influences is much more difficult for highly-aggregated impacts than for intermediate impacts. In other words, the attribution of causes and effects becomes more difficult.

Therefore, the question of which level of results to monitor and evaluate is a crucial question to be addressed by the electrification project's manager. In this spirit, an impact evaluation intends to go beyond the demands of a classical monitoring system by also investigating the indirect benefits (impacts) of the intervention. A classical monitoring system, by con¬trast, is basically restricted to tracking progress of programme implementation and to the review of achievements of the programme's intended direct benefits (outcomes). The present guide provides a pragmatic outline on how to design the implementation of a PUE impact M&E system that allows to assess both outcomes and impacts.

The approaches described in this guide mainly aim at intermediate impacts such as higher profitability or firm creation. Since, for instance, entrepreneurial activity is a promising avenue to economic development, these intermediate impacts can be considered as a prerequisite and, thus, as proxies for highly-aggregated impacts. While there is certainly no guarantee that intermediate impacts will ultimately translate into highly-

aggregated impacts, convincing evidence for the presence of intermediate impacts is an important piece of information when assessing whether the programme has induced positive, highly-aggregated impacts or not. Intermediary impacts can, hence, be seen as 'stepping stones' in the endeavour to identify the genuine impact of the intervention on the ultimately meaningful dimensions of people's well-being.

2.2. Second Round Effects

Even if the net effect of electrification on connected firms (the micro-effect) can be isolated successfully, this is only one step towards a meaningful assessment of the programme's impact. In order to obtain the beneficial effect on the local economy as a whole (the macro-effect), one needs to account for so-called second round effects. The most important second round effect is the crowding out effect. Crowding out effects occur if the benefit to one enterprise is at the expense of other enterprises. For example, if a small shop attracts more customers thanks to its new electric light bulbs, other non-connected shops may lose because their old customers now buy at the connected shop.

In principle, the intervention area as a whole only benefits, i.e. the regional macro-effect is only positive if (i) productive electricity usage replaces imported goods by locally produced ones or (ii) goods for export are produced using electricity or (iii) the total productivity of the local economy increases, for example via increased usage of mills instead of mortar and pestle, liberating productive capacities for other purposes.

While it is difficult to fully account for such crowding out effects, they have to be kept in mind in both designing a PUE impact M&E system and interpreting its findings. At least an attempt should be made to obtain indicative evidence for such effects. This could be achieved, for example, by including non-connected SMEs in the PUE impact M&E system as a control group or by probing qualitatively into the question of where the customers of newly-connected enterprises are coming from.

Further second round effects are possible. Budget effects, for example, can be detected, if people in a village spend parts of their limited budget on new products (e.g. photocopies, cold drinks) that were not available before electrification. As a consequence, they reduce their expenditures on products they used to buy before electrification. This becomes very evident in the case of expenditures for electricity itself – a typically 'imported' good. People no longer buy their candles at the local shop, thereby shifting parts of the added value in the supply chain out of the region.

3. Developing a Productive Use Impact M&E System

The objective of a PUE impact M&E system is to obtain credible evidence for impacts of the project – taking into account the attribution difficulties described above. This means that some effort has to be designated to disentangle net project effects from gross effects. The guide presents different modules for a PUE impact M&E system that are suitable for evidencing different levels of impacts. Accordingly, they differ as well with regards to the required resources.

The fundamental decision to be taken by the project manager is whether evidence on impacts *beyond the attribution gap* should be provided to donors, partner institutions or the public. If the answer is yes, this guide shall help to design and implement appropriate impact M&E activities.

3.1. General strategies to isolate the project's effect

The methodological challenge of any impact evaluation is to isolate the net effects of an intervention and causally attribute changes in indicators specific to the intervention. For this reason, the evaluation strategy has to *identify the counterfactual situation*, i.e. what would have happened to the beneficiaries' (e.g. connected SMEs') relevant outcome variables (e.g. revenue) in the absence of the intervention. Comparing the counterfactual situation to the factual situation – what has actually transpired after the intervention – provides a valuable assessment of the true impact of the project. As a matter of course, however, the counterfactual situation is unobserv-

able: we can never know for sure what change would have occurred among the beneficiary group if the programme had not been implemented and the programme impact can at best be estimated in a convincing manner.

To find such a convincing estimate, we have to plausibly approximate this unobservable counterfactual situation. In practice, three main so-called identification strategies are available: (i) simple before-after comparison (the same firms are interviewed before and after electrification), (ii) cross-sectional comparison (connected and non-connected firms are interviewed at one point in time) and (iii) before-after comparison with control group (firms are interviewed before electrification, some of which get connected; connected and non-connected firms are interviewed again after electrification). The three strategies differ in their methodological robustness, i.e. the extent to which the evaluation is able to deliver valid and reliable results on the net effects of the electrification. In general, the most robust approach is the before-after comparison with control group, while exemptions might exist, for example if no adequate control group is available. An in-depth explanation of these identification strategies can be found in *Aid 2*. This includes a discussion of the assumptions under which each strategy is able to obtain the net effect.

In general, outcomes or impacts close to the attribution gap can be investigated using simpler approaches, while the – in view of the results chain – more remote impacts have to be addressed by more sophisticated ones. The choice of an adequate approach depends on the level of impacts the project manager wants to obtain credible evidence on (see *Table 66* in *Section 3.2*). Of course, available funds also play an important role, since (iii) requires much more efforts than (i) or (ii).

3.2. Three PUE Impact M&E Modules

In the following, we propose three modules for a PUE impact M&E system that are tailored to measure impacts in the context of productive electricity use and that have been field-tested in various developing countries: *Module (a)*, based on a short enterprise survey, *Module (b)*, based on a profound enterprise survey and *Module (c)*, a case study approach based on semi-structured in-depth interviews.

Since *Module (a)* and *(b)* deliver data for quantitative statistical analysis and *Module (c)* delivers information that is interpreted qualitatively, the decision between the three proposed modules leads to the discussion about the pros and cons of so-called qualitative and quantitative research. It is important to highlight that the terms 'quantitative' and 'qualitative' do not refer to the nature of elicited information but only to how the collected data is analysed. The major demarcation between *Module (a)* and *(b)* on the one hand and *Module (c)* on the other is the sample size. In all three modules, both quantitative as well as qualitative questions can be included in the questionnaire. To sum it up, the advantage of the case study approach in *Module (c)* is the more open way in which interviews are conducted. Spontaneous adaptations of the interview are possible if deemed interesting by the interviewer and the interviewee can more readily deviate from an intended interview line. Owing to the nature of these interviews, a case study approach can only be based on a limited number of interviews and, hence, delivers anecdotal insights only. This also leads to the advantage of larger sample size surveys – as proposed in *Module (a)* and *(b)* – which enable the researcher to average across many observations, thereby benefiting from the law of large numbers. The price of this advantage of generalisation is that the researcher is constricted to the corset of a structured questionnaire. One remedy is to combine the two general approaches, i.e. to complement the larger sample size surveys by selected in-depth interviews (see White 2002).

In contrast to the profound survey, the short enterprise survey in *Module (a)* aims at 'easy to get and handle' information (see *Table 66*) and abstains completely from eliciting more aggregated impacts such as profits or improvements in market access. The aim of this modesty is to avoid difficult data processing (which includes dealing with missing values, see *Step 5a*) and deriving misleading findings on more complex issues that might result if no sufficient methodological effort is dedicated (e.g. with regards to sample size or advanced statistical data analysis). *Module (a)* envisages providing evidence on outcomes and on impacts that are close to the attribution gap. The module then resorts to plausibility when linking the observed changes in the direct results and impacts of the intervention to higher impacts. If the survey, for example, shows a considerable take-up of machinery, one could plausibly assume that this also affects positively productivity and, hence, firm profits and employee wages. *Module (b)*, the profound survey, by contrast, aims to provide direct evidence for such effects. A plausible counterfactual situation is established and the impact of electrification on, for example, firm profits can be assessed by comparing the electricity-using firm to its counterfactual.

Module (c), the case study approach, is included since SMEs are less homogenous and numerous than households, making a statistical analysis more difficult. For example, only one or two larger firms might exist in a target region. Including them in a larger sample size survey is not reasonable, since the advantage of larger sample sizes – taking the average across many observations – cannot be exploited for obvious reasons. Restricting oneself to the corset of a structured questionnaire is, hence, not necessary. Doing more open and case study-like interviews is much more sensible in such a case. Another reason for applying the case study approach is to account for unintended effects or to probe deeper into certain issues than structured questionnaires can do (e.g. crowding out effects as delineated in *Section 2.2*). The findings, of course, have to be interpreted against the backdrop of the non-representative selection. Transferring them to other surroundings or enterprises can only be done to a limited extent (even more limited than for larger sample size studies). However, such case studies can definitely help to understand complex processes among beneficiaries and provide for anecdotal evidence of electrification impacts that can, not least, be fed into the design of future larger sample size surveys.

The following *Table 66* catalogues the main features of the three modules introduced above – including their respective advantages and limitations. Of course, the components can be modified for specific reasons and the different parts of the three modules can be combined. Based on our experience in various projects, we believe that the modules are a reasonable compilation of M&E activities that are required to yield the described results and recommend that project managers design their PUE impact M&E system along these lines.

Please note that although *Module (b)* would be commonly referred to as the 'rigorous' way of doing M&E, this term is purposefully avoided. The reason is that, as White (2002) points out '... the real basis for *rigor* is the proper application of techniques. Badly or misleadingly applied, both quantitative and qualitative techniques give bad or misleading conclusions.' In this sense, all modules proposed here can and should be applied rigorously.

Table 66: Potential Approaches for PUE impact M&E – An Overview

Module (a) Short Enterprise Survey	Module (b) Profound Enterprise Survey	Module (c) Anecdotal Case Study Approach
Main purpose		
Providing evidence on impacts close to the project's direct outcomes that can be assessed with a less extensive survey set-up and without applying advanced statistical data analysis for causal attribution. Relation to ultimate poverty impacts is instead established on a plausibility basis only by results chains.	Providing evidence on the causal relationship between electrification and ultimate development indicators using state-of-the-art evaluation techniques.	Collect anecdotal evidence on electricity usage and its impacts. In particular on issues that can hardly be addressed in structured interviews (e.g. impacts on particular SMEs that do not qualify for the other two modules due to non-comparability).
Identification Strategy	Background information	→Aid 2
Before-after comparison	Cross-sectional, before-after comparison or before-after comparison with control group – The baseline survey in a before-after strategy allows to also obtain profound knowledge about the target region.[60]	Before-after comparison or retrospective questions (with critical qualitative assessment)
Sampling Method	Also see Step 4e, Section 4	
Simple random sampling	Simple random sampling or stratified random sampling	Simple random sampling or non-random sampling of SMEs of particular interest. If combined with one of the other two modules, typical firm types that have shown up during the surveys can be selected.

60) It can be particularly interesting from the project's perspective to include an already electrified control region. This allows the project to gain insights about the behaviour of the rural population/enterprises after electrification (see *PRODUSE Chapter 3* and Peters (2009) for methodological details of this approach).

61) Auspices bias refers to the frequently observed tendency of an interviewee to give a response the enumerator (does not) like(s) to hear. For example, an entrepreneur in a connected firm might answer more positively in an electrification project's impact survey, because s/he is thankful for the project. Likewise, s/he might give biased answers because s/he expects additional support from the project.

Module (a) Short Enterprise Survey	Module (b) Profound Enterprise Survey	Module (c) Anecdotal Case Study Approach
Sample Size	Also see Step 4d, Section 4	
Small sample (50-100 SMEs).	Larger sample (>300 SMEs).	5-20 selected SMEs.
Covered Indicators	List of indicators	→Aid 3
Direct results of the intervention. Collected information has to be - easy to determine by respondent - low sensitivity to formulation of questions - unaffected by an auspices bias[61] - easy to quantify and process. Additional indicators on project-relevant questions can be added.	All indicators of the short enterprise survey are integrated in this module. In addition, the more detailed questionnaire allows for gathering the more-difficult-to-obtain information e.g. on firm income: detailed questions on sales, raw materials, labour and capital input avoid sensitivity and auspices biases in assessing the firm income. Additional indicators on project-relevant questions can be added.	The interviews should attempt to collect information corresponding to the indicators listed in Aid 3 (including quantifiable business figures). The unique feature of this module are the open-ended questions that provide the opportu-nity to follow unexpec¬ted threads in the interview, e.g. on reasons for connecting or not connecting or market access barriers. Indirect and second round effects may also be brought up, e.g. if the respondent is aware of competitors who have not benefited from the interven-tion. Additional indicators on project-relevant questions can be added.
Questionnaire		
Structured, but short, focused on easy-to-get-information Interview length around 30 minutes	Structured, covering all dimen¬sions of firm activity, accounting for seasonality; decisive variables such as employment or firm profits are addressed in more detail and in multiple ways in order to allow cross-checking. Interview length around 60 minutes	Open: interview guideline should be pursued while leaving space for spontaneous, discursive deviations in directions indicated by the respondent. Interview length 30-120 minutes
Sample Questionnaires		
See addendum 2.	See Addendum 3.	The 'PRODUSE Guidelines for Qualitative Interviews' (Addendum 4) provide for an example of research questions to pursue.
Information Processing		
Simple data analysis with Excel, a sample data entry sheet in Adden-dum 5.	Statistically advanced data analysis using statistical software (SPSS, STATA, etc.).	Systematic analysis of interview notes along the lines of the guiding questions underlying the qualitative exercise (see for example the 'PRODUSE Guidelines for Qualitative Interviews', Addendum 4).
Implementation	Outline of Terms of References	→Aid 4
Can be implemented by own project staff, interns or consultants without particular skills in evaluation methods or statistics; supervision by experienced evaluation researchers is recommendable.	Profound skills and experience required in all stages, i.e. survey design and implementation as well as data analysis; some background in development (and electrification) projects and knowledge of the respective country recommendable; for data collection, backstopping of experienced local enumerators by methodologically skilled researchers	Should be implemented by or under close supervision of lead researcher; recommendable to hire consultants familiar with (qualitative) evalua-tions.

4. Step-by-step Towards an Effective PUE Impact M&E System

The project manager might scrutinise the demands of the project, choose an appropriate identification approach (see *Section 3.1*) and apply it using one of the three modules (see *Section 3.2*). But what is the best sequence of making these choices and which are the questions to be addressed systematically in this process? This section presents a step-by-step guidance for designing a PUE impact M&E system, suggesting which stakeholders should be involved at which stages of the process. *Steps 1* and *2* have to be carried out by the project manager or at least require his or her close involvement. *Steps 3* to *5* are mostly the responsibility of the project staff members or of the external researchers to whom the implementation of the PUE impact M&E system is assigned. In order to complement the guidance and information provided here and for further readings, one may consult the M&E guides referred to in *Addendum 1*.

Step 1: Getting Started

Before thinking about the concrete design of the PUE impact M&E system in *Step 2*, the project manager should take the following basic considerations.

Step 1a: Decision on Whether to Do an Impact Evaluation

Do the additional benefits of a PUE impact M&E system compared to a classical M&E system justify the additional costs from the project's perspective? If yes, continue with *Step 1b*.

The intention of conducting impact M&E should be communicated to all other project stakeholders including local partner institutions on both the political and implementation level (e.g. utilities, ministry). They should be included in the design process, if possible.

Step 1b: Examination of the Project's Results Chain

The project's results chain is the conceptual framework of the PUE impact M&E system. If no results chain with regards to productive electricity use exists, it has to be drafted by the project management in order to get a clear picture of which transmission channels from inputs to impacts exist. Accordingly, the results chain helps to determine appropriate outcome and impact indicators. Even if a results chain has already been established, a review is recommended at the time the PUE impact M&E system is designed, not least since adaptations in the project design might have occurred in the meantime. A stylised model results chain is provided in *Aid 1*.[62]

Step 2: Designing

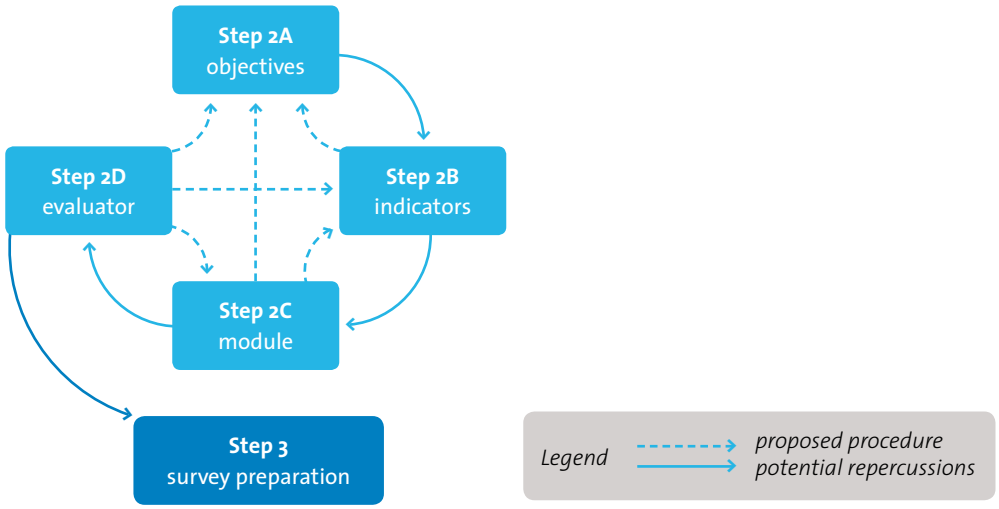
The third step is then to design the PUE impact M&E system. This includes the following parameters:

- determination of the objectives of the PUE impact M&E system (*Step 2a*)
- decision on the impact indicators (*Step 2b*)
- choice of the appropriate module (*Step 2c*)
- selection of staff members or external researchers to implement the PUE impact M&E system (*Step 2d*)
- adaptation of selected module to project needs and particularities (*Step 2e*).

As depicted in *Figure 8* decisions on a certain sub-step may have repercussions on previous sub-steps. For example, if it is decided in *Step 2d* to hire an external researcher, s/he should review the previous steps incl. the indicators to be examined. Likewise, the decision on which module to apply (*Step 2c*) can also affect the selection of indicators (*Step 2b*).

62) Note that in reality a results chain is much more complex in most cases. The purpose of the results chain presented here is only to illustrate the idea of a theory of change underlying the project and its importance to the impact M&E system.

Figure 9: Steps in the Design of the PUE Impact M&E Approach



Source: own illustration

Step 2a: Determination of the Objective and Scope of the PUE Impact M&E System

The first step in designing a project-specific PUE impact M&E system is to agree on its objective. The crucial point here is concerning the scope, i.e. which parts of the results chain shall be covered. Does the project want to monitor or assess connected firms and the usage of electricity only or also higher impacts like profits or employment? At this point, the principal research questions have to be formulated.

The objective may be subject to change when deciding on the characteristics of the M&E scheme as indicated in *Figure 9* above. For example, this can be the case if budgetary restrictions turn out to impede the implementation of a more sophisticated method (*Step 2c*) or if indicators considered as indispensable in *Step 2b* make it necessary to reconsider the objectives of the PUE impact M&E system.

Step 2b: Decision on Impact Indicators

Indicators are direct and unambiguous measures of progress toward the intended goals of a project. Indicators for the evaluation of impacts on productive electricity use range from simply counting the number of connected firms and the appliances they use to the change in their profits, the number of employed workers and the wages they earn. A systematic catalogue of indicators is given in *Aid 3*. Based on these indicators, concrete questions are to be formulated for the questionnaire. The choice of indicators has clear implications for the module to be chosen in *Step 2c* (see also *Section 3.2*). For example, the indicator item 'used appliances' can be checked with less effort, i.e. *Module (a)* than 'firm profits' (for which *Module (b)* is required). Accordingly, the list of indicators in *Aid 3*. contains a recommendation for each indicator of which module is required to measure it.

Projects might want to include additional indicators to account for particularities in their project setup. In this case, GTZ (2007) delineates aspects to be considered when constructing project-specific indicators. Such guidelines are important to follow in order to attain a priori neutral indicators that reliably record the degree of progress in the achievement of the proposed results. M&EED Group (2006) lists a range of potential indicators applicable to productive use of electricity. Potential impacts that have not been intended by the project – be they positive or negative – should also be considered and captured with appropriate indicators. For all chosen indicators, it should be checked at this stage whether relevant data can be obtained from other sources. This includes official statistics but also baseline data from other projects or the project itself.

Most indicators require interviews with firm owners. Some impact indicators may necessitate further interviewees, for example in order to obtain the perception of employees on the impact of electricity on their work-

ing environment. Such research questions, however, are best included in complementary qualitative interviews conducted in *Module (c)*. Other examples are the impact on the community in total, on the local environment or impacts related to the choice of the electricity source.

Mini-grids fed by diesel generators, for example, may result in high long-term costs and dependency on external suppliers, whereas micro-hydro projects may interfere in the local water provision of households and farmers.

Step 2c: Choice of the Evaluation Module

One of the three modules proposed in *Section 3.2*. must to be selected: the Short Enterprise Survey, the Profound Enterprise Survey or the Anecdotal Case Study Approach. The module decision should be based on a comparison of the advantages and limitations of each module (see *Table 66*) with the objectives of the evaluation (see *Step 2a*) and the available budget. Modifications of the selected module can be carried out in line with particular needs of the project. An extensive calibration should be done by the staff member(s) or consultant(s) to whom the implementation of the PUE impact M&E system is assigned as we explain in the following *Step 2d*.

Step 2d: Assign the Implementation to Qualified Staff Members or External Experts

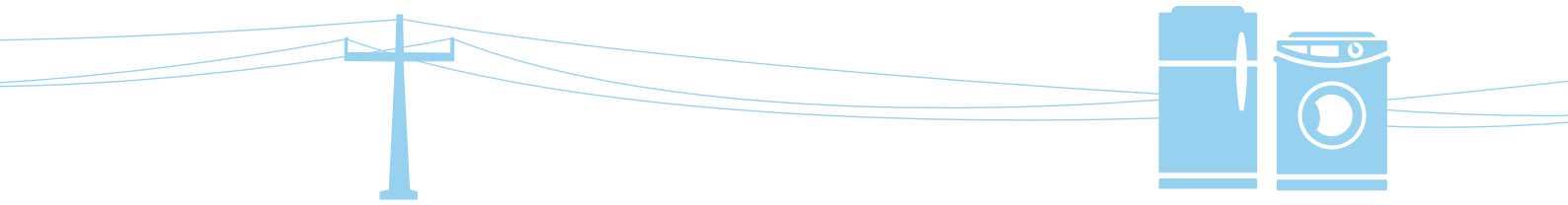
The different modules require different levels of skills and resources. The module presentation in *Section 3.2* indicates the requirements in terms of methodological know-how and time requirements to implement each module. For *Module (b)*, the hired researchers have to meet the following requirements: experience with impact evaluations, statistical skills, experience with development projects and, if possible, electrification projects. If it is intended to apply econometric methods during the data analysis, the researcher should be familiar with statistics and econometrics – at best documented by a list of publications in academic peer-reviewed journals in the fields of impact evaluation and applied econometrics.

Step 3: Survey Preparation

Survey preparation varies substantially between the different modules. For *Module (a)*, the sub-steps of this task do mostly not apply, since its features are already pre-defined, e.g. the before-after approach is the only recommended identification strategy (*Step 3a*) and no control regions are to be included (*Step 3e*). *Module (b)* and *(c)*, in contrast, require considerably more effort both with regard to desk and field work (*Step 3e* to *3h*). The field work implies a mission of the researchers to visit the target and potential control regions but also to meet the project staff (in particular if the researchers are international experts), to finalise the methodology and to train the survey team.

Step 3a: Decision on Identification Strategy

As described in *Section 3.1*, there are different ways of identifying the impacts of electrification. An appropriate comparison, the so-called counterfactual situation, has to be established. If the PUE impact M&E system is set up at the beginning of the electrification project, in principle all strategies are possible. If it is decided after the project has electrified the target regions that impacts should be examined, the cross-sectional approach is the only possible one. Methodologically, the before-after comparison with a control group is the most robust approach – but, as a matter of course, it also requires more resources, since two surveys have to be done (before and after) in two regions (project's target region plus control region). Without special methodological and statistical skills, the cross-sectional comparison is the most difficult one for *Module (a)* and *(b)*. Hence, as a general rule it is recommended to set up the PUE impact M&E system before the first regions are electrified and make either a simple before-after comparison or the extended version including a control group. If the cross-sectional approach is chosen (e.g. because it is too late to estabish a baseline), it has to be done by experienced evaluation researchers. See *Aid 2*. for a more profound description of the three approaches.



Step 3b: Submitting an Inception Report

An inception report should be drafted by the researchers to outline briefly the intended procedure at the outset of the assignment. It provides an opportunity for the project staff to get acquainted with the intended approach and to intervene if deemed necessary. The submission of an inception report is, hence, particularly recommended in case the researcher is an external person or entity but can also be a valuable preparatory instrument for in-house discussions.

This inception report should best be structured as follows: (i) project description, (ii) methodology and (iii) implementation. The first section should present basic information on the electrification project including its results chain. The second chapter should first explain briefly the selection of modules. In a second step, adaptations to the chosen module(s) can be illustrated. The purpose of the third chapter is to present an outline of the data collection and analysis process supplemented by a time schedule. This should also include the envisaged sample size and sampling method – if possible, already specifying the different SME types to be interviewed.

Step 3c: Development of Questionnaire

Based on the proposed approach outlined in *Step 3b*, a questionnaire has to be developed that covers the requirements determined in *steps 2a* and *2b* and that corresponds to the approach chosen in *2c*. Of course, the questionnaire for *Module (a)* is much shorter than the one for *Module (b)*. In all cases, the questionnaire should be well organised and furnished with complementary annotations for the enumerator, where necessary.

For *Module (c)*, the questionnaire is more an interview guideline delineating the aspects that should be addressed during the interview in spite of its principal openness. Sample questionnaires for *Module (a)* and *(b)* are provided in and *Addendum 3*. For *Module (c)*, the PRODUSE guidelines for qualitative interviews that have been developed for the Uganda case study (see *Addendum 4*) contains a list of guiding questions; of course, this list cannot always be transferred one-to-one and needs to be adjusted to the particular case, since the research objective may deviate in other countries and projects.

At least for *modules (a)* and *(b)*, pre-testing the questionnaire with 5-20 interviews is imperative to scrutinise the formulation of questions (the interviews for *Module (c)* are more conversational so that questions do not need to be as accurate). It is most suitable to do this pre-test with the already selected and trained enumerators (*Step 3h*). At the same time, the pre-test can serve as a training component for the enumerators. It is also highly recommendable for the researchers to do field trips to the target region and some focus group discussions with target group representatives to check the appropriateness and completeness of the questionnaire.

Step 3d: Selection of Field Work Team

For *Module (a)* the team may even consist of project staff only. Additionally, interns or consultants can be hired. By contrast, *Module (b)* requires one or two teams of around four enumerators and one field supervisor, depending on the sample size and availability of time and means of transport, of course. As a rule of thumb, one can expect 4 and 6 interviews per enumerator per day for *Module (b)* and *(a)*, respectively. Interviews for *Module (c)* should be conducted by the hired researchers themselves, supported by local consultants familiar with the situation and social customs in the target region.

Step 3e: Choice of Control Regions

Information that allows assessing the comparability of potential control regions and the target region of the electrification project should already be collected as part of the preparatory desk work. In addition, a field trip to the target areas of the intervention is generally indispensable. While the comparability of villages can best be assessed on the ground by visual inspection, the following list of criteria can provide for some guidance:

- level of economic activity
- distance to the capital and/or regional centres
- population size
- main source of income (agricultural and non-agricultural products)
- road accessibility (distance to asphalt roads, accessibility by cars and/or trucks)
- transit traffic
- existence of a regular market in the village
- political relevance
- availability of other services (such as vocational training or microfinance)
- presence of other development projects.

Talking to local key informants such as village chiefs, teachers or NGO representatives can help to get a better picture of the villages that are considered to be included.

Step 3f: Determination of Sample Size

The determination of the sample size for *Module (a)* or *(b)*, in principle, is based on statistical considerations. However, a statistically accurate determination of the required sample size, commonly referred to as *power analysis*, will not be possible in most cases. This statistically appropriate sample size mainly depends on the specific impact indicators (e.g. firm profits or employment, usage of electric lighting) and the extent to which they are expected to change due to electrification: the smaller the expected change, the higher the sample size that is required to derive robust and clear interpretations from statistical results. To sum it up, if one finds statistically significant evidence for an impact of electrification on, for example, firm profits, there are not so many reasons to worry about a sufficiently large sample size. The problem is rather whether to interpret a no-effect result as genuine evidence of no effect of the intervention or as a reflection of an insufficient sample size, given the setup of statistical significance tests. It might as well be the case that the sample size is simply too small to detect a positive impact. The objective of a power analysis is exactly to avoid such inconclusiveness.

See, for example, Magnani (1997) for an accessible presentation of power analysis.[63] Among the parameters required to determine the sample size, are (with + or - indicating whether the parameter increases or decreases the required sample size):

a) the number of firms in the target population [+]
b) the heterogeneity of firms in the target region [+]
c) the expected magnitude of the intervention's impact (e.g. 20 % higher profits for connected SMEs in comparison to comparable non-connected ones) [-]
d) the desired degree of confidence that an observed change would not have occurred by chance (the level of *statistical significance)* [+]
e) the desired degree of confidence that an actual change of the magnitude specified above will be detected *(statistical power)* [+]. [64]

Only *d)* and *e)* are at the discretion of the researcher. To gauge the concrete realisation of all other parameters will be difficult in most cases, however. Nevertheless, a rough power calculation conducted with approximate values will indicate how the required sample size changes if, for example, firm profits are taken as an impact indicator compared to lighting hours usage (see Bloom 1995 for more details on sensitivity tests).

As a pragmatic alternative to power analysis, one might resort to rules of thumb: the purpose of any (quantitative) evaluation study is to compare samples of firms with each other, for example connected to non-connected firms or firms before electrification to the same firms after electrification. In order to allow for statistical analysis, as a rule of thumb, the sample size per subgroup must not fall below 30 firms, e.g. 30 connected

63) As a matter of course, the presentation can only be superficial at this point. For further readings on the power of surveys see also Cohen (1988).

64) For indicators expressed as proportions (e.g. share of energy expenditures in total SME expenditures before the intervention) the initial or baseline level of the indicator additionally affects the required sample size.

and 30 non-connected firms. However, the number of relevant subgroups increases with the set of firm characteristics to be taken into account. For example, if the analysis furthermore distinguishes between commerce and manufacturing firms, the required sample size already increases to 120. Assuming that more firm categories have to be accounted for (regional differences, firms sizes, industries, etc.) a sample size of 200-500 seems reasonable and allows for the application of many statistical tools. At least for *Module (b)* considerations on this rule of thumb and the subgroups to account for should be provided in the inception report (see *Step 3b*).

For *Module (c)*, the number of interviewed firms can be determined according to the budget. Here as well, certain differences between firms that can be important for answering the research questions have to be taken into account.

For example, one might be interested in the (non-)use of electricity and its impacts on service firms supplying non-tradable goods and firms that are producing exportable goods as well as those producing non-exportable goods (exportable in this context refers to trade with regions beyond the intervention zone of the electrification intervention). In this case at least 1-2 representatives of each subgroup – further distinguished according to their connection status – should be visited.

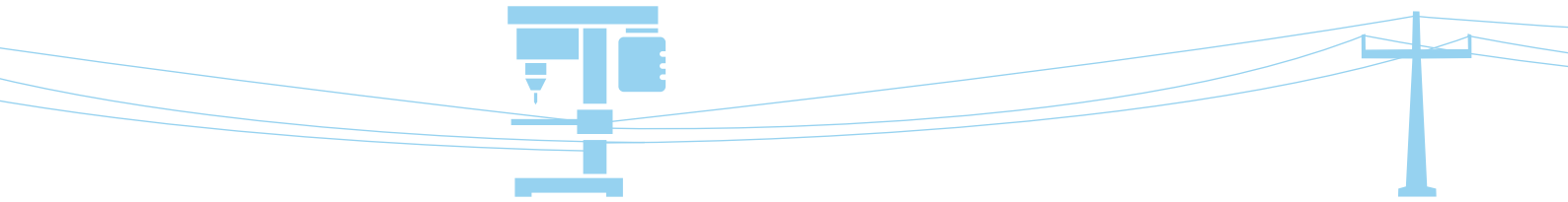
Step 3g: Decision on Sampling Design

The purpose of sampling is to select firms for interviews from the totality of firms in the target region (and potentially in a control region) in a way that is governed by chance, not by the researcher's or enumerator's choice (*probability sampling*). The resulting randomness of sample selection is crucial for guaranteeing the representativeness of the collected data. *Module (c)* is an exception by allowing as well for *purposive sampling* of firms according to specific demands or ex-ante expectations. These expectations depend on the project setup and the target region. For example, one might expect special insights on impacts in export-oriented firms. For the qualitative part of the Uganda case study on electricity usage in two export oriented fishing communities at Lake Victoria (see *Addendum 4*), to take another example, three groups were identified beforehand: voluntary non-users, 'non-performers' that get connected but do not seem to benefit from the connection and 'winners' that get connected and seem to be able to improve their performance. The type of firms on which *Module (c)* should be targeted has to be elaborated on before the survey. This should also be addressed in the inception report (*Step 3b*). Yet, in a case in which *Module (c)* is combined with another module, the researchers can decide that firms to be interviewed qualitatively are selected after the survey according to, for example, stylised firm types determined during the surveys.

For *Module (a)* and *(b)* some form of probability sampling has to be applied. In the ideal situation, the researchers have a comprehensive enumeration of all firms in the target area to draw a random sample from. In most cases, such a list will not be available, however, only a list of villages to be electrified. Often, more than a dozen villages are electrified, so that surveying all of them is hardly an option from a logistical and budgetary point of view. The first step of sampling is therefore to select a subset of villages.[65] A random selection where the probability that a village is selected is directly linked to its population size is advisable (see e.g. Iarossi 2007 for details). In particular for *Module (a)* the researcher might simply pick a subset of villages from the target region – either by chance or based on certain ad-hoc representativeness considerations. For example, one could choose a certain number of villages from each of the (sub-)regions the project intervenes in.

Per village, a certain number of firms then has to be selected – depending on the total sample size defined in *Step 3f*. The most pragmatic approach is *simple random sampling* (within the villages): if a list of firms exists, the field supervisor simply draws randomly the required number in the respective village. If no such list exists, the field supervisor assigns the enumerators to different parts of the village, where the number of firms can normally be obtained from some key informant. Since SMEs in rural parts of developing countries are often not recognisable as such, the key informant should furthermore be consulted about the location of the

65) In demarcation to the ideal situation case mentioned above, this is referred to as clustered random sampling. Because observations from one cluster do not differ as much as observations from different clusters do, one needs a larger sample size to capture the variation between firms. The choice of the sampling scheme therefore has repercussions for the sample size determination (see *4d* and Warwick and Lininger 1975).



individual enterprises. The first firm to be interviewed is picked by chance by the field supervisor or the enumerator. Afterwards, the enumerator visits every nth firm along a predefined route – with the n depending on the required sample size and on the number of firms that exist in the respective part of the village.

In brief, as long as the interviewed firms are selected randomly, basic representativeness can be expected. Further structural sampling errors that occur in many settings can be avoided if the field research team conforms to the following two principles: (i) cover the whole intervention area, especially in terms of centrally and remotely located firms and (ii) do not skip absent firms but revisit them later. Otherwise a certain part of the local economy (e.g. shops that only open in the evening hours) may be excluded from the sample.

In case of the profound enterprise survey – *Module (b)* – the hired consultants might consider other more elaborated forms of sampling, for example *stratified random sampling*. Here, firms are grouped into 'strata' beforehand. Stylised firm types such as 'manufacturing' and 'services' are one example of strata. Geography is another logical choice for stratification, because location is likely to be correlated with a number of other variables that are of relevance for the evaluation. For example, for a baseline study the enterprises in a village can be stratified into 'village centre firms' and 'more remote firms'. If information on the outline of the upcoming grid is available, this may as well be used to stratify enterprises into firms located closer to the upcoming grid and those living further away. Stratified sampling ensures that the two groups are adequately represented in the sample to be drawn and not – due to chance – underrepresented. If, for example, two in three firms in an intervention area are located in the village centre, two in three interviewed firms should be located there. For this approach it is necessary to know beforehand for each of the different 'strata' the number of SMEs it contains.

Another option is to purposefully *oversample* firms that are more likely to connect in the future in order to ensure that sufficient information is obtained about them. This option is particularly relevant if the researcher worries about the risk of a low electrification rate among SMEs in general or among SMEs of a specific firm type of interest. In our example, one might expect that the village centre firms are closer to the future power lines and therefore more likely to connect to the future grid. In the case of oversampling it is important to use weights during data analysis in order to reconstitute representativeness. Details on the implementation of the different sampling approaches and additional methods can be found in the standard literature on survey methodology (see, for example, Iarossi 2007, Magnani 1997 or Warwick and Lininger 1975). Apart from simple random sampling, all sampling approaches should be implemented by methodologically skilled researchers.

Step 3h: Training of Field Work Team

Interviews for *Module (c)* are conducted by the researchers themselves. The field work team for *Module (a)* can consist of project staff only. Additionally, interns or consultants can be hired. If enumerators or consultants are hired, they can be trained in a few hours to do the interviews, depending on the complexity of the questionnaire.

Module (b) requires a team of around four enumerators and one field supervisor, depending on the sample size and availability of means of transport. As a rule of thumb, an enumerator can conduct four interviews per day. They have to be trained and backstopped by a methodologically skilled researcher. During the training, the enumerators and the field supervisor have to become acquainted with the objective of the study and the meaning and purpose of each question. Furthermore, the enumerators have to be taught how to deal with non-responses, to pay attention to consistency problems and to report complementary qualitative information in written comments or verbally to the field work supervisor. The training takes around 1.5 days in the 'classroom' and should be interactive, e.g. by means of role plays of interviews.

The training can be combined with a pre-test of the questionnaire, which is in this case conducted by the freshly trained enumerators under supervision of the field supervisor and the researcher. It is recommendable to contract the same enumerators for data entry afterwards. Data entry should also be taught during the training course. Pre-test and data entry training take another 1.5-2 days.

In many regions, the employees of the SMEs to be interviewed will not speak English, French or Portuguese, so that some form of translation has to be applied. Whether the questionnaire itself is translated or enumera-

tors translate the questions in an ad-hoc manner depends on the particular region and the local language that is spoken.[66] This should be discussed with the local survey partners familiar with the languages that are spoken in the survey region.

Step 4: Implementation

Step 4a: Conduct Survey

In particular for *Module (a)* and *(b)*, a thorough logistical planning is a precondition for a successful implementation of the survey. Transport to and within the target region has to be ensured. For *Module (a)*, one enumerator can do 6-7 interviews per day. The longer questionnaire in *Module (b)* normally makes it difficult to do more than 4 or 5 questionnaires per day. As a matter of course, in both cases this depends on the distance from the base camp to the survey village at the respective day and from the distance between the SMEs to be interviewed, which may be located in more than one village.

The sampling strategy determined in *steps 3f* and *3g* has to be implemented in each village. In *Module (b)* this has to be done by the field supervisor, who assigns the enumerators to different parts of the village. The enumerators should make sure that the interviewees are the actual owners with full insights into their firm's operation – if necessary through an appointment or revisiting the firm later. In addition, it is recommended to do a short village level interview with, for example, the village chief to obtain an assessment of the local business environment, market access and most important barriers, reliability of the electricity grid and general income sources. After the first interviews have been completed, the questionnaires should be checked by the field supervisor for consistency and completeness. Potential problems and respective solutions can be discussed with the enumerators.

For *Module (c)* the interview length depends on the issues to be discussed with the respondent. But even if the number of questions is known, the duration is less predictable than for structured questionnaires, as spontaneous deviations from the interview guideline are possible and even desired. If enterprises state that positive or negative impacts of electrification of whatever sort exist, the researcher should – on the spot – check for other potential sources of this impact. For example, the interviewee can be simply asked if other explanations are possible for why her/his situation has improved, e.g. if the firm benefits from other development projects (in general, the comparability criteria mentioned in *Step 3e* represent a useful starting point when trying to elicit potential triggers of change).

It seems reasonable to take two hours as the maximum duration for the qualitative interview to avoid overburdening the enterprise. In this case, it might also be considered to give an in-kind remuneration to the respondent to compensate for her/his loss of time. In addition, the interview might be divided and spread over the day. Thereby, the interviewer also has the occasion to observe the business at different times of the day.

Step 4b: Data Entry

For *Module (a)* and *(b)* the entry of the collected data is a highly important step. If a proper digitalisation of the questionnaire information is not assured, even the best collected data will not be useful. Therefore, much effort has to be put into preparing an easy-to-use and trouble-free data entry template that helps to avoid data entry mistakes from the outset. In the same way, the training of staff to enter the data (preferably, this is done by the enumerators themselves, see *Step 3h*) and backstopping the data entry (which can be done by the field supervisor) including quality assurance are of particular importance. The best way is to supervise the entry of the first 3-4 waves of questionnaires directly and check afterwards for each questionnaire whether the data is entered correctly. Once the data entry staff seems to work independently, picking just a sample of questionnaires for quality control is sufficient.

66) To give an example, while Wolof is a widely spoken language in Senegal, also well-educated people are often unable to read it. Hence, enumerators prefer to translate on the spot from French into Wolof. In Rwanda, in contrast, Kinyarwanda is also widely used as a written language. Therefore, enumerators prefer to work with translated questionnaires. In Benin, many different languages are spoken within one region, so that enumerators adapt on-site to the language the interviewed firm (or household) speaks. Translating the French questionnaire into one local language would not make sense.

A code sheet for additional response categories or open questions has to be provided to the data entry staff (at best after the first 3-4 waves of questionnaires have produced the most common answers) to avoid time-consuming ex-post recoding and ensure uniform usage of codes. The data can be entered in an Excel spreadsheet and easily transferred to other statistical packages for data analysis afterwards. A sample data entry sheet is provided in *Addendum 5*.

For *Module (c)*, the data can only be processed to the extent that it is quantifiable. Depending on the number of interviewed firms, this is not always necessary. For the main body of collected information one might rather speak of 'digesting' the interviews. How this is implemented depends on whether the interviews have been done by the principal researcher or by someone else. In the latter case, a systematic way of reporting the information has to be developed. This digestion step bears the risk that information gets lost and is time consuming – another reason for assigning the interview work directly to the researcher. The staff member who conducts the interviews should at least be in close contact with the researchers responsible for the final report, also during the reporting phase.

Step 5: Analysis and Presentation of Results

Step 5a: Information and Data Processing and Analysis

For *Module (b)*, a common challenge is how to deal with non-responses inducing missing values in the data. One approach is to drop observations for which values are missing. To the extent that these values are not missing at random, however, this will induce biased estimates. One can easily imagine that specific firms, for example those exhibiting particularly high or particularly low profits, are more or less willing to respond to questions on profits. Hence, the researcher has to find ways to *impute* missing observations in order to avoid biased results. The easiest way is to simply fill in mean values for certain subcategories of firms. For example, one might impute profits according to the number of customers. More sophisticated imputation algorithms are presented by King et al. (2001) or implemented in statistical software packages such as the module ICE within STATA.

For *Module (a)*, the problem of missing data will be much less severe, as the principal idea of this module is to aim for the easy-to-get data. Variables for which one expects high non-response rates should consequently not be included in the *Module (a)* questionnaire.

For *Module (a)* and *(b)*, basic data analysis can be done with Excel, which suffices to calculate frequencies, percent distributions (proportion), means, medians and ratios. Advanced data analysis for *Module (b)* (regressions, difference-in-differences, matching etc.) has to be done using special statistical software packages like SPSS or STATA. These techniques can only be applied by researchers familiar with statistics and econometrics – at best documented by a list of academic publications in the fields of impact evaluation and applied econometrics.

The applied methods should be based on the established literature on impact evaluation: Ravallion (2008) provides a comprehensive overview of impact evaluation methods in development projects. Peters (2009) proposes hands-on solutions in electrification projects that are feasible even with limited research budgets. Examples of applied evaluations in development projects are numerous. There are many excellent papers in the literature but most of them have been elaborated based on surveys or data sets beyond the scope of the PUE impact M&E systems presented here. The following papers, however, are examples for methodologically proper evaluations based on limited sample sizes and can be considered as role models for methods to be applied in *Module (b)*: Becerril and Abdulai (2010), Becchetti and Costantino (2008), Bensch, Kluve and Peters (2011), Kondo et al. (2008), Peters, Vance and Harsdorff (2011), Schmook and Vance (2009).

For *Module (c)*, the collected qualitative information has to be analysed systematically along the lines of the guiding research questions. This includes a critical assessment of who has been referred to as information sources and how to interpret the statements of the respondents.

Step 5b: Reporting

The final report of a PUE impact M&E effort should contain a documentation of the important steps sketched in this guide. First, the project should be described with a focus on its *theory of change* (results chain), this includes activities, important steps, regional foci, objectives and intended impacts. The study and survey implementation including sampling method and sample size as well as the identification strategy have to be presented. For *Module (b)*, the extent to which the applied methods are in line with the related literature should be documented. In particular for *Module (c)*, the analytical approach has to be clearly delineated in order to allow for inter-subjective verifiability.

The collected data can then be used to describe the socio-economic situation in the survey (and control) region. Only variables that are not expected to be affected by the project should be included in this description. The variables to be affected, that is, the indicators selected from the list in *Aid 3*. (see *Step 2b*), can then be presented in the results chapter. Sample selection issues or other potential caveats that might distort the accuracy of the findings should be critically discussed.

Analysing, understanding and digesting the collected information requires sufficient time, which should be granted to the researchers. This should also involve a discussion of the preliminary results with the project staff and others, e.g. the local partner institution(s). The time for data analysis and reporting can range from around 2 months in *Module (a)*, 3 months in *Module (c)* to 3-6 months in *Module (b)*. In particular, if advanced statistics and econometrics are to be employed, the data analysis and reporting cannot be done in a few weeks. Note that the effective man-days to be budgeted are less. A longer period of 6 months is recommendable in order to allow for review and ping-ponging processes that are required to draft an understandable report on a high methodological level delivering policy-relevant results.

Step 5c: Recommendations for the Project Implementation

Among the different objectives of a PUE impact M&E system are learning effects for the project itself. Therefore, beyond the pure analysis of the data and its reporting, researchers should derive recommendations useful for the project and beyond. In the first place, of course, this concerns suggestions to improve the potentials to generate positive impacts (or also to avoid negative ones). For example, the PUE impact M&E might reveal that regional differences in impacts exist (e.g. due to different market access or different production patterns or enterprise types). This would lead to the recommendation to focus more on certain regions or types of firms.

A potential recommendation could as well be to modify the communication towards the public based on which impacts could be evidenced or not. For example, in one segment a PUE impact M&E could find substantial benefits for the target group (e.g. households that enjoy lighting) and in another segment impacts are rather thin (e.g. no substantial productive take-up of electricity). The report should formulate this explicitly and recommend calibrating the communication of impacts (e.g. 'Do not promise substantial productive use impacts, but highlight the social impact of the project among households').

Beyond the recommendations directly linked to impact results and potentials, other insights gained during the field work should be captured and used for developing further recommendations. The field work during impact surveys always brings the researchers extremely close to the target region and its people as well as intermediate partners such as private or community operators. Experience in many projects has shown that this close interaction often reveals weaknesses of the project implementation as well as potentials to improve it.

5. Aid Items

The following aids are composed of short instructions that shall give guidance for and ease implementation of PUE impact M&E activities.

Aid 1. The Results Chain Concept and Demarcation Between Outcomes and Impacts

The demarcation between outcomes and impacts can be visualised using the results chain concept. For a stylised illustration, the results chain of an electrification project is presented that promotes the provision of electricity by supporting the national utility to extend the electricity grid (see *Figure 10*). In this case it is the ambition of the programme to connect households and SMEs. Hence, the *outcomes* of the programme are connected households or firms. For which purposes electricity is used in connected households and firms is of course also relevant to the project but it can hardly influence the usage of electricity. The usage of electricity lies beyond the so-called a*ttribution gap* and, therefore, is an intermediate impact. Everything that happens as a result of this usage, for example an increase in productivity, constitutes an *impact*. Here, potentially observed changes can hardly be attributed to the programme alone but may as well be due to external factors.

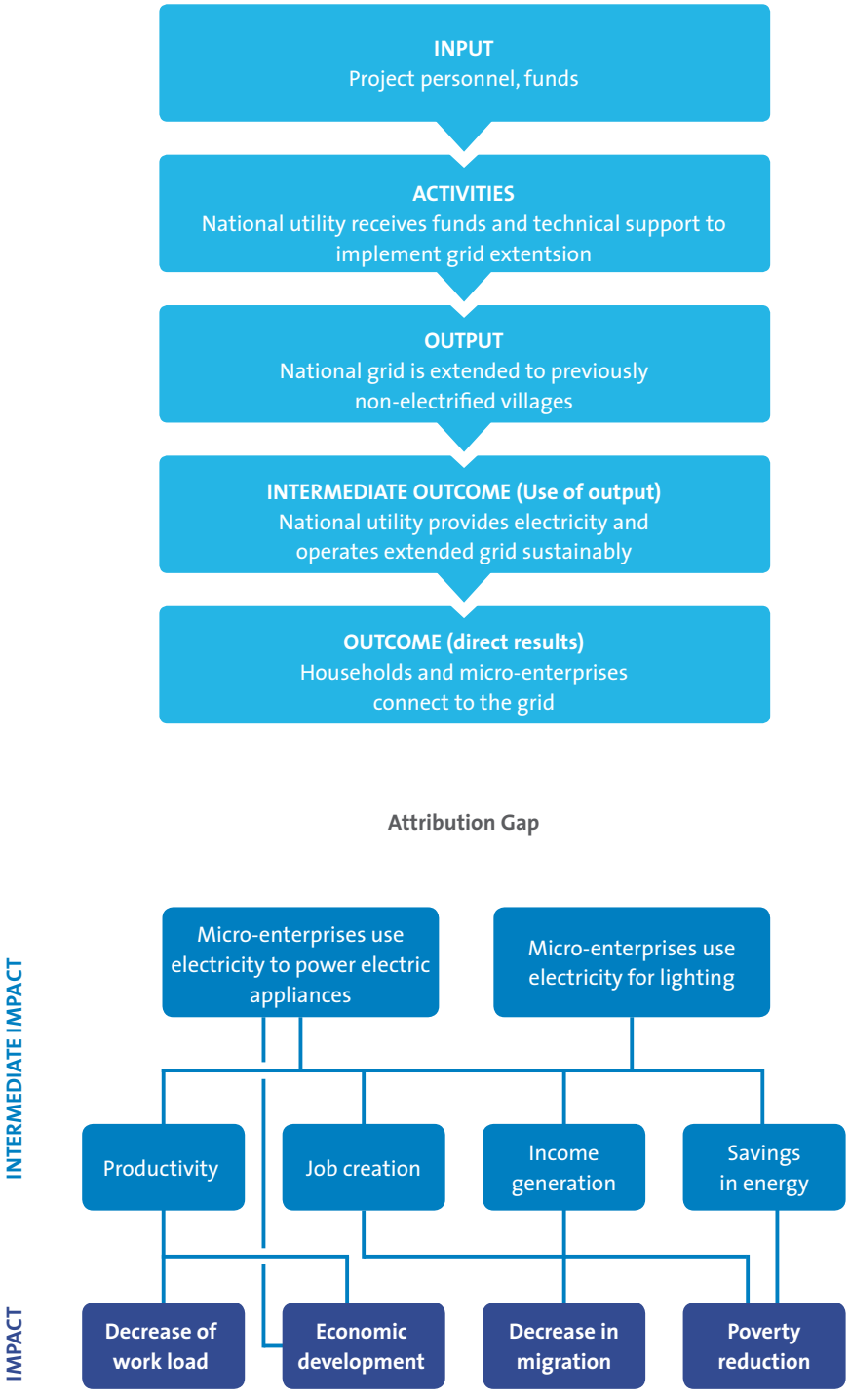
Please note that the results chain presented here cannot serve as a blueprint for electrification projects. The reality of electrification projects (and development projects in general), is much more complex. *Figure 10* only serves to introduce the principle of the project's theory of change and to highlight that it has to be clear before a PUE impact M&E can be designed, which results are considered as direct ones (hence: outcomes) and indirect ones (impacts). In most cases, it requires several results chains, not just one, to visualise the different channels via which the project intends to achieve its outcomes and impacts.

Aid 2. Strategies to Identify the Counterfactual Situation

In order to determine the true effect of electrification on the chosen outcome indicators, one would have to compare the outcome variable after electrification to the counterfactual situation of not having received it. The *counterfactual situation* shows how the firm would perform if it had not been connected. The impossibility of this is obvious, since we can never observe both situations: the firm either gets connected once the electricity service is available or not. To solve this, an identification strategy is required that allows replacing the unobservable counterfactual situation by something that is observable. This section describes briefly the different strategies that exist and that are referred to in *Section 3.2*. Basically, one can compare the connected firm after the project to the same firm before electrification or, alternatively, one can compare the connected firm to another, unconnected firm at the same time.

In all approaches a particularity of electrification projects has to be taken into account: customers, be they households or enterprises, decide whether or not to connect to the grid or to obtain a solar home system. In most projects, comparatively high connection fees and installation costs prevent a considerable share of households and enterprises from getting connected. For evaluation purposes, this bears the temptation of comparing the connected firms to the non-connected ones in order to determine the impact of electrification. However, this comparison is very likely to be a comparison of apples and oranges, since the firms that have decided to connect or purchase a solar system are different from those that did not resulting in a *self-selection bias* (see below for examples).

Figure 10: Exemplary Results Chain of Grid Extension Programme



Source: own illustration

1. Simple Before-After Comparison

For this approach, impact indicators are compared for the same firm before and after electrification. Any difference is then attributed to the electrification intervention. The underlying assumption is that the firm before electrification is the counterfactual situation of the firm after electrification. In other words, performance of the firm would not have changed, had there been no electrification intervention. One can imagine that this does not hold true in many cases. For example, different harvest yields over time might affect the purchasing power of the firm's customers in the region thereby affecting the firm's performance. In addition, other external factors could change that are unobservable for the researchers. Only provided that such factors can be ruled out or somehow are taken into account, based on, for example, qualitative interviews with key informants, before-after comparison can be a valid approach. Quantifying these factors, if they exist, however, will be difficult in most cases.

An advantage of the before-after comparison is that it does not suffer from self-selection problems since only connected firms are examined.

2. Cross-Sectional Comparison

In the cross-sectional approach, connected firms are compared to non-connected firms. The difference in indicators is then considered as the impact. The basic identification assumption here is that the non-connected firms behave like the connected ones would do if they had not connected to the grid. The result is the assumption that there are no systematic differences between those firms that get connected and those that do not.

However, this assumption is likely to be violated in an oversimplified approach: for example, one might expect that better-educated entrepreneurs are more likely to get connected. At the same time, better-educated entrepreneurs are likely to be more productive and, hence, have higher profits. As a consequence, these better-educated entrepreneurs are more likely to be connected and to exhibit better performance indicators at the same time. By simply comparing mean values in, for example, profits between connected and non-connected firms one would ascribe at least parts of the difference to the connection status that is, however, in fact induced by differences in the educational level.

Such confounding effects can be separated into observable and unobservable differences between connected and non-connected firms. The education of firm owners or employees, for example, is observable and can be accounted for by applying multivariate regression techniques. Thereby, the effect of being connected to the grid can be isolated holding other firm characteristics constant.

In contrast to the educational level, some of the differences may be hard to capture and remain unobserved. One example of a potentially unobserved difference that might violate the identification assumption is the *entrepreneur's motivation*. It is hardly measurable, it potentially affects the decision to connect and might as well affect impact variables such as profits. Again, without controlling for the entrepreneur's motivation one will ascribe parts of the difference between connected and non-connected firms to the grid connection, although the connected firm would also exhibit better performance outcomes without a connection, since it is due to the omitted variable motivation. This is commonly referred to as selection into treatment and eventually leads to biased results.

Problems resulting from such systematic differences between firms have to be addressed both on the level of data collection and analysis. On the level of data collection, all important characteristics of firms and firm owners that potentially affect the decision to connect and the impact indicators should be included. The study team needs to assess what driving forces are behind the decision to connect. Variables that are difficult to capture with a structured questionnaire might be grasped in accompanying qualitative interviews.

On the level of data analysis, methods like matching can improve the comparability of connected and non-connected firms (*PRODUSE Chapter 3*, Peters, Vance and Harsdorff 2011 and Bensch, Kluve and Peters 2011). The quest for more comparable firms becomes easier, if the non-connected firms are taken from a region where electricity service is not available, i.e. that is not covered by the grid, for example (see again *Peters, Vance and*

Harsdorff 2011 and *Bensch, Kluve and Peters 2011*). The challenge in the implementation of such a control region approach is to find regions that are comparable to the region under evaluation. It is difficult to rule out that differences between regions that are invisible at the first (preparatory) glance are uncovered during the field work (see *PRODUSE Chapter 5*).

3. Before-After Comparison with Control Group

By using a control group the above-mentioned problems of simple before-after comparisons are widely eliminated: the control group accounts for the fact that the environment of the firm under investigation is changing over time, which might also influence the impact indicators. If, for example, harvest yields change and thereby the purchasing power of the local population as well, this will also affect the sales of firms in the region. Simply comparing the before and after sales of a meanwhile connected firm would bias the assessed impact of electrification on sales. Including other non-connected firms from the region helps to estimate the effect of the changed harvest yields, so that this effect can be differenced out to get the net impact of electrification. Methodologically, this is done by comparing the *change* in impact indicators of connected firms to the *change* in impact indicators for non-connected firms. The remaining assumption that has to be formulated is that the environmental change, harvest yields for example, affect both connected and non-connected firms in the same way. If doubts about the validity of this assumption remain, propensity score matching can improve the comparability of control and connected firms and, hence, the validity of the assumption. As for the cross-sectional approach, the control enterprises are in the optimal case recruited from a comparable non-electrified region that remains non-electrified.

In addition, the problems arising from selection-into-treatment effects (see *Section 2*) are excluded as long as both unobserved characteristics affecting the decision to connect as well as the impact indicators remain constant over time.

4. Ex-Ante Impact Assessment and Ex-Post Evaluation

This approach combines the cross-sectional approach with the one of before-after comparison with a control group. At the baseline stage, a control region is selected that is already covered by the electricity service. This allows for a cross-sectional comparison of non-connected firms in the yet non-electrified project region to connected firms in a region that had been electrified before – be it in an earlier phase of the same electrification project or by another project (see Bensch, Kluve and Peters 2011 and Peters, Vance and Harsdorff 2011). In addition, an ex-post evaluation can be conducted using the control region (and those firms in the project region that chose not to get connected) to filter out the effects of changing external conditions (see Peters 2009).

The second, third and fourth approach presented, refer to non-experimental methods, which use statistical techniques to construct the counterfactual. Still, there is another group of impact evaluation methods known as **random experiment designs**, which are similar to controlled medical experiments in that they use randomisation to obtain the counterfactual. Since these designs are typically not applicable for productive use interventions, it shall only be referred to Gertler et al. (2010) and Ravallion (2008) at this point. Finally, another option (mentioned in *Section 3.2*) for the case in which no information has been gathered before project implementation is to employ **retrospective questions** that try to elicit ex-post the information of interest from the interviewee (Bamberger 2010). These, however, have the strong disadvantage of being subject to respondent's recall errors and should therefore be applied only in particular cases and their results should be interpreted cautiously.

Aid 3. List of Indicators

This list presents impact indicators for productive electricity use among SMEs. The observation fields of expected impacts are supplemented with indicators and sub-indicators ('What to measure') that represent options for possible choices to be made by the project. The following column indicates whether a specific indicator is deemed to be elicited by means of a short or a profound SME survey. Recommended indicators and sub-indicators as a minimum selection of essential impacts to be observed are highlighted in dark grey.

A sample questionnaire for both the short and the profound enterprise survey is provided in *Addendum 2* and *Addendum 3*.

Observation Field	MDG Relevance	Indicator	What to Measure	Recommended Approach to Study Indicator	Essential
Additional income generating activities	MDG 1	Business activity	• Number and types of SMEs	Short and profound SME survey	
			• Number and percentage of SMEs that use - electric lighting only - electrical machines and appliances	Short and profound SME survey	
			• Number and percentage of farming SMEs - using electric irrigation pumps - using electric machines for agro-processing	Short and profound SME survey	
			• Number of registered SMEs in the target area	Profound SME survey	
			• Energy using and non-energy using capital stock of SMEs	Profound SME survey	
			• Perception of rural entrepreneurs regarding productivity/income	Qualitative SME appraisal	
			• Working hours of SMEs • Closing time in the evening of SMEs	Profound SME survey	
			• Production of SMEs • Income and profits of SMEs, incl. seasonality	Profound SME survey	
			• Number of firms created after electrification	Short and profound SME survey	
			• Additional services or products provided/produced	Profound SME survey	
			• Crowding out effects among - non-connected enterprises - already existing enterprises - enterprises in neighbouring non-connected villages	Anecdotal case study	
			• Number of workers employed by SME	Profound SME survey	
		Employment	• Number of SMEs expanding and new jobs created	Profound SME survey	
		Market integration	• Perception of market integration of the SME/concerning the place where the majority of goods produced are consumed	Profound SME survey	
			• Destination of products (local, regional, national, international markets)	Profound SME survey, qualitative SME appraisal	
			• Origin of customers (local, transit, external)	Profound SME survey, qualitative SME appraisal	
		Productivity	• Detailed information on production of SMEs • Working hours at SMEs	Profound SME survey	

Observation Field	MDG Relevance	Indicator	What to Measure	Recommended Approach to Study Indicator	Essential
Savings in energy expenses	MDG 1	Energy expenditures	• Average total SME expenditures on energy (e.g. liquid fuels, wood fuels, bat¬teries, electricity, candles) per month • Share of energy expenditures in total SME expenditures • Ownership of generators, SHS, etc.	Short and profound SME survey	
			• Broken electric devices (e.g. due to voltage fluctuations) and respective expenditures last year	Short and profound SME survey	
Improved food storage	MDG 1	Penetration of food storage appliances	• Number and percentage of SMEs owning fridges, freezer for food storage (commercial use)	Short and profound SME survey	
Time savings	MDG 1 + 3	Time spent on firewood collection	• Relation of firewood collected versus firewood bought • Frequency and time spent (daily/weekly) on firewood collection	Short and profound SME survey	
		Time spent on fuel provision for generators	• Number of firms using generators • Frequency and time spent weekly on diesel/petrol provision	Short and profound SME survey	
		Time spent on the provision with traditional lighting sources	• Number of firms using traditional lighting • Frequency and time spent weekly on fuel provision	Short and profound SME survey	
Biomass energy savings	MDG 7	Use of wood fuels	• Average monthly amount of wood fuels (firewood, charcoal, sawdust) used per SME	Short and profound SME survey	
Reductions in toxic waste	MDG 7	Use of dry cells	• Average monthly amount of dry cells used per SME	Short and profound SME survey	
			• Battery recharging and replacement pattern for SHS (if SHS intervention)	Short and profound SME survey	SHS

Aid 4. Outline of Terms of Reference for Short-Term Experts

1. Background

In this section of the Terms of Reference (ToR) information shall be provided on the context of the evaluation, for example if the evaluation is embedded in an overarching monitoring and/or evaluation process. The relevance of the evaluation shall be outlined briefly. It shall furthermore be explained why the evaluation takes places at the projected point of time.

2. Object of the Evaluation

This section shall contain details on the project or programme that is going to be evaluated. These details comprise basic information such as the name, project/programme period and geographic intervention zone same as description of the concrete activities of the intervention and the rationale behind them.

3. Objective of the evaluation

In this section of the ToR, the specific objectives of the evaluation have to be listed and – if deemed appropriate – shortly explained. These objectives may, for example: (i) serve as a data basis for monitoring activities, (ii) assess the impacts of the electrification intervention on an empirically sound basis or – more specifically – (iii) determine the (net) employment and income effects of the SME electrification intervention or (iv) develop recommendations concerning potential complementary activities. If the study is a baseline, the objectives may rather be to (v) provide benchmark data for a potential ex-post impact evaluation, (vi) portray the local economic conditions in the project areas or (vii) reduce uncertainty about demand assumptions in the target region.

It is furthermore helpful to set up a list of questions in this section that the evaluation design is meant to help answering (e.g. which of the observed changes can be causally attributed to the SME electrification and which can only be plausibly attributed to it?).

4. Methods

The applied methods (including identification strategy and sample size) and its application to the concrete setting – shall be outlined in this section.

5. Implementation

The responsibilities of the different persons and organisations involved in the evaluation shall be defined here. This entails as well the definition of tasks to be executed by the evaluator. An indicative list of tasks is presented below:

a. *Preparation of the Study*

1. Desk study of relevant project documents
2. Preparation of an Inception Report (see *Aid 5*)
3. Recruitment of field work personnel
4. Design of a questionnaire based on sample questionnaires (*Addendum 2* and *Addendum 3*)
5. Establishment of a data entry document/programme
6. Field trips to survey/project sites

7. Exploration and selection of control sites
8. First review of questionnaire
9. Planning organisation of the survey and logistics with the assistance of field work personnel
10. Training course for the survey team (supervisor and enumerators) concerning survey objective, design and execution as well as data compilation
11. Pre-test at one of the project sites
12. Final revision of questionnaire
13. Review of organisation and logistics for the survey logistics with the assistance field work personnel

b. *Realisation of the Survey*

15. Provision of organisational and methodological backstopping to the field work personnel
16. Adaptations of the intended survey methodology (sample size, target villages/ regions/ SMEs, questionnaire, etc.), if needed

c. *Compilation, Interpretation, Reporting and Presentation of Results*

17. Preparation of a presentation of preliminary results
18. Analysis and interpretation of survey results
19. Compilation of a report of about xx pages
20. Revision of draft version in cooperation with project management staff members
21. Knowledge management: short paper (in note form) on practical experience made, (methodological) lessons learned and recommendations

6. Timeline

Along the different tasks and task sets, a timeline for the whole survey process is to be established.

Aid 5. Outline of Inception Report

If consultants are engaged to design an impact M&E system or to conduct baseline or impact studies, they should be required to submit an inception report. The inception report has to be submitted by those who will implement the PUE Impact M&E. In particular, if external researchers are hired it is imperative. The purpose of the inception report is to familiarise those responsible for the PUE Impact M&E with the proposed methodological approach at the outset of the research effort.

1. Project to Be Evaluated and Conditions

1.1. Basic Information on the Electrification Project
By means of the results chain the intervention shall be presented from the specific inputs up to the intended impacts. The overall objective of the project/programme shall as well be mentioned and put into relation to the results chain. It shall further be made clear since when the activities are being implemented (potentially addressing different project/programme phases) and since when outcomes (and impacts) are expected to have started to materialise.

1.2. General Conditions and Context

Sector and area specific conditions that are either favourable or affect adversely project implementation and the achievement of impacts are to be specified here. This includes particularly other donors' activities in the intervention area(s).

2. Methodology

2.1. Methodological specifications of the PUE Impact M&E module

It should be explained briefly why which module(s) has or have been chosen. In this section, it shall only be briefly referred to the module characteristics, (i.) identification strategy, (ii.) sampling method and (iii.) covered indicators that have been chosen for the project under examination.

2.2. Methodological modifications of the PUE Impact M&E module

In case adaptations to the module characteristics mentioned in 2.1 are deemed necessary by the implementer of the M&E activity, these shall be presented and explained here.

3. Implementation

This chapter shall include a table depicting the concrete sample size – if possible, specifying the number of different types of SMEs to be interviewed. The data collection and data analysis process shall be outlined supplemented by a time schedule defining what (task) is going to be done by whom (persons involved) with what (resources) by when (date).

Addenda

Addendum 1. Selected other M&E Guides and Literature

The 'Guide to Monitoring and Evaluation for Energy Projects' prepared by the international working group of M&EED (Monitoring and Evaluation in Energy for Development) in 2006 proposes a step by step approach to building project-specific monitoring and evaluation procedures for energy access projects while being more concerned with monitoring:
www.hedon.info/docs/MandEEDGuideFinalVersionEnglish.pdf

An extensive guide on 'Monitoring and Evaluation in Rural Electrification Projects: A Demand-Oriented Approach' has been compiled by the Energy Sector Management Assistance Program (ESMAP) in 2003. This approach intended to be both poverty and gender sensitive blends qualitative and quantitative techniques of participatory assessments and socio-economic impact surveys.
http://go.worldbank.org/JN30SKKFR0

Within the series 'Directions in Development' the World Bank published in 2000 a 'Handbook for Practitioners' on 'Evaluating the Impact of Development Projects on Poverty.' It is a comprehensive guide both delivering the methodological evaluation background and guidance on good evaluation practise.
http://go.worldbank.org/8E2ZTGBO10

The publication by the Network of Networks on Impact Evaluation 'Impact Evaluations and Development: NONIE Guidance on Impact Evaluation' (2009) contains an introduction into the theory and practice of rigorous impact evaluation. The first block is on methodological and conceptual issues while the second deals with managing impact evaluation and addresses aspects of evaluability, benefits and costs and planning.
http://www.worldbank.org/ieg/nonie/guidance.html

The book 'Impact Evaluation in Practice' published in 2010 is a comprehensive non-technical introduction to the topic of impact evaluation and its practice in development. The material ranges from motivating impact evaluation, to the advantages of different methodologies, to power calculations and costs. The book is geared specifically towards development practitioners and policymakers designing prospective impact evaluations.
www.worldbank.org/ieinpractice

Addendum 2. Sample Questionnaire, short enterprise survey
www.produse.org/m&e_guide_addendum2

Addendum 3. Sample Questionnaire, profound enterprise survey
www.produse.org/m&e_guide_addendum3

Addendum 4. PRODUSE Guidelines for Qualitative Interviews
www.produse.org/m&e_guide_addendum4

Addendum 5. Sample Data Entry Sheet, short enterprise survey
www.produse.org/m&e_guide_addendum5

Disclaimer

Following these links means leaving this guide and entering an external web link. The links provide additional information that may be useful or interesting and is being provided consistent with the intended purpose of this guide. However, we cannot attest to the accuracy of information provided by this link or any other linked site. Providing links to an external web site does not constitute an endorsement by the authors of this guide of the sponsors of the site or the information or products presented on the site.

References

Bamberger, M. (2010): Reconstructing Baseline Data for Impact Evaluation and Results Measurement. PREM Notes, Special Series on Nuts and Bolts of M&E Systems, No. 4, World Bank, Washington D.C.

Becchetti, L. and Costantino, M. (2008): The Effects of Fair Trade on Affiliated Producers: An Impact Analysis on Kenyan Farmers. World Development 36 (5): 823-842.

Becerril, J. and Abdulai, A. (2010): The Impact of Improved Maize Varities on Poverty in Mexico: A Propensity Score-Matching Approach. World Development, Vol. 38 (7), pp. 1024-1035.

Bensch, G. and Kluve, J. and J. Peters (2011): Impacts of rural Electrification in Rwanda. Journal of Development Effectiveness 3 (4): 567-588.

Estache, A. (2010): A Survey of Impact Evaluations of Infrastructure Projects, Programs and Policies. ECARES working paper 2010-005, Université Libre de Bruxelles, Brussels.

Gertler, P. J. and Martinez, J. and Premand, P. and Rawlings, L.B. and Vermeersch, C. M. J. (2010): Impact Evaluation in Practice. World Bank Publications. Washington, D.C.

GTZ – Deutsche Gesellschaft für Technische Zusammenarbeit (2007): Impact Monitoring Guide. Salvador.

Iarossi, G. (2007): The Power of Survey Design. A User's Guide for Managing Surveys, Interpreting Results, and Influencing Respondents. World Bank, Washington D.C.

IEA – International Energy Agency (2012): World Energy Outlook 2012. Paris.

IEG - Independent Evaluation Group (2008): The Welfare Impact of Rural Electrification: A reassessment of the costs and benefits. An IEG Impact Evaluation, World Bank. Washington D.C.

Kondo, T. and Orbeta, A. and Dingcong, C. and Infantado, C. (2008): Impact of Microfinance on Rural Households in the Philippines. Network of Networks on Impact Evaluation (NONIE) Working Paper No. 4.

King, G. and Honaker, J. and Joseph, A. and Scheve, K. (2001): Analyzing Incomplete Political Science Data: An Alternative Algorithm for Multiple Imputation. American Political Science Review, Vol. 95 (1): 49-69.

M&EED Group (2006): A Guide to Monitoring and Evaluation for Energy Projects. Monitoring and Evaluation in Energy for Development International Working Group. Retrieved from:
http://www.gvepinternational.org/sites/default/files/resources/MEED_Guide_final_version_english.pdf

Magnani, R. (1997): Sampling Guide. Food and Nutrition Technical Assistance Project (FANTA), Washington D.C.

Peters, J. (2009): Evaluating Rural Electrification Programs: The Methodology of Ex-Ante Impact Assessments. Well-Being and Social Policy, Vol. 5 (2), pp. 25-40.

Peters, J. and Vance, C. and Harsdorff, M. (2011): Grid Extension in Rural Benin – Micro-manufacturers in the Electrification Trap. World Development, Vol. 39 (5), pp. 773-783.

Ravallion, M. (2008): Evaluating Anti-Poverty Programs. Handbook of Development Economics, 4. Amsterdam.

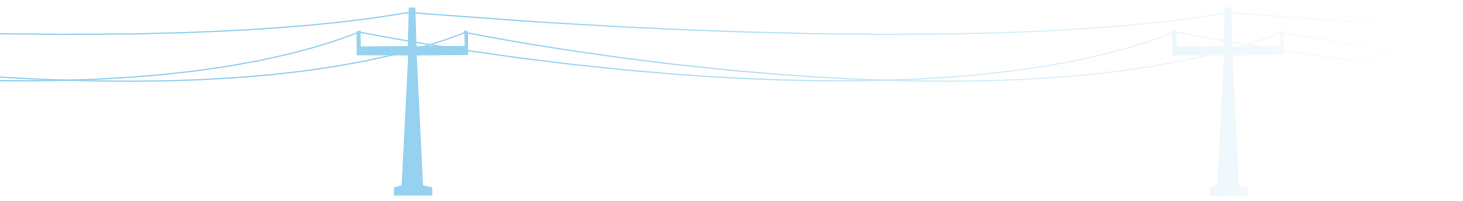
UN – United Nations (2005): The Energy Challenge for Achieving the Millennium Development Goals. New York.

UN – United Nations (2010): Energy for a Sustainable Future. The Secretary General's Advisory Group on Energy and Climate Change. New York.

Warwick, D. P. and Lininger, C. A. (1975): The Sample Survey: Theory and Practice. New York.

White, H. (2002): Combining Quantitative and Qualitative Approaches in Poverty Analysis. World Development 30 (3): 511-522.

Notes




BATTERY CHARGING
CALL: