2014:1 Sida Evaluation

Dolf Noppen

Evaluation of Sida financed interventions for increased access to Electricity for poor people

Drawing on international experience and case studies in Tanzania and Mozambique

Sida

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DRAWING ON INTERNATIONAL EXPERIENCE AND CASE STUDIES IN TANZANIA AND MOZAMBIQUE

Synthesis Report

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Evaluation of Sida financed interventions for increased access to Electricity for poor people, drawing on international experience and case studies in Tanzania and Mozambique.

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Abbreviations and Acronyms

AFD	Agence Française de Développement
AFREA	Africa Renewable Energy Program
AIDS	Acquired Immunodeficiency Syndrome (final stage of HIV infection).
ASC	Área de Serviço ao cliente (Customer Service Area – Mozambique)
BEST	Basic Electricity Support Tariff
CNELEC	Conselho Nacional de Electricidade (National Electricity Council – Mozambique)
COPD	Chronic obstructive respiratory disease
EDM	Electricidade de Mocambique
EDPG	Energy Development Partners' Group (Tanzania)
EIA	Environmental Impact Assessment
EPP	Emergency Power Plan (Tanzania)
EQ	Evaluation Question
ERAP	Energy Reform Access Project (World Bank)
ERT	Energizing Rural Transformation (Tanzania)
ESIS	Environmental and Social Impact Study
ESKOM	Electricity Supply Commission of South Africa (South African electricity utility)
ESMAP	Energy Sector Management Assistance Programme (World Bank)
EU	European Union
EWURA	Energy and Water Utilities Regulatory Authority (Tanzania).
FGD	Focus group discussions
FUNAE	Fundo de Energia (National Energy Fund) (Mozambique)
GDP	Gross Domestic Product
GEF	Global Environment Facility
GTZ	Gehschellschaf für Technische Zusammenarbeit (Now: GIZ – Gesellschaft für Internationale Zusammenarbeit)
GVEP	Global Village Energy Partnership

GWh	Giga Watt hours
HAP	Household Air Pollution
HCB	Hidroelectrica de Cahora Bassa (Mozambique)
HH	Households
HHE	Household Energy
HIV	Human Immunodeficiency Virus
IAP	Indoor Air Pollution
IBT	Incremental Block Tariff
ICT	Information and Communication Technology
IPP	Independent Power Producers
JC	Judgement Criterion
JESWG	Joint Energy Sector Working Group (Tanzania)
KFW	Kreditanstalt für Wiederaufbau, (Reconstruction Credit Institute, Germany)
kV/kW	Kilo volt/Kilo watt
kWh	Kilo watt hour
LDC	Least Developed Country
LED	Light-emitting Diode
LPG	Liquefied Petroleum Gas
M-Pesa, etc.	M-Pesa; M-Kesh; Tigo-Pesa; Airtel Money, etc; service providers with systems for transferring funds and paying bills using mobile phones.
MDG	Millennium Development Goals
MEM	Ministry of Energy and Minerals (Tanzania)
MIREME	Ministério de Recursos Minerales e Energia (Ministry for Mineral Resources and Energy), Mozambique
Motraco	Mozambique Transmission Company
Mozal	Mozambique Aluminium (supplied with electricity by MOTRACO, formed by the publicly owned electricity companies of Mozambique (EDM), South Africa (Eskom) and Swaziland (SEB) to deliver Mozal's power requirements)
MTR	Mid-Term Review
MW	Megawatt
MZN	Mozambique Metical
NERSA	National Energy Regulator of South Africa
NGO	Non-governmental organisation

Norad	Norwegian Agency for Development Cooperation
O&M	Operation and Maintenance
OECD/DAC	Organisation for Economic Cooperation and Development/ Development Assistance Committee
PARPA	Action Plan for Reduction of Absolute Poverty (English translation)
PPM	Pre-Paid Meter
PREPs	Priority Rural Electrification Projects (Tanzania)
PROBEC	Programme for Biomass Energy Conservation in SADC Countries
PRSP	Poverty Reduction Strategy Paper
PV	Photovoltaic
RBM	Results-based management
REA	Rural Energy/Electrification Agencies (Tanzania)
REB	Rural Energy Board (Tanzania)
REF	Rural Energy/ Electrification Funds (Tanzania)
REN	Redes Energeticas Nacionais (Portugal)
RET	Renewable Energy Technologies
RG	Reference Group
SADC	Southern African Development Community
SAPP	Southern Africa Power Pool
SEI	Stockholm Environment Institute
SEK	Swedish Kronor
SHS	Solar Home Systems
SIA	Social Impact Assessment
Sida	Swedish International Development Cooperation Agency
SIRG	Solar Industrial Reference Group (Tanzania)
SME	Small and Medium-scale Enterprises
SSA	Sub-Saharan Africa
SSMP	Sustainable Solar Market Packages (Tanzania)
SWER	Single Wire Earth Return
TANESCO	Tanzania Electric Supply Company
TAREA	Tanzania Renewable Energy Association
TEDAP	Tanzania Energy Development and Access Project (World Bank)

TJ	Teta Joule = 278 MWh or 278,000 kWh or energy content of approximately 27,400 m3 natural gas or 225 ltr diesel (petrol up to 10% higher)
TOC	Theory of Change
TSH	Tanzania Shillings
USD	US Dollars
WB	World Bank
WHO	World Health Organisation

Exchange rates

Currency exchange rates as at July 2013: 1 USD = 30 MZN = 1.594 TSH = 6.5 SEK

Executive Summary

Context

This evaluation analysed the contribution that rural electrification can make to poverty reduction. The context for the evaluation, and thereby also its limits, were defined by the evaluation period (2000 up to and including 2012), by the evaluation's prime focus on Sweden's own experience with the sector, and the fact that the four case studies were pre-defined in the evaluation's terms of reference and were all based on extensions of the national grid. Thus, for example, neither off-grid electricity systems nor individual solar home systems were included in the evaluation. Case study fieldwork was carried out in two countries with a long involvement with Swedish development assistance (Mozambique and Tanzania). The specific Sida experience with the sector was complemented by a review of global experience from programmes financed by other development partners.

With the overall purpose of further improving Swedish cooperation, the evaluation attempts to present conclusions and lessons in respect to what works, under what circumstances and why, to promote poor people's access to electricity and thereby contributing to better living conditions. The evaluation's Terms of Reference specify that Rural Electrification was expected to contribute to economic and social development, including improved delivery of public goods such as health services, education, water supply, information, business development and increased productivity. Moreover it was also expected to benefit the environment through a shift from polluting forms of energy (diesel, kerosene, petrol) to more environmental-friendly forms of energy.

This report synthesises a number of separate deliverables produced by the evaluation team within the framework of the evaluation. These are: an Inception Report; a Desk Review of Swedish and International experiences; and country case studies on rural electrification in Mozambique and Tanzania. All reports are available as stand-alone reports.

The evaluation was structured around the OECD/DAC's five standard evaluation criteria (relevance; efficiency; effectiveness; impact; and sustainability). These were used to formulate ten key Evaluation Questions to be addressed by the evaluation, on which its conclusions and recommendations are based.

The evaluation was carried out between January and December 2013.

Definitions

The evaluation links two key concepts that are central to the evaluation: namely "poverty" and "rural electrification". The evaluation's focus is "increased access to electricity for people living in poverty" and underscores the multi-dimensionality of poverty, with poverty not just relating to low income but also to lack of access to services and powerlessness. Poverty is a cross-cutting element in all the Evaluation Questions.

The term "rural" as it is used in the context of "rural electrification", follows the definition proposed in the evaluation's preparatory studies. Thus "rural" has been given a broader than usual definition to include also smaller towns and outskirts of cities/towns. Within this definition, the evaluation has distinguished three categories: (i) rural towns and peri-urban areas; (ii) rural villages and (iii) rural/rural, that is to say: isolated homesteads and farms, or clusters of homesteads outside villages. The case studies chosen for this evaluation fall into the first two categories.

Theory of Change

The evaluation's Theory of Change links interventions with desired impacts. The Theory of Change argues that for rural electrification to have an impact on poverty reduction, contextual factors need to be taken into consideration. These, together with complementary interventions need to combine with a series of electrification related outputs in order to have an impact not only in respect of poverty reduction but also on: (i) improved living conditions; (ii) increased rural income; and (iii) environmentally sustainable development which, together, are seen as stepping stones leading to poverty reduction.

The Theory of Change has identified four broad groups of beneficiaries of rural electrification: the public sector; the business sector; connected households; as well as non-connected households.

The last group is particularly important because the assumption must be that, in particular, it will be poor households that do not have household connections. The logic developed in the Theory of Change is that rural electrification needs to be placed within a broader *development* context, which includes positioning rural electrification within a broader *energy* context, thus also taking into consideration the fact that households – even those connected to electricity – continue to use bio-mass as a source of energy.

The Theory of Change underlines the importance of a reliable power supply as a motor for rural revenue generation but also acknowledges the fact that rural users are not able to meet the costs of extending the national grid to increasingly distant rural locations in full. Where there is a political objective to supply rural areas characterised by low population density, and with limited demands for electricity (low-load usage limited mostly to lights in the evening, TV and charging mobile phones) while maintaining tariff levels similar to those typically charged to urban consumers, a certain level of cross-subsidisation will be necessary. Increased productive use of electricity will, to some extent, offset the need for cross-subsidisation but never enough to maintain the financial integrity of a power supplier.

While the reflections contained in this evaluation are based on specific case studies, the aim has never been to evaluate the selected projects but rather to use the case-study projects as a tool for a broader understanding of rural electrification. Therefore the emphasis has been on learning from specific situations to look for ways forward, specifically on how to improve the conditions of people living in poverty. The conclusions, the issues highlighted, the lessons learned and the recommendations all have this objective.

Conclusions

There are two fundamental conclusions that have been advanced as a result of the research undertaken in this evaluation. The first is that households that are not connected can still benefit from electrification, either through non-tangible benefits resulting from the electrification of an area (the simple fact of bringing light), through increased rural income generation, and through better access to public services. The second is that an area-based multi-sectoral approach, where electrification interventions are an integrated element in the development process, provides a more appropriate strategy for improving the well-being of rural communities and

households than an isolated single-sector intervention, which assumes positive results from their interventions but, for the rest, remains outside the development process.

In this context, this evaluation argues that rural electrification needs to be seen as an integral element in an area (or district) economic and social development strategy, rather than an isolated "electricity" intervention for its own sake. Research shows that the best results for rural-electrification occurs when "electrification" is seen as a strategy that is positioned as part of a larger effort to develop a region or area.

The evaluation has shown that despite the fact that development partners' initiatives in rural electrification achieve their expected outputs, they rarely meet their higher-level outcomes. Therefore, also, there is evidence of missed opportunities, outside the direct scope of the development partner interventions in electrification (for example related to connecting health and education facilities) that would have contributed to improving the lives of people living in poverty.

Turning to the five evaluation criteria around which the evaluation was structured, the evaluation has concluded that:

1. Relevance

Sida's interventions specifically, and donor-financed support generally, were strongly aligned with stated national electrification priorities, but donor-financed programmes within the sector tended not to be specifically designed nor targeted to improve the conditions of people living in poverty. This was also a reflection of the policies and strategies at the start of the evaluation period that saw electrification principally as a pre-condition and facilitator for economic development. Increased impact on poverty reduction could be attained if development partners specifically targeted the poor and their needs rather than targeting a technical objective (such as the number of, for example, household connections). In this sense improved access to public services and increased employment opportunities (where also households without domestic connections can benefit) can do more to improve the lives of people living in poverty than a household connection that, maybe, they cannot really afford.

2. Efficiency

The decision to undertake rural electrification is almost always politically driven and is not undertaken as the result of the search for a positive return on investment. If a positive return on investment

should be the main criterion, it would be difficult to justify most rural electrification programmes. Nevertheless, cost-effectiveness can be improved by creating conditions for significantly increasing the number of connections, especially at the early stages of an electrification project, in order to build a revenue base to enable the project to be more cost-effective. Grid extensions remain the most efficient design for rural electrification, especially where large numbers of households and productive enterprises choose to connect, and where the generation and transmission/distribution capacity of the power utility is not compromised. Nevertheless, there will be a cut-off point where it will become cheaper to use off-grid sources to reach distant low-load communities

3. Effectiveness

Sida's expected intervention results for rural electrification at the *output* or induced output levels are generally achieved as planned and, with time, intervention connection targets tend to be surpassed. However, achieving higher-level *outcomes* and impacts depends not just on the number of connections achieved but on complementary interventions and contextual factors that are not generally built into the design of the interventions.

4. Impact

The impact of electrification on poverty is difficult to isolate from other factors and difficult to quantify, although electrification clearly plays a part in improving public services, in supporting private sector development and in creating a feeling of belonging to the rest of the world (lights in the streets, TV and radio, and the mobile phone are important but unquantifiable benefits contributing to this). It has been demonstrated that functioning education and health services have major positive spin-offs on quality of life for both connected as well as non-connected households. Measuring and attributing improvements is more difficult as electricity is only one factor linked to improving service levels which also include, for example, competent staff and supply of materials (e.g. school books; medicines, etc). Moreover, certainly for the Mozambique and Tanzania case studies, impacts are not district-wide but limited to those facilities connected to the distribution lines. To put this in perspective, for example in Mopeia District/Mozambique, only 2 primary schools out of 27 have been connected. The situation is similar in both the health and the education sectors in all the case study districts. The private

sector is in a similar situation needing both access to investment finance and marketing opportunities; but most importantly, for the private sector, access to a reliable and stable provision of electricity is a critical factor for any investment.

The critical assumption used by Sida and other donors when assessing the potential for electrification to improve living conditions in rural areas almost always includes the ability of national power utilities to generate and distribute a reliable power supply. While households and certain services can accommodate a situation where there are problems with power cuts and unstable power (kerosene lamps can always be used during a power cut; biomass continues to be used for cooking), the productive sector needs a reliable and constant supply of power. Development of the productive sector is dependent on this condition being met. Many intervention designs treat this assumption as an externality, but this evaluation has shown that weak generation capability and poor transmission/distribution systems seriously hinder the extent to which improved productivity can be attained. More recently, development partners are increasingly becoming aware of this important risk. There are a number of Sida funded interventions that target both strengthening the institutional capacity within the sector (the power utilities and rural energy agencies, the regulatory agency) as well as funding interventions to provide additional power generated and supplied to the grid. These interventions are not usually part of the same project agreement as a rural electrification grid extension programme but are equally important.

5. Sustainability

Even at the present levels of rural electrification, serious sustainability issues already exist. This is so both in relation to the capacity to produce and distribute sufficient good quality power, as well as the financial sustainability of utilities constrained by politically motivated tariff setting. Tariffs set at below cost-recovery levels combined with unacceptably high non-technical losses (chiefly unpaid bills) affects utility sustainability. The result is an inability to undertake adequate maintenance on the power system and an inability to plan ahead for capital infusion where needed. Within this context, increasing the number of rural connections can also be a blessing in disguise. While a large and increasing number of connections is an important element of cost-effectiveness, yet in a situation where tariff

levels are set too low this may also contribute to undermining the overall financial sustainability of the utility.

Electrification alone will not satisfy the energy needs of rural households that continue using biomass for cooking and for heating. This has environmental health impacts within the household, as well as not insignificant impacts on greenhouse gas emissions (estimated to be about 20% of global GHG emissions) as a result of the incomplete combustion of traditional cooking practices and unsustainable use of forest resources.

Key issues and lessons learned

This evaluation has argued that for rural electrification to have an impact on poverty reduction (what works, under what circumstances and why), the outputs resulting from electrification interventions need to be combined with other complementary interventions to arrive at the desired impacts. The evaluation has grouped these issues under a number of themes.

Area focus: It is not necessary for all households to be connected in order to benefit from electrification. Supporting the productive sector and public sector connectivity within an area will benefit all households. (Examples include increased financial viability and competitiveness of enterprises and thereby ability to provide productive employment; or health centres that are able to provide services after dark and attract and retain professionals.)

Tariff policies and payment policies: Subsidizing household connections and designing payment modalities for less well-off households can help to maximise the number of household connections and improve cost-effectiveness of a service area being connected. Notwithstanding, rural electrification will always need to be cross-subsidized by users at the higher end of the scale (the urban/industrial users). This is a choice that is politically completely justifiable, given the importance attached to rural electrification. However, setting political rather than economic tariffs and accepting high levels of non-technical losses (and impunity in the face of non-payment) will impact on the financial sustainability of the utility and, in consequence, also its obligations to its customers (e.g. reduced operation and maintenance).

Poverty impact: It is difficult to quantify poverty impact but the evaluation has shown a series of non-tangible benefits (the "feel-good" effect of bringing light) and the widespread acceptance of mobile

phone technology (made possible by the nation-wide expansion of base stations and the possibility to recharge phone batteries). Public services in the rural electrification service areas close to the distribution lines have improved their service to the public (educational and health facilities) and the private sector, notably restaurants, shops and bars, with electrification value-added (lights, refrigeration, entertainment) can both stay open longer and provide employment spin-offs. Both case study areas suffered from power cuts and quality of supply. This restricts development of enterprises in the productive sector that depend on a stable 24/7 supply; but such enterprises would also have needed a product to transform (grain to flour; timber to planks, etc.), markets to supply and access to investment credit. For this reason, quantification of electricity's poverty impact is problematic in a situation where it is difficult to isolate electricity as a single cause in a development process, where many public institutions were not connected, where poor quality electricity discouraged private sector development and where there was virtually no overall national or local change in poverty indices during the evaluation period.

The broader energy context: At the household level, this includes the continued use of biomass by both connected and non-connected households for cooking and heating. The continued use of biomass has both gender and environmental impacts. Continued use of kerosene (by non-connected households and as back-up by connected households) has environmental health impacts as a result of indoor air pollution. Small-scale solutions at household level are becoming more accessible as solar home technology and improved cookstoves are becoming more affordable and more acceptable.

Gender: Outside the home, women benefit proportionately more than men from improved public services (especially related to women's health, education and safety). Inside the home, changed cooking and lighting practices can have major positive health impacts on women's health.

Environment: Electrification has had virtually no impact on biomass use. Continued use of biomass in cooking has serious environmental health implications that can be addressed by improved cooking practices. Improved cooking practices that decrease total biomass requirements, can also be assumed to have a positive effect on the forest resource. However there are positive local environmental effects from replacing existing stand-alone diesel systems supplying a local grid, with a connection to the national grid providing "cleaner" power.

Management levels: Finding the lowest appropriate level links with the area focus issue. The evaluation observed the negative aspects of too much centralisation, as well as the challenges of making local authorities effective partners (planning capacity, financial resources).

Recommendations (grouped by sub-headings)

It is *recommended* that:-

Area based approach.

1. An area-based approach is followed when developing rural electrification and rural energy programmes, and that this approach is inspired by planning and decision making methodologies, such as those developed as part of the Strategic Environmental Assessment toolbox.

Public Institutions

2. When rural electrification programmes are planned priority focus should be on making sure that key public institutions are connected and that this be done proactively. This should include connections, meters, internal wiring and, where relevant, electrical equipment.
3. During the planning phase, local authorities and key public institutions (connected as per previous recommendation) are assisted to prepare budgets to ensure that funds for recurrent expenditures can be accessed, so that the real consumption costs for electricity use can be met through the appropriate budgets – even if this includes elements of user payment.

Manufacturing, small industry

4. As part of the planning phase, the potential for supporting the development of productive activities (agricultural processing, irrigation, small-scale manufacturing, etc.) and small-scale enterprises is assessed, and a sufficient and reliable supply of energy is put into place to allow the private sector to connect and expand.
   A parallel system of credits or micro-credits could be included to help productive enterprises in this regard.
5. An assessment is made of the productive potential of an area so that when plans are made to electrify that area, parallel support activities and services to allow enterprises to develop are also mobilised.

Targeting improved household access

6. A national contextual package of financial support to enable more households to access electricity is prepared, with the

objectives of making connection costs and low-load electricity for poorer households affordable, while supporting efforts to develop a sustainable institutional model based on decentralised decision-making (where appropriate), realistic tariffs (instead of political tariffs) and national technical standards.

Improved development partner coordination and institutional support

7. Sida continues to actively broaden its energy agenda in development partner working groups and joint energy sector working groups to specifically include *all aspects* of rural energy provision, including a focus on the strengthening of institutions dealing with rural energy and rural electrification, as well as the national transmission system and generating capacity.
8. Sida seeks complementarity with other development partners in order to develop more comprehensive programmes that include, for example, electrification and energy, forest resource management and the fuelwood value chain, SME development, education and health sectors, governance and decentralisation, etc.
9. Sida continues to provide institutional support to ensure that potential partner institutions (e.g. national utilities, power producers and suppliers, specialised energy agencies) develop the means to sustain their roles subsequent to the exit of the development partner.
10. In line with national development priorities, Sida assists national governments with an analysis of the rural electrification gaps on the map and the development of strategies to also connect these areas on a sustainable basis, potentially through other means than grid extensions.
11. Better monitoring systems be developed but these should focus more on outcomes and impacts while not neglecting better output monitoring.

Broader energy sector focus

12. Sida expands its focus within the energy sector to also focus on household energy in the broadest sense, including energy options for households that will not be connected to grid electricity;
13. Sida seeks synergies within its own organisation, within the broader energy field in Sweden, as well as by drawing on more strategic work with multilateral organisations and research institutions to enhance its work in the energy field.

1 Introduction

Sweden's international development cooperation aims to support poor people's own efforts to improve their quality of life. Sweden also has a history of long-term commitment to rural electrification as an intervention necessary to contribute to the achievement sustainable development. This evaluation combines these two elements with, as an expected outcome, the formulation of a number of conclusions and recommendations to support the formulation of guidelines for the sector.[1] As stated in the Terms of Reference, the objective of this evaluation is: "to present conclusions and lessons in respect of what works, under what circumstances and why, to promote poor people's access to electricity and thereby contribute to better living conditions".

This evaluation – with an evaluation period covering the period 2000 up to and including 2012 – was carried out within the framework of Sida's commitment to poverty reduction with, as mandate, to analyse *the contribution that rural electrification can make to this*. The Terms of Reference specify that Rural Electrification is expected to contribute to economic and social development, including improved delivery of public goods such as health services, education, water supply, information, business development and increased productivity. Moreover it is expected to benefit the environment through a shift from polluting forms of energy (diesel, kerosene, petrol) to more environmental-friendly forms of energy.

This report synthesises a number of separate deliverables produced by the evaluation team within the framework of the evaluation, with each deliverable being a stand-alone output. These are: (i) the *Inception Report* which outlines the approach taken, the Evaluation Questions around which the evaluation has been structured, and a number of preliminary findings and issues; (ii) the *Desk Review*[2] and

1 Reference is made to the Terms of Reference for this evaluation – see Annex 1.

2 *Desk Review Report* on Sida experiences with Rural Electrification in Selected Countries and Global Experiences from Programmes financed by other Development Partners. (August 2013)

(iii & iv) the country case studies on rural electrification in *Mozambique* and *Tanzania*, based on fieldwork carried out in a number of pre-defined areas[3] as well as relevant documentation and stakeholder interviews.[4] The scope of the evaluation was circumscribed by the pre-defined choice of both country and case study, and by the fact that the designated case studies were all grid extensions.[5]

The evaluation was structured around the OECD/DAC's five standard evaluation criteria (relevance; efficiency; effectiveness; impact; and sustainability).[6] These were used to formulate ten key Evaluation Questions (EQ's) to be addressed by the evaluation, on which its conclusions and recommendations are based. The Evaluation Questions are the framework around which the evaluation is based. Thus the Desk Review is structured using the Evaluation Questions; as are the two country reports.

During the Inception Phase, a number of judgement criteria, indicators and research actions were defined for each Evaluation Question. The data so gathered and structured provides the inputs to answer the Evaluation Questions in this Synthesis Report.[7] The Desk Report and the Country Case Studies are all structured around the same ten Evaluation Questions. Hence, as well as functioning as reports in their own right, these reports also serve as supporting stand-alone annexes to this Synthesis report – thus allowing for a shorter and more accessible Synthesis report.

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3 The case studies covered two projects in *Mozambique* (Ribaue/Iapala rural electrification, Nampula Region – 1997–2000, and Morrumbala rural electrification, Zambézia Region – 2001–2004); and two projects in *Tanzania* (Grid extension in Serengeti District – 2003–2008; and Makambako substation and network expansion in Njombe District – 2004–2007).

4 The areas where fieldwork was to be carried out were defined in the Evaluation's Terms of Reference and are areas where Sida has implemented grid extension rural electrification projects (all of which were completed and handed-over).

5 Other technical options such as isolated grids (whether stand-alone diesel or mini-hydro), photovoltaic, wind, etc., all fell outside the immediate scope of the evaluation.

6 Ref OECD/DAC: http://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm, plus the discussion in the Inception Report.

7 The Inception Report provides the theoretical foundation for the Evaluation; whilst the Desk Review and the Country Reports provided the quantitative and qualitative data annexes to the Synthesis Report. This data is drawn on rather than repeated.

This report opens with a discussion of the evaluation framework and the evaluation's Theory of Change; moving on to the global context of rural electrification (drawing on the Evaluation's *Desk Review*) and then a brief country context (drawn from the Tanzania and Mozambique *Country Case Studies*), before proposing responses to the Evaluation Questions (Chapter 5). These responses form the basis for Issues, Conclusions and Recommendations (Chapters 6, 7 and 8). Finally the report contains a series of annexes: the terms of reference (Annex 1); the Evaluation Questions/Judgement Criteria matrix (Annex 2); Methodology (Annex 3) and finally a series of data annexes.

The evaluation was supported by Reference Groups in Mozambique and Tanzania (drawing participation from national stakeholders), and an overarching Reference Group, overseeing the whole evaluative process. The Sida Evaluation Office in Stockholm managed the entire evaluation process. The reference groups and the national stakeholders played an important role throughout the process, particularly enriching country case study findings through commenting on the fieldwork results in case study areas; but also adding additional data and more recent developments not covered by the pre-selected case studies (including more information with respect to, for example, renewable energy and tariff policies).

2 Evaluation Framework

2.1 DEFINITIONS

Two key concepts need to be clarified, as they are central to this evaluation. Namely what is understood by "*poverty*" and what is covered by "*rural electrification*". The focus of this Evaluation is increased access to electricity for people living in poverty – and argues for a definition which embraces the multi-dimensionality of poverty. The poverty definition as formulated (in 2005) by Sida focuses on its multidimensionality, as follows: "A multidimensional definition of poverty acts as a guide for Swedish developmental cooperation. Poverty is not just a case of low income, but also a lack of access to health care, schools and social security. Other factors include exposure to violence, injustice, and powerlessness and uncertainty in the face of unexpected situations like sickness, accidents and natural catastrophes." For the purposes of this evaluation it is the *multi-dimensionality of poverty* that is emphasized and, as such, the focus on poverty is a cross-cutting element in all the Evaluation Questions.

In the same way it is important to reflect on the term *rural* as it is used in the context of the term "rural electrification", and as it will be used in this evaluation. Following on from the definition proposed in the preparatory studies, "rural" has been given a broader than usual definition to include also smaller towns and outskirts of cities/towns. "Rural areas" are characterised by a comparatively low share of users who have access to modern energy services and that a suppressed demand for such services are found in the area.[8] Notwithstanding the above, the evaluation has noted a number of sub-categories within the overall definition of "rural" which will be important when arriving at conclusions. Briefly we can distinguish between: (i) rural towns and peri-urban areas; (ii) rural villages; and (iii) rural/rural, that is to say: isolated homesteads and farms, or clusters of homesteads outside villages. The case studies chosen for this evaluation fall into the first two categories. In fact, there is not

[8] Reference is made to Ann Kämpe: *Preparatory Desk Study on the concepts of rural and access* (2011).

much data on the rural/rural category apart from a couple of studies cited in the Desk Report, mostly because rural electrification interventions have had difficulties in electrifying the most poor and the most remote.[9]

Finally it is useful to distinguish between *electrification* and *energy*. In many electrification reports, both terms are frequently used synonymously, interchangeably and incorrectly to refer to electrification. Energy is a much broader concept, including traditional biomass, etc. In fact, for example in Tanzania, the *electricity* sub-sector contributes to less than 2% of total *energy* consumption, with almost 90% of current energy use met by traditional biomass (woodfuels).[10] The situation in Mozambique is similar.

2.2 THEORY OF CHANGE

The evaluation's Theory of Change links interventions with the desired impacts and is shown in diagrammatic form on the next page. The Theory of Change builds on the work done by development partners such as the World Bank's Energy Sector Management Assistance Programme (ESMAP),[11] arguing that the cross-sectoral cooperation is necessary to contribute maximising the productive uses of electricity, to supporting socio-economic development, and to improving the lives of people living in poverty. The Theory of Change argues that for rural electrification to have an impact on poverty reduction contextual factors and complementary interventions need to combine with a series of electrification related outputs in order to have an impact on (i) improved living conditions; (ii) increased rural income and (iii) environmentally sustainable development which, together, are seen as stepping stones leading to poverty reduction.

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9 For example: *State and People, Central and Local, Working Together: The Vietnam Rural Electrification Experience*. IBRD/WB, 2011. An interesting observation in the light of the rural/rural situation is that: *"In 2008, 100 percent of the households in the one remaining unelectrified commune expressed a desire to be electrified; however, of unelectrified households in electrified communes, the proportion who desired electrification was somewhat lower at 76 percent"*.

10 Source: SEI, 2012. Sustainable Energy Markets in Tanzania.

11 Gouvello & Durix, 2008.

The Evaluation Questions[12] which this evaluation seeks answers relate to the Theory of Change, and cover the five principal OECD/DAC evaluation criteria, as well as Sida's cross-cutting evaluation criteria.[13]

The Theory of Change has identified four broad groups of beneficiaries of (rural) electrification: the public sector; the business sector; connected households *as well as non-connected households*. The last group is particularly important because the assumption must be that, in particular, it will be poor households that do not have household connections.

In the Theory of Change, rural electrification interventions are put into a broader *development* context, specifically drawing in programmes that are designed to provide a direct impact on livelihoods and revenue generation – and where linking up to a reliable power supply is an important input into increased rural income generation. The theory of change also places rural electrification within a broader *energy* context – thus taking into consideration the fact that households – even those connected to electricity – continue to use bio-mass for cooking and space heating.

Key issues which were taken into consideration when elaborating the Theory of Change were:

- That even households that are not connected can benefit from rural electrification, for example through better public services, an improved business/employment sector and benefits provided from neighbours who are connected. Non-connected households are also more likely to be "people living in poverty" and therefore *non-connected households are one of the principal groups of beneficiaries on which the fieldwork will focus.*
- The dynamics and conditions helping or hindering the transition from non-connectedness to connectedness, such as: system capacity constraints; availability of technical solutions; financial

[12] An initial series of Evaluation Questions was contained in the Evaluation's Terms of Reference prepared by Sida and included in the Evaluation's Terms of Reference (see annex 1); these were modified, adjusted and the revised text agreed on during the Inception Period. The final evaluation questions with their judgement criteria are included as Annex 2.

[13] The additional cross-cutting criteria incorporated into the Theory of change are: Participation & Human rights; Partnership; Gender equality; Environmental sustainability; Internal complementarity; and External complementarity.

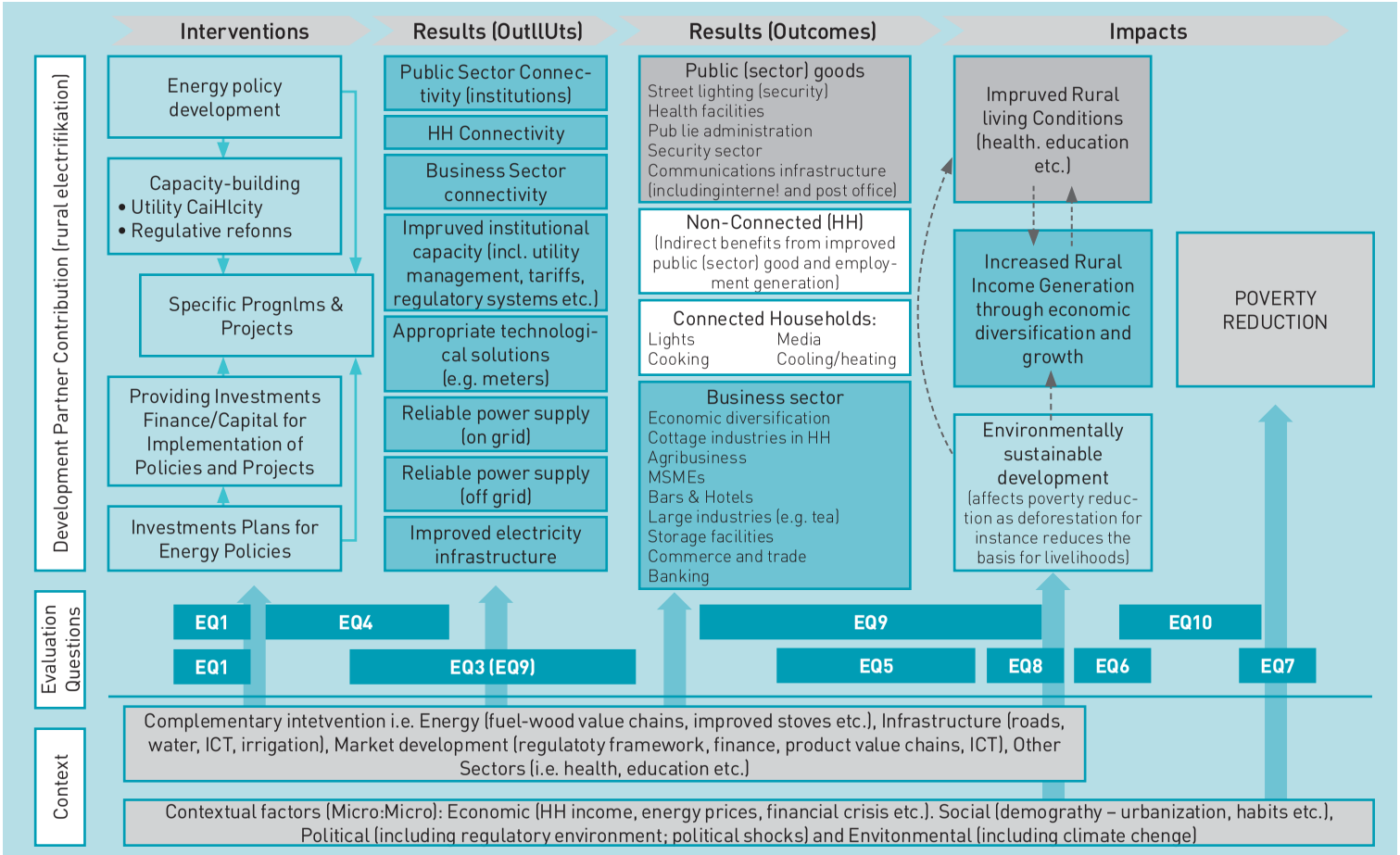

Figure 1 Theory of Change

barriers (connection costs, tariffs and subsidies, credit, cost of appliances, etc.)

- Impact of electrification on "environmentally sustainable development" at the household level (such as replacement of kerosene and biomass) and at the grid level (replacement of isolated diesel systems with a connection to the national grid).

3 The Global Context of Rural Electrification

3.1 FINANCIAL, TECHNICAL AND INSTITUTIONAL CHALLENGES

Providing access to electricity remains a global development challenge. Electricity remains particularly unreliable and scarce across most of Sub-Saharan Africa but with major access variations between urban and rural settings; thus while 60% of the urban population have access, this figure lies at just in 14% in rural areas.[14] Notwithstanding national differences in socio-economic development and geography, the basic challenge of providing rural electrification remains the same – it is expensive to provide electricity to isolated and scattered populations living at a distance from major electrified urban centres (and the greater the distance, the greater the expense). Thus, while the productive and economic development outputs resulting from electrification can be expected to remain relatively modest, the capital investment costs per connection are extraordinarily high. Resource allocation frameworks for rural electrification will need to take into consideration the fact that connecting areas where the load is expected to be low and connection costs high, *will always entail elements of subsidy and the users are unlikely to be able to fully match the costs of a sustainable supply*. Moreover, expansion of the grid within a situation where utilities are already making losses and tariffs are not cost-reflective (which is the case in both Tanzania and Mozambique) will further deteriorate the financial situation of the utility, and impact on system maintenance and replacement.[15]

Institutional challenges are additional important elements. The point made by Gaunt[16] is pertinent here, as it appears to apply to

[14] Figures quoted in the Desk Review and drawn, amongst other, from Kämpe, 2011. Note also that these overall Sub-Saharan Africa figures hide national variations.

[15] A conclusion supported by the NORAD-financed *Impact assessment of Rural Electrification in Mozambique*. (Norplan, October 2013)

[16] Gaunt, C. T. Electrification Technology and Processes to meet Economic and Social Objectives in Southern Africa. 2003. (Ph.D. Thesis – Dept. of Electrical Engineering, University of Cape Town.

both Tanzania and Mozambique, and many other Sub-Saharan African countries:

> *"Electricity distribution utilities that are already experiencing massive problems with inefficiency, financial losses, poor quality of supply and service, a backlog of network maintenance and rehabilitation, and inadequate staffing cannot be expected to undertake system expansion effectively, without making existing conditions even worse and incurring high economic costs for the country as a whole*". (Gaunt, 2003. p. 231)

Within this context, rural households and many, if not most, urban households in Sub-Saharan Africa continue to use "traditional" energy sources.[17] The transition from traditional biomass to full dependence on modern energy forms is a complex process. Households do not simply substitute one fuel for another as income increases, as was previously assumed, but rely instead on multiple fuel use[18] with modern energy services applied sparingly at first for particular uses only – e.g. use of electricity for lighting, radio and television, and charging cell phone batteries, or use of Liquefied Petroleum Gas (LPG) for making tea or coffee. Replacing irons using charcoal with electric irons, and purchasing electric rice cookers, are examples of early choices where, for those who can afford the cost of the appliance, life is made easier. These choices also depend on marketing chains that are capable of delivering reasonably priced appliances of reasonable quality consistently, coupled with a reliable and constant power supply.

Poor households have little disposable income and resources are prioritised to cover basic needs. Poor households' survival strategies have always depended on risk spreading. Therefore, even in a situation where electricity is available, multiple fuel use will remain as the most sensible option for poor households. Even resource strong households will follow the same pattern in situations where power supply is unreliable, power cuts are frequent, utilities have governance challenges, system capacity is inadequate, etc. Thus, electricity will be used primarily to replace basic lighting (switching from

[17] This applies not only to Sub-Saharan Africa. The IBRD/WB study noted that even in Viet Nam with its over 90% rural electrification coverage, and despite purchase of rice cookers (after colour TV and fan), *fuelwood and kerosene expenditures have only declined slightly* (p. 46/47). However, there is a definite advantage linked to the fact that Vietnamese eat rice and that it is easier to cook on a rice cooker. Notwithstanding this, multiple fuel use remains the household energy strategy.

[18] Also termed "fuel stacking" – see Kämpe, 2011.

kerosene and batteries to light bulbs) knowing that well-tried back-ups systems still exist (the old lamps, torches and candles).[19]

The bulk of the electricity available to rural areas has mostly been through extensions of the national grid – but the overall and per unit cost of these extensions becomes even more prohibitive as attempts are made to reach the more remote locations with fewer people, and smaller and more scattered settlements. This is coupled with the fact that existing system capacity, in many cases, does not even meet present system demand in areas already connected, and that the cost of increasing system capacity needs to be added to the costs of grid expansion. A complementary strategy has been to electrify administrative centres with stand-alone systems – normally diesel-based – but these rarely generate sufficient capacity to provide more than the most basic lighting services to government offices and a select number of government officials and the local elite living in the expensive part of the (rural) town. Mozambique, which has its main grid transmission lines emanating from Hidroelectrica de Cahora Bassa (HCB) near Tete, moving south to link in with the Southern African Power Pool (SAPP), is attempting to extend the grid to cover at least all the countries' administrative centres, providing a low-load supply sufficient to cover not much more than the most basic lighting services. Technical problems linked with low loads and long (transmission/distribution) line lengths can also cause voltages to rise at the end of the line (the "Ferranti effect").[20] This was commented on in the Mozambique Impact Study, which also concluded that: "eventually it becomes cheaper to use off-grid sources of supply to reach distant communities".[21]

The choice made by Vietnam[22] illustrates that successful rural electrification is based, first and foremost on a *long term* holistic commitment to invest not only in *infrastructure* (expansion of both the national grid as well as generating capacity, and harmonisation of national technical standards), but also in *governance* aspects (institutional capacity, local accountability, culture of payment plus

[19] See also: Ahlborg 2012, p. 8.

[20] The Ferranti effect is an increase in voltage occurring at the receiving end of a long transmission line, above the voltage at the sending end. This occurs when the line is energized, but there is a very light load or the load is disconnected. The Ferranti Effect will be more pronounced the longer the line and the higher the voltage applied.

[21] Norplan, 2013. pp. 27–28.

[22] IBRD/WB. 2011. *Vietnam. State and People, Central and Local, Working Together. The Rural Electrification Experience.*

a focus on technical and non-technical loses) as well as a focus on *affordability for poor* households through lifeline tariffs supported through cross-subsidisation.[23] As noted in the Vietnam study, it is difficult for development partners to make long-term commitments both to a country and to a sector. This puts the onus on national governments to provide the long-term focus and commitment.

The energy sectors in developing countries have traditionally been dominated by state-owned utilities and characterised by heavy regulation. In recent decades, efforts to de-regulate energy markets have been undertaken globally.[24] A number of African countries have turned their electricity utilities into corporations (parastatals). Other countries (incl. Kenya, Nigeria and Zimbabwe) have commercialised their power utilities or, as in some African countries such as in South Africa, Tanzania and Uganda, introduced private sector involvement in the energy sector (Independent Power Producers, IPPs), which are allowed to own electricity production plants and to sell the electricity to the government-owned utility. Other forms of commercialization include the introduction of a *contract management* form, which has become a common feature, particularly in West-African countries. Most of these contracts involve an agreement through which the operational control of a company or part of a company is delegated to an external operator, while the host company remains the owner of installations and, in principal, retains control.[25]

In addition, although semi-independent regulatory organisations have been created as part of ongoing reforms in the power sector (EWURA in Tanzania, CENELEC in Mozambique, or NERSA in South Africa, etc) tariffs are often politically set and tend not to focus on sustainability of the sector, nor on increasing infrastructure and generating capacity, but rather on short-term political gains linked to a perceived popularity index in the context of elections. The Tanzania example is a good illustration of this where a recent study has shown that the level at which tariffs are set means that all consumers are actually subsidized (not just poor households) and that TANESCO continues to make a loss and does not generate enough funds to

[23] Source: IBRD/WB, 2011. Note that even with an increase in coverage from 2.5% in 1975 to 96% in 2009, there is a continued dependence on multiple fuel use where fuelwood and kerosene expenditures have only declined slightly (p. 46/47).

[24] World Bank, 2005.

[25] Source: Ilskog 2008: p. 18.

cover neither ongoing operation and maintenance, nor investments.[26] The situation in Mozambique is similar. EdM tariffs are also far from cost-reflective, with domestic and social tariffs being the furthest away from cost-reflectiveness, and where every new rural connection contributes to increasing the overall financial loss.[27]

3.2 SIDA IN THE SECTOR

Sida has been involved in electrification activities dating back over more than 20 years. Since 1997, Sida has financed many rural electrification projects in Africa and Asia, totalling roughly SEK 2 billion, with SEK 296 million in the form of credits.[28] The overarching focus of Sida´s support to rural energy has been "access to modern energy services" i.e. provision of electricity.

Over the years Sida has gradually shifted from more or less isolated project support to more programmatic support through (sometimes pooled) funds managed by Rural Energy/Electrification Agencies (REA). Sida has actively supported the establishment and capacity development of REAs in Uganda, Zambia and Tanzania.
In terms of *technology* the support has, to a large degree, targeted grid extension. Only in Vietnam has Sida support been exclusively directed towards off-grid technologies (photovoltaic). In respect of institutional support within the sector, Sida has tended to focus on the national utility, although this has seen a shift in recent years away from an exclusive focus on the utility towards a broader support that also encompasses, for example, cooperatives and the private sector. In the last decade focus has increasingly shifted to also include increased support to capacity building. *Capacity building* is mostly concerned with strengthening the national ability to plan, implement, operate and maintain electricity supply systems. Most capacity-building support has been directed towards improving policy development, utility management and community level participation, while local government and the private sector has received little attention.

In parallel to its direct support to (rural) electrification, Sida also channels funds into renewable energy, into research and into the private sector. This includes a number of activities more broadly related

[26] Source: Millennium Challenge Account. *Consulting Services for Electricity Access Scale-up and Subsidy Policy Study.* January 2013.
[27] Norplan, 2013. p. 25.
[28] The Sida rural electrification portfolio is contained in Annex 3 of the Desk Report.

to rural *energy*, frequently in the same countries where Sida also has rural *electrification* programmes. There appears to be an opportunity to integrate lessons learned from other Sida programmes into rural household energy needs.

Sida is also involved in a number of multi-donor programmes in the energy sector, where core funding is provided by Sweden and by other development partners. The following multi-donor programmes active in the energy field, in the broadest sense, are being implemented in most of Sida's programme countries; and many have also received programme/project support or core funding from Sida at one time or another.

Table 1 Multi-donor programmes in the Energy Sector

The Energy Sector Management Assistance Programme (ESMAP):[29] ESMAP is a global technical assistance programme administered by the World Bank. The ESMAP mission is to assist low and middle-income countries to increase know-how and institutional capacity to achieve environmentally sustainable energy solutions for poverty reduction and economic growth.

Energy Reform and Access Program (ERAP):[30] The main goal is to expand access to electricity through grid intensification and renewable energy development in peri-urban and rural areas.

Energy Development and Access Project (EDAP):[31] EDAP includes: network transmission efficiency improvement; rehabilitation and reinforcement of the primary network; and extension of distribution networks and customer connections.

Energy Development (EnDev):[32] EnDev promotes grid densification, photovoltaic (PV) systems and micro hydropower schemes to improve access to electricity. The primary aim of grid densification was to facilitate access to electricity services to as many poor peri-urban households as possible.

[29] World Bank and a number of European countries provide funding to ESMAP.

[30] ERAP is active in Mozambique where IDA, GEF, NDF and GoM provide funding.

[31] The World Bank funds EDAP.

[32] Funded by Germany, the Netherlands, Norway Australia, UK, Switzerland, Ireland and EU. GIZ and the Dutch Ministry of Foreign Affairs cooperate on programme management.

3.3 LONG-TERM COMMITMENT AND FINANCING

Development partners continue to be main players in (rural) electrification in particular and in the energy sector in general, with both positive and negative impacts. Thus, an EU study observed that rural electrification in Tanzania presently relies heavily on government and donor finance with private sector participation remaining a limited option, and recommended that new ways of finance should be explored, particularly accessing concessionary loan finance from foreign export/import banks (EXIM) and strengthening the microfinance sector at the local level (EU 2008).

Furthermore, Winther[33] observes that dependency on external funding impacts the budgeting and planning process negatively, as government development plans take on the form of "wish-lists". Donors are criticized for not coordinating with one another, thus creating unnecessarily heavy workloads for domestic actors. This situation is, however, improving as development partners increase their levels of coordination post Paris Declaration through, for example, energy sector working groups.[34]

Winther also points to the predicament that donor funding comes with time constraints that endorse short-term thinking, while experience from other countries shows that rural electrification is a long-term investment that takes decades to implement even in the wealthiest countries (Winther 2008). While Winther's comments relate specifically to Tanzania, the same conclusions also hold true elsewhere, where the experience from Vietnam shows the value of holding on to a long-term national vision and commitment.

[33] Winther, 2008. Empowering women through electrification: experiences from rural Zanzibar.

[34] Sida been a strong partner in energy sector working groups in both Tanzania and Mozambique, as well as lead donor in the sector. See also the Paris Declaration on Aid effectiveness. http://www.oecd.org/dac/effectiveness/parisdeclarationandaccraagendaforaction.htm

4 Country context for Rural Electrification in Mozambique and Tanzania

The two country case studies forming part of this evaluation follow a similar structure to the Synthesis Report allowing for cross-referencing of information. Nonetheless a certain level of information about the two countries is deemed relevant as background information also in this report. Thus context information on the economy and institutions, and the energy situation is provided in the annexes together with an overview of ongoing initiatives to overcome the serious energy generation challenges faced by each country – colloquially called "mega projects". The country context is contained as Annex 5, with Annex 4 containing the maps of the Mozambican and Tanzanian national grids.

This section will restrict itself to an overview of Sida involvement in the sector during the evaluation period. Nonetheless it is worth noting that both Tanzania and Mozambique experienced high rates of economic growth over the last decade (including the evaluation period) and are today among the world's fastest growing economies.

4.1 SIDA SUPPORT (MOZAMBIQUE)

All Sida supported rural electrification projects studied as part of this evaluation are based on extensions of the national grid, supplied by hydropower, and implemented by the national power utility Electridicade de Mozambique (EdM). Sida has also engaged in multi-donor financing of rural electrification interventions – notable with Norway and with Denmark. Sida has as part of other projects supported the formulation and/or updating of energy generation, transmission and distribution master plans. Sida's financing has been on a grant basis to the Government of Mozambique (GoM), which on-lends to the investment funds to EdM.

As part of the present evaluation, quantitative and qualitative fieldwork was carried out in Ribáuè district and Morrumbala district.

Table 2 Sida financed rural electrification projects in Mozambique between 1997 and 2010

	Project period	Approved financing (in MSEK)
Napula province, Ribáuè district:	1997–2000	51.0
Zambezia province, Morrumbala district:	2001–2004	47.0
Niassa province, Gurué-Cuamba-Lichinga transmission line and local distribution networks.	2001–2006	120 + 189 MNOK
Sofala, Manica and Tete provinces: Extension of the national grid	2003–2010	204.1 + 33.5 MDKK + 50.0 MNOK
Niassa province, Mechanhelas, Meterica, Maua and Marrupa districts: Extension of the national grid from the substation in Cuamba	2005–2011	52 + 41 MNOK
Source: Kämpe, 2011		

4.2 SIDA SUPPORT (TANZANIA)

Sida is one of the highest contributing development partners to the energy sector in Tanzania and has, in recent years, funded a number of rural electrification projects. Sweden's commitment in the energy

Table 3 Sida financed rural electrification projects in Tanzania 1985–2010

	Project period	Approved financing (in MSEK)
Serengeti rural electrification	2003–2008	50.0
Urambo rural electrification	2003–2007	50.0
Ukerewe rural electrification	2005–2008	30.0
Simanjiro rural electrification	2006–2008	27.0
Makambako-Njombe rural electrification	2004–2007	48.0
Makambako-Songea (credit 226 MSEK)	2008–2012	504.0
PV Market Development	2002–2007	27.0
Rural Energy Agency TA	2008–2013	14.0
Rural Energy Fund (pooled funding)	2010–2013	203.0
Source: Kämpe, 2011		

sector was SEK803.9 million for the period 2006–2010; this is an increase of 133% compared to the previous period (Sida 2010: p. 29). Sweden has been the largest donor in that period and its assistance rests on three pillars: institutional support, rural electrification and renewable energy. The Rural Energy Fund pools funds from Government contributions, from levies and from development partners (where Sida has been a prime mover).

As part of the present evaluation, quantitative and qualitative fieldwork was carried out in Serengeti district and Makambako-Njombe.

5 Answers to the Evaluation Questions

This section contains the responses to the ten evaluation questions based on the data synthesised under their respective judgement criteria, and includes references to the source of the data (e.g. Inception Report; Desk Study; Tanzania Case Study; Mozambique Case Study); and an indication of where in the document the issue is discussed (e.g. Desk Study, EQ3). The function of the judgement criteria is to provide the basis for answering the evaluation questions and to structure the analysis process. The complete Evaluation Questions and Judgement Criteria matrix is included as Annex 2.

For ease of reference, the Evaluation Questions have been grouped under the respective evaluation criteria of: 1-Relevance; 2-Efficiency; 3-Effectiveness; 4-Impact; and 5-Sustainability. These criteria provide this chapter's five sub-headings. The evaluation questions pertaining to each evaluation criterion are then introduced by a short heading, which contains the essence of the question.

The original numbering of the Evaluation Question and its respective judgement criteria have also been retained, to allow for ease of cross-referencing with: the Theory of Change (where each Evaluation Question relates to elements within the Theory of Change); the evaluation matrix, as contained in the Inception Report, and as Annex 2 of this report; the Desk Report (both Volumes); and the two country case studies.[35] Judgement criteria are introduced by a short heading covering the essence of the criterion; the numbering after each criterion refers to the original numbering in the Evaluation Question/Judgement Criterion matrix in Annex 2 which contains the complete text on which the judgements are based.

[35] For ease of reference and for ease of comparison between the Synthesis report and the two country case studies, the same chapter layout in respect of the Evaluation questions has been used.

5.1 RELEVANCE

5.1.1 Alignment with stated needs and priorities

EQ1: To what extent are the interventions aligned with the stated needs and priorities of target groups and the development priorities and policies of partner country governments?

At the national level there is policy alignment between partner country priorities and policies, and those of Sida. By contrast, there is little evidence that there has been stakeholder involvement at the planning stage which contributed to project design. Where there has been involvement with "stakeholders" this has tended to be with potential customers (households, businesses and institutions) but not with the population at large. This has focussed more on willingness and ability to pay, than on tackling local development priorities. In addition, energy policies tend to have a narrow focus on electricity, rather than on the energy sector as a whole.

Judgement criteria:-

- *Sida interventions consistent with partner country energy/electrification policies. (JC 1.1)*

Projects tend to be aligned with national policies – thus the electrification of Njombe notes the project as … "*the outcome of initiatives by the Government of Tanzania through the Ministry of Energy and Minerals and Sida to address the need for rural electrification of remaining district townships and villages, and fight poverty in Tanzania*" and for Serengeti, the project is seen as the outcome of … "*initiatives by the Government of Tanzania through the Ministry of Energy and Minerals and Sida to address the need for rural electrification of remaining district townships and villages, and fight poverty in Tanzania*" (Tanzania Case Study, EQ1)

However, the tendency is to see energy in a rather narrow focus – i.e. electrification, and within electrification, large scale infrastructure projects. Within this context, energy in general, and renewable energy in particular, feature less in national development programmes than large-scale electrification projects. [36] The targeted focus on rural electrification, and the support for the creation of

[36] For Mozambique the aim of the 2000 *Rural Electrification Strategy Plan* and a priority action of the Government's *Five-year program for 2010–2014* is that all district capitals were scheduled to be electrified and connected to the national grid by year 2014.

specialised funds and agencies (for example the REF and REA in Tanzania), go some way to address the gaps within the electrification sector; they do not, however, address the gap between a more narrow focus on electrification and a broader focus on rural energy needs. (Desk Report, EQ1)

- *Incorporation of stakeholder analysis into project preparation. (JC 1.2)*

There is no real evidence of this happening in a consistent manner in respect of project design although, in a number of cases, socio-economic and gender baseline studies were carried out for monitoring purposes. This was the case with Ribáuè-Iapala, Mozambique, for example, which was closely monitored throughout – but is more an exception than the rule. However there is little evidence that there has been any systematic engagement with local populations as part of planning activities. (In respect of the uneven distribution of network resources between Ribáuè (district administrative centre) and Iapala (larger population, economic growth centre) which did not take into consideration the different characteristics of the two towns "*It was concluded that the two towns – i.e. Ribáuè-Iapala – could have had equally well performing networks if stakeholder consultations had taken place and if the result of these had been taken into account*" – Desk Report, EQ1).

At the household level, and not surprisingly, given the important impact it can have on living conditions, the bringing of electrification is seen as very relevant. Notably the importance of bringing light where before there was darkness. It is clear that more stakeholder involvement might have changed the design of the intervention – for example, more three-phase capacity to run grain mills or a water-supply system. (The example from the Tanzania Desk Report is pertinent describing the non-implementation of a World Bank water project because there was only single-phase power being supplied – Tanzania Case Study, EQ3)

Stakeholder involvement during project preparation tends to focus more on potential customers, and their willingness and ability to pay for a connection. Focussing on those households, private enterprises, industries and public institutions likely to want to be connected. However such surveys focus more on technical aspects than on poor people's increased access to electricity; overall, therefore, the analysis of stakeholder positions in Sida-financed projects is generally weak. For Tanzania, the examples of Urambo 2001, Ukerewe 2005 and Simanjiro 2005 are cited. (Desk Report, EQ1).

There is also little evidence that gender was seen as a factor when projects were planned. Instead assumptions were made, without research, in respect of how women would benefit. (Desk report, EQ1)

Furthermore, projects have been planned as *electrification* projects rather than as *development* projects. Assumptions were made that there would be synergies, and that outputs and outcomes would somehow be interlinked. Mostly the anticipated synergies are formulated as an after-thought by reviews.*37* (Desk Report, EQ1)

At the same time, no matter how well done, a stakeholder analysis also has its limits and operates within the context of the stakeholders' view of the world; it cannot be expected to predict the unforeseen. Mobile phones, virtually unknown in programme areas when the interventions now under evaluation were being planned, benefitted from rural electrification to expand network coverage, and mobile phone ownership has embraced connected and non-connected, poor and non-poor alike.

- *Harmonisation with development partners. (JC 1.3)*

This is increasingly the case. At national level, following the Paris Declaration, energy sector working groups were established. These did not exist at the time when projects started to be implemented. In Tanzania, the Swedish Embassy has been the co-chair of the energy sector working group; and in Mozambique, Sweden is one of the key development partners in the energy sector working group, which it chaired from 2009–2010.

In Tanzania an Energy Development Partners Working Group has been established which now brings together the various development partners working in the sector. The dialogue with the government improved through the joint Energy Sector Working Group, with Sida as an important participant in the dialogue and a former co-chair (2010–2012) – (Tanzania Case Study, EQ1). The establishment of the Rural Energy Agency (REA) and Rural Energy Fund (REF) in Tanzania (with Sida as prime mover – are further examples of the development partners and the Government of Tanzania working together in the sector.

Below the national level, there is a lot less harmonisation. This is not unexpected in a situation where the move, by development

[37] The arguments that there will be benefits from projects inter-linking and adding value are "generally made by Sida internal reporting and summaries of projects mainly related to decision-making". (Desk Report, EQ1)

partners, from project to programme assistance is still ongoing. Nevertheless, here too progress is being made. In Mozambique, joint funding of rural electrification interventions (Sida/Norad/Danida) are evidence of increased development partner harmonisation both at national but also at project level. In the broader context, district and local development plans and decentralisation become vehicles for harmonisation. Nonetheless examples are frequent of electrification not harmonising with other sectors: water supply programmes needing three-phase electricity with only single-phase electricity provided under rural electrification programmes and consequently not implemented; street lights provided but no recurrent funds to pay the bill; etc. (Tanzania Case Study, EQ3).

5.1.2 Relevance to people living in poverty

EQ2: To what extent have electrification programmes been designed to improve the conditions of people living in poverty, also taking the various contextual factors into account?

When rural electrification programmes are planned they are rarely specifically designed to improve the conditions of people living in poverty – instead it is often assumed that this will happen as a logical consequence of the intervention. The assumption is made that rural economic growth will automatically follow electrification, and that this will automatically lead to poverty alleviation. While it is generally accepted that electrification is a necessary condition contributing to improved living conditions, electrification interventions need to be linked with complementary interventions, specifically targeting beneficiary groups, if poverty alleviation impacts are to be achieved.

Given that all Sida projects pre-identified for this evaluation were grid extensions, the interventions studied were also not necessarily targeted at the poorest areas in the country. Instead they focussed on those areas where grid extensions were possible. This means that the really poor areas physically distant from the national grid were not included. Institutional support to rural electrification agencies may change this to some extent as these agencies start to broaden their approach to also incorporate other technical (off-grid) solutions.

Judgement criteria:-

- *Alignment with partner country PRSP. (JC 2.1)*

Generally speaking, this is the case, certainly at the national policy level, and alignment is also reflected in the formulation of the interventions' development objectives that normally include a

poverty focus. The Mozambique Poverty Reduction Action Plan (PARP), signed 3rd May 2011 by the Council of Ministers, has references both to "energy" generally, as well as "rural electrification" specifically; the rural electrification projects financed by Sida directly contribute to the overall policies of Mozambique as formulated in the PRSP. The PRSP in Tanzania, known as the National Strategy for Growth and Reduction of Poverty II (NSGRP II or MKUKUTA II), implemented from 2010/11 to 2014/15, has references both to "energy" as well as to "rural electrification" specifically. Thus the rural electrification projects financed by Sida contribute directly to these overall policies as formulated in the PRSPs. (Desk Report, EQ2)

Rural electrification projects do not specifically target poor households; the tendency, to a large extent, is to implicitly assume that rural electrification is automatically poverty oriented. The observed tendency, both with Sida and other development partners, has been to assume that rural electrification was good for economic growth and would therefore, automatically, lead to poverty reduction. (Desk Report EQ2[38]) However, rural electrification remains, first and foremost, focused on geography, i.e. connecting *rural* areas, rather than focussing on *poverty*. The Inception Report quotes Gaunt: "*Rural electrification is based on the geographic segregation of customers, addressing the needs of both the poor and the not-poor in the rural areas. On the other hand, electrification for social objectives is directed to meeting the needs of the poor and, although most people live in rural areas, many people in urban areas are also poor*". (Inception Report, Section 3.2)

The rural electrification programmes supported by Sida (including all those identified and studied as part of this evaluation) have been based on extensions of the national grid. There are many sound technical reasons for this but the result is that large swathes of the country (Tanzania and Mozambique are typical examples) are left untouched. Therefore Sida rural electrification programmes have only focussed on people living in poverty in those areas where grid extensions were considered as technically and economically feasible. The choice is logical – the alternatives are very expensive and institutionally challenging – but the result remains the same. As noted in the Desk report: *The construction of electric grids or decentralized power systems to distribute power in rural areas are expensive undertakings, not least*

[38] Sources include: Sida 2002: Thematic Evaluation on Rural Electrification.

so in most African countries where existing infrastructure is rudimentary and distances to the isolated and scattered low population settlements from the electrified (urban) areas are substantial. This makes capital investments per connection extraordinarily high. In addition, rural electrification has also proven to be institutional and regulatory challenging tasks. (Desk Report, Section 3.2)

Programme support to specialised agencies which have as their mandate to focus on rural electrification and which receive core funding from Sida, other donors and national governments (such as the Rural Energy Agencies and the Rural Energy Funds) are initiatives which mandate an organisation to focus exclusively on the rural areas, leaving the national utility to focus on its main task, namely maintenance and extension of the national grid, and ensuring that there is sufficient generating capacity to meet the country's needs. Whilst Tanzania's REA/REF is also mandated to work with renewable energy and off-grid solutions, their interventions during the evaluation period were mostly linked to grid extension.[39] This was also the case with the Rural Energy Agencies that Sida has supported in Uganda and Zambia. It is only in Vietnam that Sida support has been almost exclusively directed towards off-grid technologies (specifically photo-voltaic)[40] (Desk Report 3.4).

- *Barriers to bringing benefits to the poor. (JC 2.2)*

Sida interventions in rural electrification have tended to be extensions of the national grid. Therefore, the focus of the intervention has primarily been *geographical* with assumed spin-offs to: "*people living in poverty in the area being connected to the national grid*". Sida's insistence that elements of a connection subsidy be included in their rural electrification interventions, both in Tanzania and Mozambique, have provided conditions which have allowed more households to connect, even though barriers to connecting the poorest remain.

The Tanzania country case study notes that: *there are still barriers in reality for most households to directly benefit from electrification, as the number of connected households only represents a small share of the population. In this regard, it is found that electrification and "people living in poverty" poses a contradiction in terms, at least if we look at the poorer segments of society. First of all, most households are constrained by the connection fee (even when heavily subsidised as has been the case in the two case study projects). Furthermore,*

[39] The REA in Tanzania is now increasingly also starting to expand its work to also include renewable energy.

[40] For Vietnam, the assumption is that with over 90% coverage there are no opportunities left for supporting grid extension

TANESCO also applies criteria to the state and quality of the house, which means that poorly constructed houses (for example mud walls and grass roof) will not qualify for being connected in the first place[41]*. In addition to the financial barrier, there are also other limitations to the outreach of electrification, especially the geographical distribution of lines, which favours those (few) houses, which are placed along the main distribution lines.* (Tanzania Case Study, EQ2)

The costs for the poor to connect their household remain a major barrier even though a mix of technology improvement and subsidies can contribute to greater affordability.[42] As noted by the 2008 World Bank Study[43]*: The direct benefits of RE programs have traditionally gone to the non-poor. This continues to be the case, but the poor gain a greater share of benefits as coverage increases. The distribution of benefits is affected both by the manner of selecting communities to be electrified and by the connection cost barrier preventing poor house-holds in electrified villages from connecting.*

The poor are rarely "early adopters", which means that all donor subsidies are long gone by the time that poor households may be ready to consider an investment. In that context, the costs of new connections are likely to be greater after the initial development partner-supported intervention, when the power utility takes over responsibility. This is exemplified in the Tanzania projects where Sida insisted on subsidizing connection costs in order to maximize the number of initial connections. Once handed-over, these connection conditions may no longer be applied by the utility. (Desk Report EQ2; Tanzanian Case Study, EQ 1 & 2)

Figures from Mozambique and Tanzania confirm that very few poor households actually have household connections, despite subsidies and technical solutions designed to help poorer households. For this reason also, this evaluation has also focussed on the benefits of electrification to non-connected households living in areas connected as part of Sida's rural electrification programmes. The Inception Report hypothesizes that poor, but also other non-connected households, will derive indirect benefits from electrification. (Inception Report, Section 3.2).

41 Only houses built of burnt muddy bricks/cement blocks and roofed by corrugated irons sheets qualify for electrification. The reason for this is to avoid risks of fire.

42 In Mozambique, when both connection and ready board are subsidised, energy costs are relatively low (1.07/MT/kWh) on EDM social tariff for consumption below 100 kWh.

43 Ref: The Welfare Impact of Rural Electrification: A Reassessment of the Costs and Benefits. An IEG Impact Evaluation. The World Bank, 2008, p.27

5.2 EFFICIENCY

5.2.1 Cost-effectiveness of interventions

EQ3: To what extent have rural electrification interventions been cost-effective, i.e. what has been the relation between costs and the results achieved?

Rural electrification is a political choice and will never be as cost-effective as increasing the number of connections in urban areas. However fixed and approved national technical standards combined with international tendering procedures will ensure that costs per unit are predictable and comparable.

There are few studies done on the cost-effectiveness of rural electrification. However surveys do show that the actual number of early connectors tends to be lower than the number of potential customers identified during the design stage. Improved start-up conditions – loans and subsidies; staggered connection fees; etc. – would increase the number of early connectors thereby increasing cost-effectiveness. The advantage, in respect of economies of scale, of contractors being on-site instead of having to depend on the utility and its organisation to provide for new connections after project hand-over, can also contribute to cost-effectiveness.

There is also a distinction to be made between a choice of technical solutions which focus on maximising basic connections through least-cost options (providing basic electricity services for lights, radio/TV and cell phone charging) or more conventional three-phase networks which can provide the required power supply for operating heavy machinery. The least-cost option is also the least cost-effective option.

Judgement criteria:-

- *Factors involved in judging costs per unit. (JC 3.1)*

Rural electrification is an expensive undertaking but few studies examine cost-effectiveness. (Desk report, EQ3) While the number of connections by category or type is an immediate output that can be quantified, connections also require the extension of distribution networks, transmission lines and sub-stations – the cost of which varies depending on the distance from existing lines and the density of connections. Connections also increase steadily over time but the vast majority remain small consumers in the category of 0–200 kWh/month, using electricity mainly for lights and small appliances: e.g. TV/radio; mobile phone charging; ironing. Moreover, besides

the connection fee, additional costs are incurred when consumers live at a distance from the distribution lines and need to pay not only a connection fee but also the additional costs not borne by the utility (e.g. poles).

The private/public sector consumption tends to account for between 6–10 % unless there is a large consumer in the district.[44] The Ribáuè example, where there are a few large customers (cotton ginning factory, secondary school, maize mills) accounted for 26% of total electricity consumption, with the cotton-ginning factory being the largest consumer, but this is quite unusual. (Desk Report, EQ 3)

- *Budget and implementation schedules. (JC 3.2)*

The Desk Report notes that budgets are generally fairly well observed and planned outputs more or less reached, but timelines are generally exceeded.[45] (Desk Report, EQ3)

However the Tanzania Country Case Study (EQ3) suggests that it is difficult to generalise on budgets with the Serengeti project coming in under budget while Makambako project is significantly over budget. However, the evaluation shows that project implementation timeframes were unrealistically optimistic. A fact also noted in the Desk Report. Delays were experienced throughout the process including: tender period; contract negotiations and approvals; reception of payments; supervision of works; testing and commissioning.

Table 4 Tanzania: tracking intervention budgets and costs

Case	Planned budget	Actual costs	Amendments
Serengeti	SEK 50 million	SEK 41.9 million	- SEK 8.1 million
Makamba-ko-Njombe	SEK 48 million	SEK 70.8 million	SEK 22.8 million

In Mozambique, (Mozambique Country Case Study, EQ3) the budgets were followed and the major interventions (distribution lines, transmission stations, transformers, etc.) were completed within the time frame. Targets for the number of connections within the timeframe of the intervention were not met before the finalisation of project interventions but were met over time, and considerably

[44] The number of customers in Ribáuè/Iapala increased from about 300 in 2000, to 1,900 in 2005; and to more than 4,000 in 2013.

[45] For example, the Tanzania case study projects lasted between 166% and 308% longer than expected.

exceeded intervention targets, as new connections, implemented through EdM, continue to be made.

Table 5 Mozambique: project budget tracking

Case	Planned interventions	Planned budget	Comments
Nampula province, Ribáuè district: (1997–2000)	Connection of: 1,000 HH and 25 commercial/institutional	SEK 36 million	Finalised on time and within budget
Zambezia province, Morrumbala district: (2001–2004)	Connection of: 1,300 HH and 35 commercial/institutional	SEK 47 million	Finalised on time and within budget

In Mozambique, the forces of nature and unforeseen events also played a role in attempting to disrupt implementation schedules.

Table 6 Mozambique: impact of climatic events on implementation

> The rains were quite heavy during February and March and made it difficult to access the line routes. The rains continued during the first part of April but by the end of April all parts of the line route were fully accessible. Due to the long delay caused by import procedures, the setting-out and pegging had to be redone at some part of Section 1 and 2. High water levels in the Zambezi River caused a lot of delays during the initial stage of the construction work as well as continuous breakdown of the ferry. The average waiting time for crossing the river during March and April was 4–6 days. Despite all the above problems which delayed the Project with about five months, the installations were ready according to the submitted Work Plan in the Tender!". Morrumbula Project. Final report, 2006

- *Predicting costs per unit of delivered electricity. (JC 3.3)*

Very basic figures for cost-effectiveness can be calculated but they remain a difficult form of comparison. Although a cost per connection can be calculated, the real connection costs do not relate to the costs of connecting a consumer to a distribution line, but relate more to the costs of the construction of the distribution lines and transmissions stations connecting the area to the national grid. This is purely and simply a factor related to the number of kilometres of line rather than the number of connections. However a simple calculation (total project budget divided by number of connections) gives an estimated

cost of around SEK 35,000 per connection in Mozambique, and between SEK 30,000 and SEK 69,000 in Tanzania. The Mozambique experience shows that the actual cost per connection during the intervention period ended up being higher than estimated. However, drawing negative conclusions from this would be counterproductive given that consumers continued to connect after handover thus also impacting on connection costs over a longer period, thereby reducing cost per connection over time. This is illustrated in the table below.

Table 7 Mozambique: Evolution of cost per connection related to initial project budgets (in SEK)

	Total budget	Estimated cost	End of intervention	2013 situation
Ribáuè district: (1997–2000)	36 Million	35,122	59,900	5,728
Morrumbala district:(2001–2004)	47 million	35,206	66,478	13,023

In Tanzania, there are significant differences in costs between the two case studies. The cost per connection in Urambo (Tanzania) is about SEK 30,000, well below half the price of a connection in Makambako-Njombe (also Tanzania) which is about SEK 69,000. Again, this is not a sign that budgets for Makambako were underestimated, but rather that the project was re-designed in the initial phase to include more hardware including an additional transmission/distribution line. While adding additional connections after project finalisation will start to reduce connection costs over time, these would not normally be reflected in the initial analysis of cost per connection.[46] (Desk report, EQ3; Mozambique and Tanzania Case Study EQ3). The Desk Report also points out that the number of *potential* consumers identified is far greater than the number of *actual* consumers that connect, and that bringing the *actual* closer to the *potential* requires consistent and uniform policies in respect of: installation and connection costs (and potential targeted subsidies);

[46] Which is not to say that such figures cannot be misleading. The Makambako/Njombe unit cost is so high because the main project component was actually the installation of the new sub-station.

financial assistance (loans or payment over time); appropriate technical solutions (ready boards; reliable meters; pre-paid meters) and realistic tariffs (Desk Report EQ3). The efficiency of an intervention – i.e. the cost per connection – would be improved if more people connected during the construction period, rather than in dribs-and-drabs after project completion.[47] Nonetheless, the fact that the utility continues to make connections after the finalisation of the intervention contributes to increasing cost effectiveness over time. Expanding the number of consumers also underlines the competence of both utilities (EdM and TANESCO) to continue connecting consumers, as well as consumer willingness to connect, and ability to pay.

The progression of connections compared to project targets (for number of connections) is discussed under 5.3.1

- *Investment cost per unit delivered within expected range. (JC 3.4)*

The evaluation did not manage to obtain comparative figures. However, it is worth noting that: (i) many projects within the electrification sector are joint projects (e.g. in Mozambique, the reconstruction of the Chimura-Mutarara 33 kV line was jointly financed by Sida and NORAD); moreover, (ii) once national technical standards have been set and fixed (and these are linked to international standards) the technical specifications and bills of quantity for all international open tenders are both transparent and straightforward.

[47] This also makes the best use of the economies of scale with a contractor being on site and already mobilised; and accessing additional benefits through the involvement of an externally financed project with a development partner.

5.2.2 Programme design and implementation modalities

EQ4: How have programme designs and implementation modalities contributed to achieving efficiency?

Rural electrification is a political imperative. However, achieving financial sustainability for rural electrification without cross-subsidisation from high-load high-density areas is nigh on impossible.

Increasing the number of connections within a major urban area is a more appropriate solution, in purely financial cost-benefit terms, than any form of rural electrification with its low-load and low-density characteristics. Within the various rural electrification modalities, the consensus is that the most efficient design for rural electrification is one that is based on grid extensions. Off-grid solutions will normally be more expensive, even though stand-alone diesel systems may be a bridging option until an area can be connected to the grid. Eventually, though, it will become cheaper to use off-grid sources of supply to reach distant low-load communities.

Within these parameters, and acknowledging the political imperative, the challenge, for rural electrification, is to design and develop approaches and modalities to make rural electrification more efficient and less of a loss making venture. Means and strategies to this end include: least-cost design modalities; maximising the number of connections during project implementation to achieve economies of scale, including designing and implementing financial and technical packages (e.g. subsidised connections fees; pre-paid meter systems) to encourage connection by poorer households; providing (three-phase) system capacity to allow for the private sector to connect, thus increasing the number of large consumers of energy (i.e. consumers which need electricity for production and not just for providing electric lights). And, finally, integrating rural electrification programmes with broader development initiatives targeting the same areas.

Judgement criteria:-

- *Appropriate technical solutions including least cost design. (JC 4.1)*

Least-cost design approaches (imperative for all TANESCO projects), are intended to minimize initial investments, presumably to allow for greater coverage or allocation of funds over more potential investments (in rural electrification). Here the distinction between "least-cost" and "low cost" is also important since it is also important not to compromise quality. Least-cost design is based on a shorter design horizon and a lower load forecast, thus reducing costs related to development of new installations. However, including prepaid meters as opposed to conventional meters into the design of the

intervention does increase investment costs because of the system requirements necessary for pre-paid metering to function (namely a local area network allowing meters to work "wirelessly"). However, once installed pre-paid meters contribute both to reducing maintenance costs, utility staff time and the possibilities of corruption linked to payment; as well as allowing consumers to better manage their own consumption. (Reference is made to the discussion in Tanzania Case Study, EQ4; and also Mozambique Case Study EQ4.)

The Inception Reports for both Tanzanian projects state that: "*It is anyway important in least cost installation to consider the growth of the energy demand for a shorter time than the usual period of 15–20 years. In order to minimize the initial investments, a load forecast period of about 5 years would be used in this project*". (Tanzania Case Study, EQ4)[48]

The least-cost design means that the design is based on cheapest possible solutions, but without compromising quality (hence the distinction between low-cost and least-cost). Cheaper solutions can be found if planning is done for a shorter time horizon because the energy demand will be less and thus demand less system capacity. By contrast, in the Mozambique interventions, longer design horizons were chosen mainly because, in the view of EdM, the cost of upgrading from least-cost solutions to cater for system expansion is high.

Least cost design was also found to cause problems where the alternatives chosen sometimes compromised the sustainability of the interventions[49] as well as contributing to power interruptions where sub-standard materials are used. The Serengeti project interventions are an example (Tanzania Country Study, EQ4). A particular issue is also the choice made in the distribution ratio between single-phase and three-phase under the least cost installation, favouring single-phase and initially limiting the number of three-phase connections. Lack of three-phase limits growth opportunities for certain kinds of business (such as milling machines, welding, carpentry/saw-milling)

[48] It should be mentioned that the team was informed by the consultant on the Serengeti project, that the 5 years design horizon (as mentioned in the inception report), was changed to 10 years.

[49] Problems with least-cost design included: single-phase transformers were supported by one single pole whereas double poles are normally advised; steel earth wire rusting and poles were not properly treated and decaying already seven years after installation; 32 mm2 LV wires used instead of 50 mm^2 LV wires. The Bunda-Serengeti line has frequent power cuts through poles decaying and collapsing, etc.

and public sector interventions (for example, piped water supply).[50] A certain amount of post-project follow-up by TANESCO itself has now resulted in the replacement of a number of single-phase transformers by three-phase transformers. (Tanzania Case Study, EQ4)

This choice between single-phase and three-phase also implies a choice between providing a basic service to households or providing electricity suitable for (small-scale) industries. In Mozambique there is some experience with the cheaper SWER (single-wire earth return) technology but this also remains a low load solution.

Table 8 Mozambique: advantages and disadvantages of SWER technology

EdM has just 3 Medium Voltage lines on 19.1 kV SWER lines with a total of approximately 140 km. Two of these are unproblematic. The third one, in the south west of Maputo province, has a length of some 90 km and crosses an important farming area. It works well with more than 20 single-phase MV/LV transformers connected to the line. However some of the farms have electrical pumping for irrigation and a project of a three-phase MV line (33 kV) to the area is now under implementation to allow for installation of three-phase motor/pumps. Due to their reduced cost, MV/LV single-phase transformers on the SWER lines and on the three-phase MV lines (33 or 22 kV) are being installed wherever necessary. When the MV/LV single-phase transformers are connected to a three-phase MV line they can be replaced by a three-phase MV/LV transformer if and when required. **(Mozambique Case Study)**

One of the findings of the evaluation is that both connected and non-connected households continue to have monthly expenses on kerosene/candles/batteries. Thus, although connected households have a monthly saving on around 4.00 USD (6,570 TSH) in Tanzania and USD 2.50 (MZN 72.00) in Mozambique, because they spend less on kerosene/candles/batteries, this still begs the question as to why connected households still need to spend money on alternative lighting sources. The answer is found at two levels. Firstly many households do not have lights in every room of the house and continue to use kerosene and candles, for example in the kitchen and bathroom/toilet (See also Annex 7). And secondly, because of the

[50] Examples from Tanzania include: milling machines purchased on the expectation of 3-phase but still not in use because no 3-phase available; water supply project (World Bank) not implemented because only villages with 3-phase qualifying, etc.

unreliability of the service provided, respectively by EdM and especially by TANESCO, households need a back-up system, as power cuts are a recurring and regular phenomenon. (Reliability of the power supply is further discussed under the EQs dealing with sustainability; and also under Annex 8).

It should be noted that, given that virtually all households continue to use bio-mass for cooking and space heating, there are no savings to report there, as even connected households do not use electricity for cooking or heating. (Mozambique and Tanzania Case Studies, EQ4; and Annex 7)

While the amount "saved" is not substantial, it is still worth noting that poor households continue to pay more for lighting than households that could afford to connect.

A realistic demand analysis is also important when defining technical solutions. For example, Ribáuè/Iapala would have been more efficient if a more comprehensive demand analysis had ensured that the installed electricity capacity corresponded better to the actual demand.[51] Electrification projects in Sofala, Manica and Tete provinces also indicated that the demand for electricity was higher than the EdM planned capacity for service connections. (Mozambique Case Study, & Desk Study, EQ4).

- *Technical and financial solutions reflecting utility capacity. (JC 4.2)*

In Tanzania, only people living within 30 meters of existing lines can avoid the extra charge of erecting additional poles. This is in addition to the connection fee charge by TANESCO. This raises two issues:

(i) Appropriate planning of the initial construction intervention including the design of the internal distribution network to meet the anticipated demand; and

(ii) Allocation of responsibility for network intensification (i.e. connecting new customers within the electrified area) after completion and handing over to the utility.

In Tanzania, "the responsibility of payment for the poles does not formally rest with the households; but because neither the government nor TANESCO provide the poles, then households are told that they have to pay for those poles, if they want their household to be connected" (Tanzania Case Study, EQ4). Therefore it is

[51] A grid extension project is now under implementation in the area, using the same original MV line. This project is part of EDAP APL 2, jointly financed by World Bank, EIB, AFD, OFID and GOM.

financially impossible for (poor) people (in rural areas) living at any distance from existing lines to afford a connection after the completion of project interventions without a loan or subsidy system.[52] Similar procedures are followed in Mozambique by EdM.

When discussing subsidies and financial barriers to households, as well as the capacity of the utility to manage the intervention after handing over, it is important to consider the entire cost both to the household and to the utility over, at least, the medium term. Connection subsidies (for example payment over time instead of up-front) have allowed less well-off households a greater opportunity to connect; whilst pre-paid meters allow households (and those businesses that have them) to keep track of consumption and avoid bills piling up. Pre-paid meters simplify utility procedures and improve utility financial governance, as there is less ready cash in circulation. However provision of pre-paid meter technology increases the cost of the initial intervention, requiring investment in the communication interface with the utility, a necessity for the system to function.[53] Additional improvements to the pre-paid metering system, acknowledging the high mobile phone ownership, could be the introduction of scratch cards and mobile phone-based payment platforms.[54] The same system functions in Mozambique (called mKesh or M-Pesa according to the mobile phone operator). The system and the advantages or pre-payment for electricity are the same in Mozambique as for Tanzania. Figures from Mozambique indicate that over half of energy sales to customers are "pre-paid".[55] However, these figures do not cover the Mozambique case study areas, as pre-paid technology was not seen as being sufficiently mature at the time the projects were planned; and the two service areas continue to use conventional meters. (Mozambique Case Study, EQ 4)

Grid technology has generally proven a more efficient rural electrification technology than off-grid, with better economic rates of

[52] In Tanzania, the current (2013) connection fee charged by TANESCO is TSH 177,000 (USD 111) and the price charged for *each* pole is TSH 300,000 (USD 188)

[53] Tanzanian case study notes that households mostly use pre-paid (Luku) meters (92%) with businesses mainly using conventional meters.

[54] In Tanzania, mobile phones, apart from communication, are used in the mobile money transfer service, through payment platforms such as M-Pesa, Tigo-Pesa and Airtel Money; the torch function is also appreciated.

[55] Figures drawn from EdM Statistical Report, 2011. (Table 6.4.1)

return, and more chance of being financially sustainable. The proviso here is, of course, the distance from the main grid of the area under consideration for electrification.[56] (Desk Study, EQ4) In such cases, non-renewable energy options, such as small diesel power plants, may continue to provide more appropriate medium (and even long-term) solutions in a scenario where future extension of the national grid is envisioned. Although renewable off-grid technologies are becoming more mature they will remain expensive. Even if costs are optimized, tariffs are targeted and suitable financing instruments are used, very poor income groups will remain difficult to connect. (Desk Study, EQ4)

- *Involvement of the local labour force. (JC 4.3)*

No evidence was found on whether the local employment base benefited from any employment opportunities during the construction phase, or whether any considerations were given to the use of the local employment resource. In addition, no evidence was found that an HIV-AIDS risk analysis took place.

A certain amount of HIV-AIDS awareness training appears to have taken place but results have not been recorded. In respect of on-going activities, it can be noted that, in 2010, EdM was awarded the prize for business excellence, in the category of "Best company in testing and counselling in the area of HIV-AIDS". The EdM Centre for HIV-AIDS, in coordination with the National Council of Combat against HIV-AIDS, contributes to the dissemination of information to prevent and combat this pandemic, as well as for non-stigmatization of colleagues who suffer from disease. These activities are also addressed to people involved in EdM projects, including not just the EDM workers but also workers from contractors and people resident in the project areas. (Mozambique Case Study, EQ4).

- *Development partner coordination. (JC 4.4)*

At the project implementation level, no evidence of coordination with other development partners was found, neither in developing the electrification intervention, nor in linking electrification interventions with other interventions. (Mozambique and Tanzania Case Studies, EQ4)[57]

[56] The grid versus off-grid discussion is based essentially on the Desk Study, as the country case studies were all grid extensions.

[57] The non-implementation of a World Bank water project because no three-phase electricity was provided is an example of a missed opportunity. (Tanzania Country Case Study, EQ3)

However at the national level, Sida has worked closely together with other development partners (in sector working groups) and with the national governments (through joint working groups, and energy sector working groups). This has included cooperation on the creation of, for example, the Rural Energy Agency and the Rural Energy Fund, in Tanzania. The Rural Energy Fund, which is strongly supported by Sida, has become a multi-donor trust fund receiving contributions from the major development partners in the energy sector in Tanzania. And, in Mozambique, there is comprehensive coordination with development partners in the preparation of the Electricity Master Plan project, focussing on grid extension and supply reinforcement to support industrial development and load growth, as well as supply extension and network expansion. This is not to say that there is always agreement between partners, but development partner discussions and joint sector working groups are a clear improvement on the pre-Paris Declaration situation.

Table 9 Mozambique: development partner dialogue on issues of principle

The 2003 annual sector review of the Danish Energy Sector Programme Support (Danida 2008) reported on discussions amongst the donors and the Mozambican stakeholders on the privatisation of EdM. The World Bank was pressing for the privatization of EdM in line with its general policies. In response the Nordic donors emphasised the need for EdM to address social and poverty issues. The argument was that if EdM was privatised or required to be fully financially sustainable that this would rule out further rural electrification. In connection with the joint donor review in 2004 of the energy sector, it was proposed that support to electrification in Maputo should be counterbalanced by more support to rural electrification. Two recurring issues were discussed: the poverty orientation of EdM; and delays of planned transmission expansion. **(Desk Report and Mozambique Case Study, EQ 4)**

- *Coordination with other Sida interventions. (JC 4.5)*

There is very little evidence that Sida rural electrification interventions have been coordinated with other Sida interventions whether in the energy sector or elsewhere. It has been noted that the Serengeti project was selected partly because it was believed that it would support the Sida-funded district development programme in the area.[58] Sweden has also been working with decentralisation and

[58] Source: comments by Sida on Draft report.

local government reform including resource allocation and execution but no real evidence of formal coordination was noted. Yet there is ample scope for coordination as non-connection of public services, non-payment of bills, etc., also link with the challenges which local government faces: corruption; teachers and health workers salaries not paid, local infrastructure not being improved, etc.[59]

Environmental and social impact studies have been carried out, with Ribáuè/Iapala and Morrumbala as good examples. (Desk Study and Mozambique Case Study, EQ4). Environmental impact studies were carried out although mostly limited to direct impacts on project site but no Strategic Environmental Assessments, which would have placed the potential electrification interventions within a broader development scenario, thus potentially linking electrification with other (Sida) interventions, were undertaken.

It is further noted that Sida funds interventions within the energy sector through a number of different channels and organisations. Thus the Innovations Against Poverty network (also supported by Sida) is working on solar-powered mobile phone chargers (being developed by a Swedish company); Sweden supports the Global Alliance for Clean Cook stoves (an important intervention given the continued use of biomass even by connected households); and the energy work being carried out by, for example, the Stockholm Environment Institute. In addition, Sweden supports a number of multi-donor energy initiatives such as ESMAP, ENDEV, etc. This wide range of instruments, projects and mechanisms provides an opportunity for future coordination. However many of these instruments only started maturing and developing after the case study projects were planned. The opportunity is there for better coordination in the future. The evolving work of, for example, the Rural Energy Fund in Tanzania suggests that Sida's country support strategies are increasingly integrating broader experience within the sector.

[59] Source: comments by Swedish Embassy, Tanzania.

5.3 EFFECTIVENESS

5.3.1 Achievement of objectives

EQ5: To what extent have electrification programmes achieved their stated immediate and medium term objectives?

Intervention results at the output level (such as number of connections) are generally achieved but the links to outcomes and impacts (which focus more on poverty alleviation) depend not only on the sustainability of the outputs but also on complementary interventions and contextual factors. Achievement of objectives is equally dependent on a number of conditions, such as: a well functioning utility, a stable power supply and a tariff system that provides the foundation for the financial viability of the utility. None of these conditions have been completely met.

Financial viability, at the output level, can be improved through various incentives. Spreading the cost of connection fees will encourage more early connectors; improved metering, using pre-paid meters, allows for payment of actual consumption, etc. These measures also acknowledge the seasonal nature of earnings in areas where agriculture continues to dominate. Financial viability can also be improved through providing reliable and appropriate power to businesses, as the employment spin-offs will include more households being able to connect. Broader benefits, through electrification of public services, will be more difficult to achieve in a situation where (local) government does not have the financial means either to pay for connections or pay their electricity bill.

- *Reliable power supply. (JC 5.1)*

Neither in Tanzania, nor in Mozambique is the power supply to the case study areas completely reliable (Tanzania and Mozambique Case Studies, EQ5; and Annex 8). Although, generally speaking, rural electrification projects achieve their stated immediate objectives in terms of hardware (i.e. numbers of connections, transmission lines, etc.) maintaining the reliability of the system has proven to be a challenge. (Desk Report EQ5)

Power supply reliability is a reflection on the capacity of the utility to provide and maintain this, but also a reflection on the design of the intervention, and the quality of the work of the contractor during intervention. In the Tanzanian case studies, the combination of a least cost design with, possibly, poor supervision of the contractor, is seen as one of the reasons both for the frequent power cuts, as well

as for the power fluctuations leading to damage to electrical equipment (37% of case study consumers in Tanzania and 20% of case study consumers in Mozambique report damages to equipment). That the problem is not worse is likely to be related to the fact that most consumers only have lights, radio/TVs and mobile phone charging requirements. Sophisticated equipment is less at risk because there is simply less of it. In the Tanzanian case studies, businesses that depend on a steady supply of electricity still feel the need to have back-up generators. (Tanzania Case Study, EQ5) Based on the field survey, power supplied to the Mozambique case study areas seems both more reliable and with fewer fluctuations than is the case in Tanzania. Fewer power cuts are reported and fewer businesses have stand-by generation capacity. (Mozambique Case Study, EQ5; reference is also made to Annex 8 of this report.)

Focussing on power supplied to business, 40% of businesses in the Tanzania case studies report power cuts as a daily occurrence (and consequently 22% of businesses have a stand-by generator); while in Mozambique it is less of a daily occurrence (reported by 2%) but more of a weekly occurrence (28% – and consequently only some 9% of businesses have a stand-by generator). (Country Case Studies EQ5). The energy crisis in Tanzania with an absolute power shortage as a result of drought-induced decreased hydro-electricity power generation capacity, has affected the availability of supply. Available power is channelled to urban centres with the rural network at the end of the queue. In Mozambique, the challenge is that the national grid is, to a certain degree, over-extended with long line lengths and low loads impacting on system stability.[60]

A reliable power supply is not only a reflection of the physical works and the proper construction of the electrification infrastructure, but also reflects on the utility itself, how it manages and distributes power, and how it ensures sufficient system capacity. An inappropriate tariff policy impacts on the utility's capacity to manage the system. TANESCO runs at a loss, selling electricity at tariffs below production cost, and so does EdM. (Desk report, EQ5; and Norplan 2013).

In relation to the physical works, normally the advantage of a fully funded project with a professional design is that construction is done to international technical standards, and that a fully

[60] Norplan, 2013, p. 27.

functioning system is handed over. Evidence from Mozambique suggests that EdM provides professional supervision enduring construction ensuring high standards; while the Tanzanian case suggests that this is not always so. (Tanzania Case Study, EQ5) (Mozambique Case Study EQ 5 and Norplan 2013)

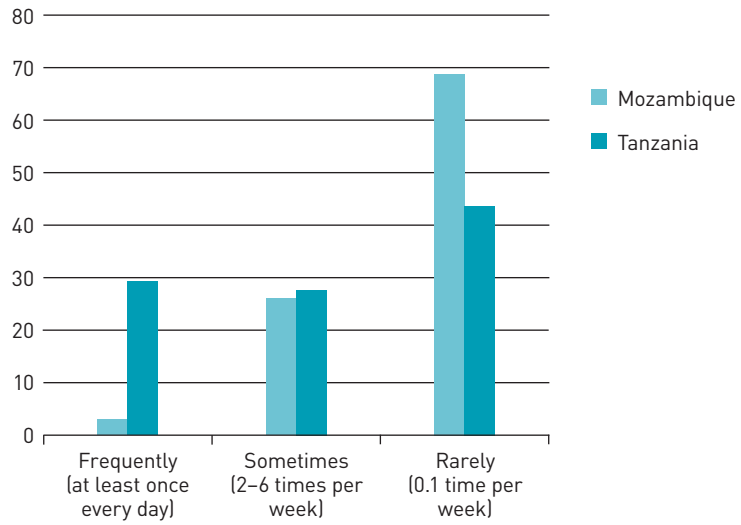

Figure 2 Power supply reliability

- *Maintenance procedures in place and sustainably financed. (JC 5.2)*

As mentioned, as a result of inappropriate tariff policies, TANESCO runs at a loss – a fact not helped by reports of flawed tender deals and power theft.[61] TANESCO sells electricity at tariffs below production costs. This includes all tariffs and not just the "pro-poor tariffs". It is therefore impossible to be financially secure, even at the operation and maintenance level, much less when considering capital replacement and depreciation. In Mozambique a recent study come to similar conclusions, noting that low tariffs combined with small shares of the load used for productive purposes: "*results in a worsening financial situation for each customer connected*".[62]

[61] As reported in the newspaper *The East African*; and also in the Millennium Challenge Account report of 2013.

[62] Norplan, 2013, p. ii.

Table 10 Tanzania: flat-rate tariffs versus charging according to real consumption

In Tanzania, the lifeline tariff that TANESCO provides to households consuming less than 50 kWh/month has been maintained, although it still has followed the general increase that TANESCO have applied on all tariffs. The lifeline tariff is currently less than half of the tariff that large consumers pay for their consumption. From a sustainability perspective, the growing consensus is that in order to ensure sustainable provision of electricity clients should be charged according to their consumption, and that flat-rate tariffs should be avoided. Experience shows that the tariff for low-income consumer is reasonable in terms of affordability; and that low-income households can be expected to maintain the consumption at a basic-need level even as tariffs increase. **(Desk Report, EQ5, drawing on Ilskog and Ahlborg)**

The consequences of TANESCO being a loss-making enterprise are that funds are not available to allow for the proper functioning of maintenance procedures, etc., of which the frequent power cuts are evidence. Rural networks suffer more from the frequent power cuts, spikes and load shedding than the main urban centres, as a consequence of prioritising urban areas within a situation of national power generating capacity shortage. Despite TANESCO's maintenance plans and procedures, some challenges were noted, which gives the impression that, in reality, the maintenance procedures are not followed. (Tanzania Case Study, EQ9)

Concerning maintenance procedures, the Mozambique Case Study notes that maintenance is done regularly by EdM on its network and that EdM, generally speaking, has a good reputation. However, EdM's tariffs are not cost reflective and continued grid expansion and focus on new connections is leading to a deteriorating financial situation. The utility's financial challenges are starting to have a negative impact on maintenance procedures and replacement. (Mozambique Case EQ5) As noted by Norplan: "*Because nominal prices have been kept constant while inflation has been in the double digits for most of the last decade, the current tariffs for most categories are hardly sufficient to cover the real cost of generation per kWh. This is before the cost of operation of EdM and maintenance of the system is included.*"[63]

- *Public sector consumers connected. (JC 5.3)*

The experience from Tanzania of connecting public institutions is discouraging, seen purely in terms of the totality of public services

[63] Norplan 2013, p. 18.

within a local government area, and the number of institutions that ended up being connected (see below). Public service connection depends on proximity to distribution lines and inclusion in the initial intervention. It is more difficult to connect public service institutions once the development partner supported interventions have been completed. The figures in the table give some indication of the extent of the missed opportunities.

Table 11 Tanzania: Connection of public services in case study administrative districts

Health sector		
Serengeti	7 out of 51 health institutions connected	1 health centre, 1 hospital, 5 dispensaries; (5 other dispensaries have solar)
Makambako/ Njombe	7 out of 24 health institutions connected	Only one is on the grid; the rest are solar
Education Sector		
Serengeti	5 out of 108 primary schools; 2 out of 23 secondary schools	Of these, 3 primary & 2 secondary connected in 2006
Makambako/ Njombe	7 out of 28 secondary schools; and 31 out of 154 primary schools connected	Of the 31 primary schools, 10 are connected to the grid; the rest are either solar or hydro-power
Water supply		
Serengeti	Electricity driven pumps only in Mugumu	
Makambako/ Njombe	Both Njombe & Makambako have an electrified water supply, using both single and three-phase	

Mozambique presents a similar picture. The Mozambique case study notes that when public institutions are close to the power-lines and the distribution network, they are normally connected. Moreover they normally pay their bills as the local government budgeting process includes payment for services – although not always on time, and not always in full. (Mozambique Case Study, EQ5) However, many public institutions such as schools and health centres will remain unconnected because they are located outside the built-up areas and too far from the distribution lines.

Table 12 Mozambique case study: education and health facility status (2011)

	Number of electrified institutions	District total per sector
Ribáuè		
Education	3 primary schools; 1 secondary school and 1 vocational technical school	**2011 figures:** EP1 schools = 119; EPC schools = 31; Secondary schools = 4; Vocational technical school = 1
Health	1 Rural Hospital; 1 Health Centre in Namigonha locality; 2 Health centres in the Administrative Post of Iapala, and 1 in Iapala village	1 Rural Hospital; 1 Health Centre Type I; 5 health centres Type II; and 2 Health Posts
Mopeia		
Education	2 primary schools; 2 secondary schools	**2010 figures:** EPC schools = 27; Secondary Schools = 3
Health	1 District hospital with a maternity ward in Mopeia village; 1 health centre in Chimuara	1 district hospital; 1 Health Centre Type I; 4 Health Centres Type II; 4 Health Posts
Morrumbala		
Education	3 primary schools (EPC); 1 secondary school; and 1 technical school (teacher training)	**2011 figures:** EP1 schools = 135; EPC Schools = 75; Secondary Schools = 3; plus 1 technical school (teacher training)
Health	Only the Rural Hospital and one of the Health Centres are electrified, both situated in Morrumbala village	1 Rural Hospital; 3 Health Centres Type I; 14 Health Centres Type II; 1 Health Post.

The issue of street-lights, and the importance of well lit streets (whether public street lights or the outside lights of all other connected customers) in providing a safer environment after dark, has been discussed elsewhere.

- *Commercial/private sector consumers connected. (JC 5.4)*

While connection fees are an issue for household connections in Tanzania, this is not the case for businesses, where raising the funds for the connection fee does not generally pose a problem. Rather, once connected, businesses complain about the reliability of the power supply and the power cuts – and consequently the increased expenses needed to maintain a stand-by generator. (Tanzania Country Study, EQ5)

Existing productive enterprises will generally connect to the new grid as this reduces the costs of their existing supply, normally provided by diesel generators. In Ribáuè/Iapala (Mozambique) the productive capacity of the existing cotton factory has improved after connection as well as the profit margins; this is linked to an exogenous increase in diesel and cotton prices, as well as the provision of a reasonably reliable supply provided by EdM. The service sector (such as restaurants and hotels) is less dependent on a reliable supply as most cooking is still done using biomass, and kerosene lamps are always available in case of power cuts. However, investing in new productive enterprise which require a reliable supply will need a thorough risk analysis before investing in electricity-powered machinery.

- *Households connected (also in relation to non-connected households). (JC 5.5)*

The number of households connected, and hence also the number of households that can benefit from favourable or targeted tariff regimes, needs to be put into the perspective of the number of households that can potentially avail themselves of the benefits of tariff subsidies. In Tanzania, this excludes 92% of poor households.[64] No exact comparable figures are available for Mozambique, but they are of the same order.

With respect to consumers connected as part of rural electrification programmes, targeted subsidies will help poorer households to connect. For most potential consumers, the initial capital investment is high, and charging the full capital cost to the few initial clients will

[64] Figures taken from *Millennium Challenge Account* report (2013) on the electricity subsidy policy. The report also notes that: "*the existing 'across the board' subsidy, which is consumption linked, is not beneficial for the country, as a vast section of the population that is not connected remains outside this benefit area due to low level of access*" (p. 46)

make the product too expensive for individual clients and eliminate poorer households.

Table 13 Tanzania and Mozambique: variations in household dependency on agriculture and employment

Of those interviewed, the Tanzania case study reported that 48% (connected) and 64% (non-connected) households had agriculture as a source of income; for Mozambique, this was, respectively, 35% and 76%. Interesting, for Mozambique, 41% of those connected reported employment as a primary source of income ahead of agriculture. This is seen as being linked to the fact that the two Mozambique case study areas included four rural towns of which three were district capitals, providing public sector employment coupled with the employment opportunities presented by the cotton-ginning factories. By contrast, the Tanzania cases were more "rural" in nature. **(Tanzania and Mozambique Case Study; Desk Study, EQ5)**

By contrast, studies also show that consumers are more able to manage monthly payments as well as manage their consumption, when introducing technology improvements, such as pre-paid meters. The lifeline tariffs, where these are in operation, also do not support a high load, thus accepting, by default, that cooking with electricity is not an option and that the connection is simply for the provision of very basic services. A related finding is that the lifeline tariffs (less than 50 kWh/month) are not necessarily connecting poor households; rather they tend to be "normal" middle-income households using less than 50 KwH/month, who don't need more than the very basic services.

The case studies have also shown that once an area has been connected, new clients will continue to connect. The most important condition here seems to be the creation of a local distribution area to which consumers can connect. Although interventions often fail to achieve the target number of connections before the end of the project (see table below), once an area is connected new consumers continue to connect at a steady pace and rapidly overtake the numbers targeted in the project documents. Thus, in Ribáuè/Iapala Mozambique, ten times as many clients were connected in 2013 than were connected at the end of the intervention period. A similar pattern is observed for the other cases.

Table 14 Progression of connections compared to project targets (objectives)

Mozambique case studies[5]						
Ribáuè/Iapala (1997–2000): target – 1,000 households; 25 SMEs, commercial consumers, health centres, and schools						
2001	601	2005	1,882	2013	6,285	Domestic: 6.041; institutions/private sector: 244
Morrumbala/Mopeia district (2001–2004): The project objective was the connection to the national grid enabling about 1,300 households, 35 SMEs, commercial consumers, health centres, and schools						
Morrumbala						
2005	527	2009	1,640	2013	2,409	Domestic: 2,158; institutions/private sector: 251
Mopeia						
2005	180	2009	766	2013	1,200	Domestic: 1,074; institutions/private sector: 126

Tanzania case studies						
Serengeti District (2003–2008): The objective was to connect the district to the national grid enabling 1,000 initial connections (not specified in relation to HHs, business or public sector institution and current figures do not specify neither)						
Year	2008	2009	2010	2011	2012	2013
Number of connections	1,448	1,541	1,645	1,778	1,987	2,181
Makambako Sub-station and Network Expansion in Njombe (2004–2007): The objective was to install a sub-station in Makambako and connect Njombe region to the national grid. Figures below are for Njombe District.						
2007	1,025 new connections established during the project. NB: The number of existing connections prior to the project was approx. 3,000. So 4,000 total in 2007		2012	Current number of connections in Njombe District is 6,580.		

[65] Note: in Mozambique, EdM does not distinguish between connections to public institutions and private sector connections; only between domestic connections and "others".

5.4 IMPACT

5.4.1 Effects on living conditions

EQ6: To what extent has better access to electricity affected socio-economic development and the living conditions of people living in poverty?

Better access to electricity has the **potential** to positively affect the lives of people living in poverty. The **extent** depends on a number of factors linked both to the interventions and their sustainability, to supporting complementary interventions, and to the broader context within which the interventions happen. Provision of electricity, in and of itself, is not enough to sustainably affect the lives of people living in poverty just through its simple presence. How the **outputs** of electrification programmes interact with other interventions and with contextual factors dictates both the broader **outcomes** as well as the **impacts**.

The most basic improvement to the living conditions of rural people living in areas where electricity has been provided is that there is now electric light where before there was light from kerosene/candles/batteries. This alone, for many people, makes it all worthwhile. Being able to move around at night, having access to TV and radio, and being able to go to the shop in the evening are enormous improvements for all households – connected or not.

Nevertheless, the potential for electricity to improve the living conditions of rural people (including those living in poverty) is based first and foremost on the provision of a reliable power supply. All other social and economic improvements are dependent on this condition being met. The evaluation found that power supply to case study areas was erratic and unpredictable. As a consequence, many potential benefits were not realised or only partially realised.

Unexpected benefits, found by the evaluation, which are difficult to quantify, included the ownership and access to mobile phones and all their advantages (communication, money transfers, etc.). Such technology improvements, which need a power source to recharge batteries, were not foreseen when the projects were planned.

Electrification of **public services** and of the **productive sector** has the potential to make a significant impact on the conditions of people living in poverty. Apart from a reliable power supply, public services require both capital investment costs (connection fees, internal wiring, electrical equipment, etc.) as well as funds to cover the recurrent costs to pay the electricity bill. The productive sector, for its part, needs complementary investments to be made in parallel (improved infrastructure, access to finance, etc.), to support their development within the area served by the arrival of rural electrification.

Judgement criteria:-

- *Electrification of public services. JC 6.1)*

Provision of electricity to an area enables the connection of public service institutions, such as schools and health facilities. As shown under JC 5.3 the number of public service institutions connected through grid extensions remains limited. Moreover with rural electrification distribution lines constructed primarily to serve the urban cores of rural towns, households and public institutions (schools, health centres) in remoter locations remain largely unserved. The Desk Study, quoting experience from Zanzibar and also international experience, notes many positive aspects of public service improvement that come after "intensification".[66] (Desk Study, specifically EQ6). The example of the non-payment of street lighting bills in Tanzania illustrates the problem of an intervention happening in isolation or based on the premise that once electricity arrives in a rural area, the rest happens automatically. However, if sector ministry budgets (or the project budget) do not include, for example, internal wiring for schools and health centres, they don't get wired; if there are no capital funds to connect the institutions, they won't get connected; and if there are no recurrent budgets, the bills will not get paid. (Tanzania Case Study, EQ6); moreover, if the public services are located too far from the distribution lines, they won't get connected. (Mozambique case study, EQ5)

Improvements in public service provision can also arrive in a more roundabout way, as the provision of electricity to an area can make it more attractive for qualified teachers and health workers to stay in the area, especially if their residence has electricity. Given that public servants are salaried, they will normally be in a position to afford better housing conditions – including electricity; thus, all things being equal, more competent staff will give better service. (This is supported by information from the case studies; but also by considerable anecdotal evidence from elsewhere). Challenges linked to the regular payment of teachers and health workers salaries can moderate these benefits.[67]

[66] "Intensification" in the sense of increasing the number of consumers within a connected area; as opposed to "extensification", which focuses on opening up new areas.

[67] As exemplified by the delays in implementing decentralisation of planning and budget execution in Tanzania. Source: Swedish Embassy, Tanzania.

Table 15 Tanzania: provision of electricity to educational facilities

In Tanzania it was found that the high potential impact on children's education of better lighting, modern technology, and prolonged working days for teachers implies that the government prioritizes to connect all primary as well as secondary schools in the defined project area in the initial phase of the project. While all secondary schools applied for connections immediately after an area has been electrified, experience has shown that most of the primary schools which are not connected before project implementation normally remain unconnected regardless of the overall development of an area or district. Most primary schools are day schools and students stay far from them, which make them unable to come back in the evening for preparations making the need to connect schools unjustifiable. Connection of secondary schools on the other hand is necessary in order to make students have quality light for evening studies etc.

The benefits of lighting in heath centres giving light 24/7 is an enormous improvement over the past where patients would have to provide their own kerosene lights for night-time emergencies. Lights at the hospital have also meant that now the existing generator can be used as a standby generator when power cuts happen rather than the hospital being dependent on the generator as their single source of supply (and dependent on having enough funds to purchase diesel to run it). **(Desk Study EQ6; Tz Case Study EQ6)**

Taking the definition of providing a service to the public into a wider context, the practice that most connected households (as well as businesses such as restaurants, bars and hotels) have outside lights does contribute to a greater feeling of safety – a "feeling of safety" which public street lights should have provided. (Desk Report, EQ6)

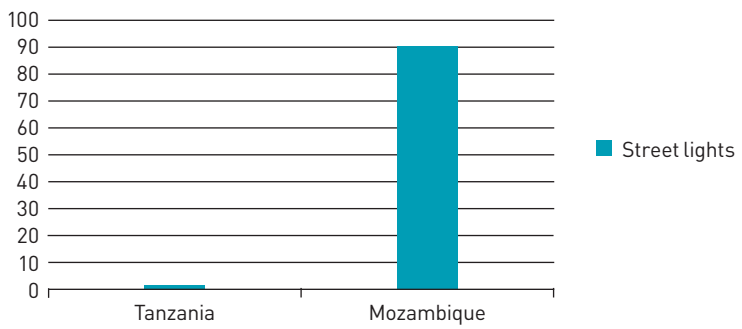

Figure 3 Reported benefits from streetlights

The assumption that lights would make it safer for individuals (especially women and girls) to move around at night seems to hold true; however, it is not the streetlights provided as part of rural

electrification projects but rather the exterior lights of connected households and the private sector that contribute to providing this "feeling of safety". In Tanzania, the streetlights provided as part of project design don't work because the local authorities don't pay the bills. The experience from Tanzania suggests that this is because the challenges of bringing ownership of public investments down to decentralised government levels were not well analysed. Streetlights were cut by TANESCO when local authorities did not pay the electricity bill and have not worked since. (Tanzania Case Study, EQ5 and EQ9) In Mozambique the situation is both similar and different. Similar in the sense that energy consumption for streetlights, and their maintenance, is supposed to be paid by the local authorities; and similarly the bill is rarely paid. However, different in the sense that EdM is reluctant to cut streetlights. Instead, when the lights break or need replacing, they are at the end of the list for maintenance. Nevertheless, anecdotal evidence suggests that sufficient pressure is put on EdM to repair and maintain streetlights, despite payment problems. (Mozambique Case Study, EQ5). This is also reflected in the responses to the Household questionnaires.

- *Job creation and economic development. (JC 6.2)*

As mentioned above, it is easier to retain qualified health workers and teachers in areas where their houses have electricity.

However, when looking directly at the response of the private sector in the case studies, both Tanzania and Mozambique case studies report increases in both production and increases in profits (significantly higher in Tanzania) whilst also reporting a smaller increase in number of employees (significantly higher in Mozambique than in Tanzania – probably a reflection on the fact that the electricity supplied by EdM is more reliable than that supplied by TANESCO (Mozambique/Tanzania case study EQ 6; as well as Annex 8 of this study). The increased profits are seen as being linked to: lighting for extension of working hours for bars, groceries, household business and household income generating activities. Generally the "effects of rural electrification are greater on home enterprises than those from medium and large firms". (Desk Study EQ 6).[68]

The Mozambique case study points to the importance of the cotton ginning factory and the benefits of connection to EdM; but the Desk Study also notes that this is difficult to replicate noting instead

[68] The cotton factory is the exception here. It is also not a new enterprise, pre-dating the rural electrification programme and replacing its stand-alone diesel with a grid connection.

that small-scale rural production and business activities (such as: mills, pumps for irrigation, mechanical workshops, poultry farming, dairies) are seen as having a greater development potential and wider application than large scale activities, such as factories. The Mozambique case study also notes that the cotton-ginning factories pre-dated electrification, as did the TanWat industry in Njombe, Tanzania. In other words, the industry pre-dated the rural electrification programme and then benefitted from the programme once it arrived. Moreover, the connection of an existing rural industry to the grid is a strong factor supporting a better cost-effectiveness.

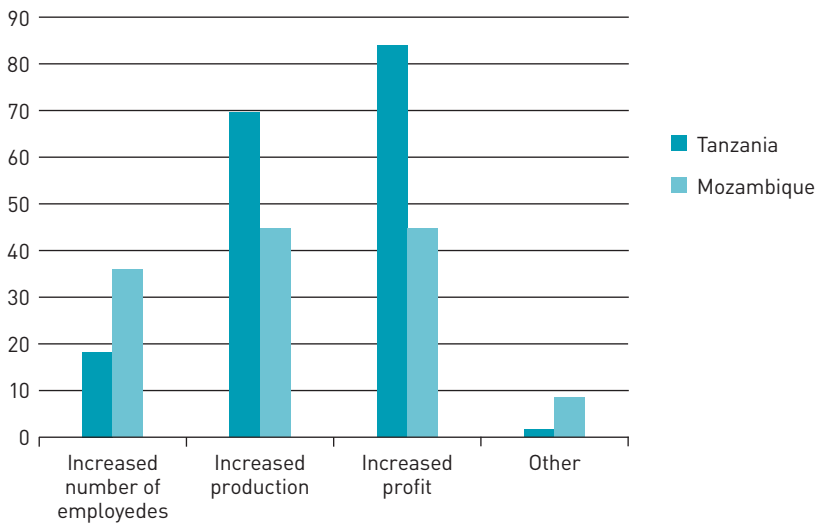

Figure 4 Changes since business connected

The issue here, as also raised in respect of public institutions, is that rural electrification is more effective when there is a specific programme to promote the productive uses of rural electrification. Thus a lesson learned is the need to reach beyond small-scale low load increases, which essentially concentrate consumption during evening peak hours (allowing for extended working hours in shops, bars and restaurants). Instead, increasing effectiveness of electrification through harnessing the potential for the transformation of agriculture production and the development of service industries, including light manufacturing. It is clear that the lack of significant productive uses of electricity remains a constraint on the financial viability of rural electrification, because of the low daytime load

factors. (Desk Study EQ6). Notwithstanding the above, the key remains the reliability of the power supply that, notably, TANESCO has had problems guaranteeing. (See Country Case Studies: EQ1; EQ4; EQ5; EQ8).

An additional note of caution may be appropriate. While businesses included in the case study reported positively (overall increased employment, production and profit), more efficient production and better machine may also result in job losses or reduce the human workload. (Tz Case Study, EQ 6)

- *Changes in household energy consumption patterns (JC 6.3)*

With respect to connected households, the dominant use of electricity in rural households is lighting. However, as a result of the unreliability of the power supply all households (connected and non-connected) continue to also use kerosene/candles/batteries for lights. In Tanzania, as an indicator of the frequency of power cuts, the main back-up source for lights is kerosene (61%) followed by candles (47%); by contrast in Mozambique only 5% have kerosene as a back up, with 80% reporting candles as their back-up suggesting that EdM is able to provide a more reliable power supply than its Tanzanian counterpart. (Tanzania and Mozambique HH questionnaires)

Connected and non-connected households also share the requirement for energy sources necessary to re-charge mobile phones. Communication using mobile phones is one of the main areas where the nature and quality of a service to both connected and non-connected households has improved since electrification. Mobile phone communication provides a service to the public (even though service providers are private or public-private enterprises), the installation of traditional telephone lines. No distribution lines are required – just a stable source of electricity for the transmitting tower.

Table 16 Mozambique and Tanzania: mobile phone penetration

According to the BBC's Click Online Programme: "in a country where only one in 10 households has electricity, some 97% of Tanzanians say they can access a mobile phone, and what is just as interesting, as in many African countries, is how those phones are being used. Including as a tool for business development. And for people who don't actually have cell phones, call centres have sprung up everywhere."

BBC Click Online, 2005. http://news.bbc.co.uk/2/hi/programmes/click_online/4706437.stm

Mobile phone penetration is less widespread in Mozambique. Thus although all 128 administrative districts have mobile network coverage, in most cases this is restricted to a 5 km radius of the district headquarters town.

http://infoasaid.org/guide/mozambique/telecommunications-overview

Connected households still have a higher percentage of phone ownership than non-connected (in the Tanzania Case Study 98% compared to 69%; and in Mozambique 87% of connected households and 42 % of non-connected households reported needing access to electricity to charge mobile phones). With a third operator now active in Mozambique since 2012 and continued expansion of base stations, the rural mobile phone customer base is expanding rapidly. (Mozambique & Tanzania Country Studies questionnaire responses).

Spin-offs from the ownership of mobile phones include the potential to undertake financial transactions making for easier payment of the electricity bill and other services. The widely used pre-paid system for SIM-cards also confirms that consumers are perfectly capable of managing consumption patterns and payment systems, such as those also used in pre-paid (electricity) meters. The Tanzania case study also reported the use of mobile phones by dispensary staff in communicating with health authorities, etc. (Tanzania case study, EQ6).

In respect of non-connected households, the only real change in energy consumption patterns of any significance is the increased ownership of mobile phones; and the need to charge their batteries.

For the rest, non-connected households continue to use kerosene/candles/batteries for lights; and continue cooking using biomass. The discussion on cooking and biomass is further explored under EQ8.

- *Changes in household time management. (JC 6.4)*

Very little evidence was available on direct changes in time management from the case studies. There is some improvement noted in centres where electric pumps supply water and there are also indications that the provision of electric lights has had an impact on longer opening hours and more diverse activities in the evenings. The Desk Study, however, notes a number of benefits which start to accrue as electrification becomes more a part of daily life, as electrification within an area "intensificates" and as power supply becomes more reliable (access to information; better access to schooling – and increased safety for girls; longer opening hours; easier to move outside after dark, etc.).

The provision of electric power driven grain milling (cheaper and cleaner than using diesel) is seen as a benefit, but does, in some cases, take longer when the grain-milling facilities are further afield. (Tanzania Case Study, EQ6). Nonetheless, generally speaking, the electric mills provide a quicker and cleaner service.

- *Impacts on forest resources. (JC 6.5)*

Studies have shown that it is not only the continued use of biomass that, necessarily, has the most significant impact on forest resources – land clearing for agriculture, cattle grazing and construction also contribute significantly.[69] Nonetheless, continued use of biomass for cooking will have an impact on the forest resource around rural settlements. This in turn will have an impact on household time management – especially on those household members charged with gathering firewood, as they will be required to go further afield to access the resource. Alternatively, households will need to purchase either firewood or charcoal, which will also become more expensive as the distance to and from the market increases; thus having an impact on the household budget.

The use of improved stoves has the advantage of both reducing household air pollution but also reducing the amount of biomass needed in cooking. The fact that even connected households continue to use biomass for cooking underlines the fact that electricity is not an alternative; and that better, more efficient and more resource-sustainable approaches to cooking and biomass use are needed. (See also EQ8)

[69] Source: Gaunt, 2003. p. 138.

5.4.2 Impact on poverty

EQ7: To what extent has there been an impact on poverty at different points in time after the completion of the interventions; and to what extent has electrification contributed to this?

The multi-dimensional definition of poverty includes more than just low income; it also includes lack of access to health care, schools and social security, as well as exposure to violence, injustice and powerlessness. However, quantifying this, even the more tangible aspects such as income, is difficult. This is so, even when related to statistical trends, as the necessary data, even when available, are difficult to disaggregate down to district level. It is also essentially impossible to define the effect of independent upon dependent variables in the case of rural electrification.

Certain positive trends are clear concerning both tangible and intangible benefits. Simply bringing electric light into a previously non-electrified area increases exposure to the outside world, opens communication channels and includes an unquantifiable "feel-good" element. Electricity brings light where previously there was none; enables contacts with the outside world through images (TV, where previously there were only battery-driven radios); and establishes two-way communication with the outside world, through mobile phones. Electrification is a factor that contributes to improved public services such as health care and education, but in and of itself, is not a sufficient factor to make a tangible difference. Other interventions are needed to add value to the opportunity provided through electrification (qualified staff; appliances; supply of drugs and educational materials; local government competence and financial resources; etc.) as well as needing greater geographical coverage (improvements are restricted to those areas where distribution lines are provided). Electrification of rural towns has also brought with it the potential for increased employment.

Nevertheless, in order for there to be a more tangible impact on poverty as a result of rural electrification, the provision of electricity needs to be actively placed as one of the elements within a broader development context. This means not providing electrification in isolation as a simple project intervention, but relating the intervention to other contextual interventions (such as improved public services or stimulation of growth and employment).

Judgement criteria:-

- *Poverty statistics (JC 7.1)*

The evidence base for establishing visible positive correlations between rural electrification and poverty remains thin. (Desk Study EQ 7 based on studies by GTZ and World Bank). Generally, the groups that have benefitted most from electrification are small and medium-sized enterprises, and households with a certain income level that enables them to connect. [70]

The data, which the team has been able to retrieve on poverty does not disaggregate by district, but only provides information on rural versus urban clusters. Nonetheless, the increase in the number and nature of businesses, which the case study districts have seen in the period covered by the evaluation, is assumed to have a positive impact on poverty reduction, but due to lack of socio-economic indicators, it is not possible to provide further evidence. (Tanzania and Mozambique Case Studies, EQ 7). Increase in employment in the Mozambique case study area is also assumed to have an impact on poverty reduction. (Mozambique Case Study data; and data quoted in the Desk Study, EQ 7, drawing mainly on Åkesson & Nhate, 2002)

A common characteristic of both Tanzania and Mozambique is that high economic growth and impressive macro-economic performances have not been translated into poverty reduction. Thus, while the economy showed sustained high growth rates, there is little evidence that the income distribution has changed dramatically. Even with the economy growing at some 8% each year during the period from 1997 to 2009, the average annual reduction of the poverty headcount of 1% is small. [71]

- *Benefits to non-connected households. (JC 7.2)*

This criterion covers not only those households who could potentially have been connected; but also those who use the services in the area but maybe live outside the immediate zone. In this respect, the pre-selected case studies included in this evaluation are all grid

[70] As discussed elsewhere in this study, the ability of a household to connect will vary not only in accordance with their income, but is also dependent on the financial constraints or incentives imposed by the power provider and/or development partner (constraints, such as full payment in advance; or incentives, such as subsidized connections with payment over time, etc).

[71] The figures and conclusions for Mozambique are taken from: Boom, 2011: *Analysis of Poverty in Mozambique.*

extensions and here, as also noted in the case studies, the focus has been on the urban cores of the rural projects, rather than on remoter households or institutions. For example, in Tanzania, the cost of individual connections more than 30 metres away from the distribution lines needs to be fully borne by the connecting household. Even with subsidized connection fees, the physical cost of bringing electricity to households is prohibitive for most rural households – and certainly for those households "living in poverty". The same applies to Mozambique.

In the case study areas, a number of potential direct public service benefits were not realised – including electrification of schools, health facilities, water supply and streetlights. It can be argued that certain indirect benefits have been obtained, such as connected households with outside lights providing street illumination; teachers and health workers more willing to stay because of better housing facilities and entertainment facilities. These benefits are mostly anecdotal (qualitative data) and difficult to quantify, but would, in theory, benefit all and not just connected households.

Certain tasks have been made easier, such as grain milling, while others have remained virtually unchanged. Firewood still needs to be collected for cooking and, in the absence of a functioning improved water supply, water still needs to be fetched. Communication has improved through access to radio and TV (either through neighbours, or shops and restaurants); and through the expanding mobile phone network and the ever-increasing ownership of mobile phones.

- *Benefits to connected households. (JC 7.3)*

While connected households in both Tanzania and in Mozambique are definitely more resource strong than non-connected households living in the electrification distribution area, they are by no means rich. The need to subsidize connection costs and the generally low load usage would bear this out this. Therefore most impacts are modest due to low household consumption of electricity, essentially being limited to lighting, plus radio and TV. Communication with the "outside world" has also improved through mobile phone communication. (Ref: HH questionnaires).

In addition to the direct benefits at household level, connected households and non-connected households essentially have access to the same indirect benefits, notably access to public services and the business sector.

- *Benefits to business. (JC 7.4)*

Businesses have profited from electrification both in terms of increased employment, increased production and increased profits. Contextual factors play a role here, with the most important factor seen as being the provision of a reliable power supply. This condition is met more in Mozambique than in Tanzania. (Tanzania and Mozambique Case Study, various references) Multi-country evidence suggests that the number of (home) businesses grew significantly with the introduction of (reliable) electricity. (Desk Study, EQ7). In respect of meter sharing, over half the businesses interviewed in Tanzania (53%) reported that the business shared a meter with the household connection, while in the Mozambique case study areas this was not even 10%. (Household questionnaires). It is difficult to advance a completely adequate explanation for this difference, but it may be linked to the fact that businesses in the Mozambique case study areas tend to employ more people (19 as compared to 3 full-time employees in the Tanzania sample). It is not just the cotton ginning factories pulling up the average, as 43% of businesses in the Mozambique sample, compared to just 15% in the Tanzania sample, reported more than 3 fulltime employees. It can be assumed that a more reliable power supply may influence the creation or expansion of a business.

Banking and access to credit are important contextual factors limiting expansion. There is no banking system in Ribáuè and access to credit is difficult to obtain. Therefore, the main factor contributing to employment growth there is the increased levels of sales and the corresponding increase in production levels of the cotton ginning factory, and its need for more labour. It is more difficult for other (small) businesses to expand in a situation where access to credit and banking facilities are needed, although a number of new shops, bars and restaurants have been established. (Mozambique Case Study EQ 6). Thus, while both Morrumbula and Ribáuè have a cotton-ginning factory which provides core employment, only Morrumbula has banking facilities, including ATM; for Ribáuè the nearest bank is 140 km away in Nampula. And while Iapala has a good railway station on the Nacala-Malawi railway, the line is under-utilised.

5.5 SUSTAINABILITY

5.5.1 Environmental consequences

EQ8: To what extent have rural electrification programmes contributed to changing energy consumption patterns in a sustainable way and what are the environmental consequences?

Electrification contributes to changing energy consumption patterns with electric lights replacing kerosene lamps; by contrast, there is no noticeable impact on timber resources as households (connected or not) continue to use biomass for cooking. Therefore the focus on electrification is not sufficient to address poor households' demand for energy, and greater emphasis needs to be placed on energy and, in particular, on improved stoves.

There is some improvement in environmental health as kerosene is replaced by cleaner fuel (electricity). However, women and girls continue cooking using biomass and are more affected by indoor air pollution as a result. Therefore, an increased focus on modernising traditional cooking appliances would have both positive environmental health impacts within the household (less indoor smoke) as well as important impacts on the demand for fuel wood (hence reducing the rate of deforestation). The Global Burden of Disease Study (2012) concludes that approximately four million people die prematurely each year from illness attributable to household air pollution due to biomass and coal cooking fuels alone.

Locally there are environmental improvements as a result of grid connections replacing the need for diesel generators to produce power.

Judgement criteria:-

- *Moves towards use of cleaner fuels. (JC 8.1)*

The Desk Study and the two Country case studies confirm that while connected households replace kerosene with electricity for lighting, both connected and non-connected households continue to use firewood and charcoal for cooking. There is, therefore, no noticeable positive effect on the national timber resource. As the number of households increase nationally, so too does the demand on the timber resource and, eventually, poorer households will need to turn to low quality biomass fuels, like sisal leaves, euphorbia grasses and cow dung, all of which are more polluting than firewood/ charcoal. (Desk Study, EQ8) Connected households use electricity

for lighting but continue to use kerosene and candles in some rooms (especially kitchen and toilet) but also as a back-up during power-cuts. (More detailed analysis in Annex 7)

Businesses that used to use diesel generators have switched to grid connection, while keeping the gen-sets as back-up systems for power failures. And the stand-alone diesel systems that used to provide electricity to mini-grids have been replaced by grid connections. Not only doe this have a positive environmental impact locally, but businesses save money through connection to the national grid and national tariffs.

- *Environmental health improvements (JC 8.2)*

Connected households benefit from environmental health improvements through the replacement of kerosene with electricity – with the usual proviso that the power supply remains reliable and that the household does not constantly need to re-use its kerosene lamps as back-up. There is a certain gender imbalance built into the household's potential environmental health improvements as cooking continues to depend on different forms of biomass and women, girls and babies spend proportionately more of their time in the kitchen than do boys or men. (See also Annex 7)

Accepting that households will not switch from biomass to electricity for cooking, and also accepting that there is a risk that poorer households especially will start switching to more polluting forms of biomass, the Desk study (Desk study EQ8 drawing on work by GTZ and SEI) highlights the importance of improved stoves. Research has shown that modernising traditional cooking appliances (with savings of between 40–80% in household fuel consumption) will have both environmental health impacts within the household (less indoor smoke) as well as impacts on the demand for fuel wood (hence reducing the rate of deforestation). In addition, SEI's recent work suggests that, of the options for reducing black carbon emissions, residential stove and fuel interventions offer the highest net benefits per unit cost. This discussion is further developed in Annex 7, with analysis contained in the Global Body of Health Study (published in 2012) on health impacts; and figures from household energy use from the Mozambique and Tanzania case studies.

- *Service sector energy use. (JC 8.3)*

The replacement of kerosene for lighting, and the replacement of diesel generators (both stand-by as well as those supplying a local

grid), will have a positive environmental impact at the local level. While there is a localised environmental improvement as a result of the replacement of stand-alone diesel systems by a national grid connection, such improvements need to be put into the context of:

(i) The continued use of stand-by generators used to provide a back-up when there are power cuts, and

(ii) Connecting new areas with stand-alone diesel systems in order to meet national rural electrification targets.

Quantifying these impacts is outside the scope of this study. However diesel generators remain a tried-and-tested technology for rural electrification. While the balance may be shifting as a result of increases in the price of fuel, combined with the maturing of renewable technologies, the actual contribution to global CO_2 emissions through the use of diesel generators for rural electrification is low in comparison to the current situation in OECD countries.[72] This should also be put in the context of the construction of new regional generating capacity that is not based on hydro-electricity. For example, the construction of new coal-fired power stations in South Africa to generate more power to the Southern African Power Pool (SAPP); the exploitation of Mozambique's own enormous coal reserves; Tanzania's increasing use of thermal (fuel, gas, etc). Therefore, in the overall order of things, the connection to the national grid of a few rural towns and the replacement of their diesel generators, does not make a huge difference on the national cleaner energy balance sheet.

The discussion (Desk study EQ1) that renewable technologies are not mature enough (e.g. Åhlborg, 2012) and that connection to a local grid linked to a stand-alone diesel system is easier to deal with once the national grid arrives (see also the example of Njombe in the Tanzania Case Study) is a national level discussion that needs to involve all ministries and development partners working in the sector.

At the purely local level, the service sector replaces kerosene with electric lights and will benefit from electrification to either replace certain equipment (refrigerators) or buy new equipment (such as photo-copying machines). Wholesale replacement or purchase of new electrical equipment on any large scale will, however, be dependent on the electricity supply proving to be reliable (no power cuts; no

[72] This discussion is taken up in Ilskog, 2008, p. 43.

damaged equipment through power fluctuations). (Tanzania Case Study, EQ8) Annex 8 explores the implications of a more reliable supply on investing in electrical equipment, noting that the more reliable supply provided by EdM has resulted in less damage to electrical equipment.

By-and-large electricity is not used for cooking in hotels, bars or restaurants which continue to depend on biomass; therefore the negative side of the equation could be that as more hotels, bars and restaurants open, the demand for firewood and charcoal increases.

- *Household use of biomass. (JC 8.4)*

Rather than decreasing, and as the population increases, the absolute amount of biomass used within households for cooking is increasing. In fact, as expected, rural electrification has, to date, had no noticeable effect on the non-sustainable utilisation of the forest biomass resource.[73]

A significant difference between Mozambique and Tanzania though, is that while virtually 100% of households in Tanzania (connected and non-connected) continue to cook on open fires or traditional stoves, there is a significant trend in Mozambique towards the use of improved stoves (with over one-third of households reporting using an improved stove for cooking) (Tanzania and Mozambique HH questionnaires; and Annex 7 of this report). A shift to improved stoves can have a major health impact on the women and girls responsible for kitchen work. The Mozambique Ministry of Energy is actively involved in the promotion of cleaner cook stoves, promoting, for example, the POCA charcoal stove in close collaboration with programmes such as PROBEC[74] and C-Quest Capital.[75] The stoves are available on the market and marketing chains exist within the private sector allowing rural families to access these stoves, which are also affordable to poor rural households.[76] The experience

[73] Reference is also made to SEI/Renetch 2012 which noted the continued non-sustainable harvesting of forest resources and the abolute increase in bio-mass use; also in urban areas.

[74] PROBEC. http://www.stoves.bioenergylists.org/taxonomy/term/56?page=1

[75] C-Quest Capital. http://www.cquestcapital.com/programs/cookstoves-in-malawi/

[76] In respect of Tanzania, the Swedish Embassy has noted that following negative experiences and cumbersome implementation, Tanzanian authorities are reluctant to work with improved stove programmes. Exploring this in more depth was outside the scope of the present evaluation.

from Tanzania is less positive and there is a reported reluctance from the authorities to continue work with improved cookstoves.[77]

The case study results show no change in cooking patterns – a general finding also confirmed by the Desk report. In fact the global dependence on wood fuel is projected to grow and cannot be neglected: to the extent that biomass production on a renewable basis remains the top priority in meeting the energy needs of the poor. (Desk – EQ6). Meanwhile, the use of traditional forms of energy for cooking causes serious health problems in households, with biomass fuels such as firewood, charcoal, dung and agricultural residues often the only sources available.

Table 17 Household Air Pollution links to biomass and kerosene

WHO has shown that 1.5 million deaths every year are caused by indoor air pollution from traditional cooking stoves. Most of these deaths are among women and children. **(Desk Report EQ6)**.
While the Global Alliance for Clean Cookstoves estimates that in Tanzania the percentage of the population using "solid" fuel (basically biomass) is in the region of 95% and that the number of Household Air Pollution (HAP) related deaths annual is in the region of 18.900; the comparative figures for Mozambique are 80% with an estimated 11.000 HAP-related deaths per year. (http://www.cleancookstoves.org)
Electric lighting has a number of positive health effects. One major positive effect is that it has reduced the uses of kerosene and other sources of lightning (candles, torches, firewood). According to the World Bank study on impact by rural electrification "Kerosene lamps emit particles that cause air pollution; these are measured by the concentration of the smallest particles per cubic meter (PM10). Burning a litre of kerosene emits PM51 micrograms per hour, which is just above the World Health Organization 24-hour mean standard of PM10 of 50 micrograms per cubic meter. But these particles do not disperse so burning a lamp for four hours can result in concentrations several times the World Health Organization standard". **(Tanzania Case study EQ6; and Annex 7 of this report)**

The inference that can be drawn here is that men may derive more health benefits from electrification than women because men will benefit proportionately more from a change to electric lights (less exposure to kerosene) than women (continued exposure to

[77] As reported by the Swedish Embassy/Tanzania. No further data was available to enrich this study.

Household Air Pollution in the kitchen through use of biomass). Women's role has, essentially, not changed dramatically as they continue to be responsible not only for work in the kitchen, but also for collection of firewood and water. Proportionately women are likely to have less leisure time to benefit from the electric lights in the sitting room than men. Accepting that biomass will continue to be used, the only way to have a serious impact on the debilitating effects of Household Air Pollution will be through cleaner improved stoves.

5.5.2 Sustainability of interventions

EQ9: To what extent are the established electrification services sustainable during the life cycle of the intervention and after the exit of the development partner?

Serious sustainability issues already exist, even in a situation where the numbers of connections within the service area continues to expand. Increasing the number of social customers (i.e. poor households) paying tariffs below cost recovery levels simply makes the interventions even less financially sustainable. Notwithstanding, the main problems with respect to financial sustainability are caused by non-technical losses attributed to large customers not paying their bills (particularly government) together with tariffs perennially set at levels below cost recovery.

Where power generation and distribution system capacities are overloaded, frequent power cuts occur. Where national generating capacity is insufficient, for whatever reason, rural electrification distribution systems are the first to suffer as the tendency will always be to provide electricity to urban high-density high-load areas first, and load shed the more remote areas. Unless these challenges are tackled, sustainability is in jeopardy.

Judgement criteria:-

- *Energy is supplied continuously (JC 9.1)*

A major factor on which sustainable electrification service will be built is the perceived dependability of the electricity supplied. Productive enterprises cannot be established unless reliable energy is supplied continuously. In the two Mozambique case studies this was clearly the case, with power cuts and damage to electrical equipment reported to be present but within reasonable limits; this was not the case for Tanzania, which has led to serious negative consequences. (Tanzania Case Study, EQ8)

The low load factor and the evening peak factor are similarly issues related to system capacity. The examples from Tanzania are of low load connections with an evening peak, as the lights go on; the Mozambique cotton-ginning factory, by contrast, is an example of an industrial daytime load that needs a constant and reliable supply.

The situation in Tanzania is one of an absolute shortage of power, leading to unmet demand, load shedding, unreliable supply and lack of reliable access to electricity in rural areas connected to the grid. (Desk Study, EQ 9) There are reasons for this which are linked to reduced hydro-power capacity as a result of climatic conditions and increased reliance on diesel power to bridge some of the gap (at a high cost to TANESCO because of the global increase in fuel prices). While steps are being taken to increase generating capacity (see, for example, Annex 5.2) the result remains a down-prioritisation of rural areas at the expense of the urban areas when load shedding is necessary.

Table 18 Insufficient system capacity to meet increased demand

In Tanzania, even if poor (rural) households could afford to connect, there is not enough system capacity to allow for major increases in system demand. Although electrification targets exist, many are unrealistic (e.g. Tanzania's electrification targets in 2015 are almost 10 times the annual average for 2007- 2012) implying a huge funding gap – and probably also an organisational capacity and capability gap. The same holds true for Mozambique, particularly for those areas too far from the Cahora Bassa transmission lines where new investment is required. **(Desk Study, EQ9)**

Rural electrification is generally considered not to be a commercially viable investment; hence it is left to governments supported by international development partners, to bring electricity to remote areas. While the non-commercial viability of rural electrification is challenged in some of the literature (Mulder & Thembe, 2008 quoted in Desk Study EQ9), in particular using the example of the Ribáuè/Iapala project, which demonstrates that rural electrification can be commercially viable and lead to structural transformation within a short period of time, the example is built around a main driver, a rural industry (a cotton-ginning factory) which pre-dated grid connection. Thus the example actually illustrates that a number of factors need to come together for sustainability.

Any approach to rural electrification which focuses purely on poverty alleviation, where consumers derive social rather than economic benefits, will result in system losses, low load and political

choices to focus reliable and sufficient power in the urban/industrialised areas; while the continued reliance on subsidies for rural connections rocks the very principle of sustainability. (Desk Report, EQ 9 drawing on Gaunt, 2003 a.o)

- *Maintenance procedures in place and functioning. (JC 9.2)*

National utilities struggle to maintain already *existing* systems (both technically and financially). In these circumstances maintaining a rapidly expanding system in order to meet (unrealistic) electrification targets within a context of ongoing subsidies and politically influenced tariffs, is unlikely to be successful. The Desk Study (EQ9), quoting a number of studies, underlines the importance of non-technical aspects, such as governance and institution building, impacting on the sustainability of (electrification) projects. The principal challenge remains to balance financial sustainability with growing coverage, demanding increased efficiency while limiting system losses. These system losses are further exacerbated by approaches that focus on social (i.e. poverty alleviation) rather than economic benefits. (Desk Study EQ9; Inception Report Section 3.2; Gaunt 2003, p. 11)

Both the Tanzania and the Mozambique case studies report that maintenance procedures are in place. For example, in Tanzania, maintenance routines require that every three months TANESCO checks the lines, changes damaged poles, and changes the fuses in the transformers. However, despite the maintenance plans, some challenges were noted during the study, which gave the impression that in reality the maintenance procedures do not work to perfection. (Tanzania Case Study EQ9)

Provision of spare parts is sometimes a problem – as also shown in the example from Morrumbala (Mozambique Case Study) where 74 meters were stolen and the Quelimane Customer Service area did not hold enough in stock to replace the stolen items. The majority of customers were therefore without electricity awaiting the arrival of new stock.[78] EdM has also been criticised for focussing too much on installation, with technical capacity necessary for operation and maintenance being diverted to expanding the number of new connections.[79]

[78] The suspected thief was apprehended quite easily as there is no market for these meters – which all have their unique identification number – apart from EdM.

[79] Norplan 2013, p. 25/26

Generally the reliability of EdM's High Voltage and Medium Voltage lines is good and power interruptions are logged and monitored. In addition it is noted that while there were a number of non-planned interruptions, the bulk of the power cuts relate to interruptions linked to planned maintenance; although the Norplan study also notes problems in the transmission/distribution system caused by long line lengths and low loads contributing to instability and voltage fluctuations.[80] By contrast, the washing away of power lines on the Zambezi north bank between Mutarara and Chimuara, during the floods (see also EQ10) cannot be attributed to a lack of maintenance but more to an unfortunate coming together of extreme weather conditions. (Mozambique Case Study, EQ3)

- *Covering infrastructure depreciation. (JC 9.3)*

The two case study countries and the literature review of international experience note that external financial support is necessary to cover initial investments. The Desk Study also notes that: none of the organisations are able to accumulate capital for re-investment, which becomes a major sustainability issue. (Desk Study, EQ9). Particularly government utilities lacked the ability to reduce non-technical losses much of it related to the non-payment of electricity bills by the different government institutions. This is a major governance issue, not only linked to straight non-payment of the electricity bill but also linked to other governance issues, such as flawed tenders. The East African, reports that the bulk of TANESCO's large debtors are: companies, factories and institutions.[81] The governance issue is also underlined in the comparison of non-technical losses (which include: theft; illegal connections; non-payment) between Vietnam (3% total system losses) and Mozambique (30%).[82]

In addition, politically fixed tariffs set below system sustainability preclude the ability to cover depreciation costs. Studies show that the estimated "Willingness to Pay" for rural electrification is high and almost invariably exceeds the average supply cost for areas in which grid connection is considered feasible. The immediate implication of this finding is that the financial rate of return can be raised by increasing tariffs if a stronger financial rate of return is needed to

[80] Norplan 2013, p. 27.

[81] *The East African*, September 2012. http://www.theeastafrican.co.ke/business/Tanzania-recovers-1-million-US-dollars-in-power-theft-crack-down-/-/2560/1514452/-/byni3ez/-/index.html

[82] The Vietnam evaluation IBRD/WB 2011, highlights the culture of payment that has been instilled in the Vietnamese system.

secure sustainability (Desk Report, EQ9). The Vietnam example shows that it is possible to put in place transparent and effective systems of governance for the electrification sector, as well as setting and managing cost recovery tariffs at levels that allow for sustainability.

- *Sufficient technical and institutional capacity. (JC 9.4)*

National utilities already struggle to maintain existing systems (both technically and financially).

Nonetheless, in the case study areas households and businesses have requested and paid for new connections after the completion of the projects; even though, in Tanzania for example, many have to wait for around six months after payment of connection fees (reportedly due to the centralised procurement system). Meanwhile public institutions are hardly connected after project completion (see also discussion above on non-payment of electricity bills by government). (Tz. Case Study, EQ9) In Mozambique, sufficient customer service capacity and materials (poles, cables and meters) exists within EdM to connect new customers. [83] However reports also suggest that this comes at the expense of EdM's maintenance obligations.[84]

- *Capacity to accommodate increased demand. (JC 9.5)*

Both Tanzania and Mozambique are faced with a nation-wide lack of generating capacity. On a daily basis, this is manifest through power cuts. With the favoured approach to rural electrification being through grid extensions, it is the absolute capacity of the national grid that defines how many new projects can be implemented. Expanding rural electrification *extensively* implies expansion of the national transmission network (which is costly) while *intensification* within already connected areas is less expensive but also draws on already stretched generating capacity.

Both Tanzania and Mozambique are presently involved in the construction of so-called mega-projects which are likely to help increase national capacity – even though they are first and foremost being implemented to support major industrial industries and for export. The mega-projects will address the national generating capacity requirements and will also include a number of extensions to the national grid. This is being addressed in Mozambique as part of the EdM Master Plan Update Project. (Annex 4 contains maps of

[83] For example, in Morrumbala the number of customers in 2005 was 527 and in 2012 this had increased to 2.435; for Mopeia this was 180 (in 2005) and 1,188 (in 2012)

[84] Norplan, 2013.

the existing national grid; and Annex 5 includes an overview of the so-called megaprojects)

5.5.3 Sustainability factors

EQ10: To what extent have rural electrification programmes contributed to changing energy consumption patterns in a sustainable way and what are the environmental consequences?

In order for there to be long term sustainability of rural electrification interventions it is important that the utility/power provider is capable of providing sufficient power to cover the needs of consumers and generates sufficient revenue to meet its financial obligations (operation and maintenance, new connections, new infrastructure). The evaluation found that many of the factors critical to long-term sustainability were not in place.

While progress is being made in both Tanzania and Mozambique on achieving additional generating capacity sufficient to tackle present capacity shortages and future expansion of the grid, the institutional and financial factors for long term sustainability do not appear to be in place. Neither are measures in place to cushion the effects of foreseen and unforeseen factors.

A number of parallel developments are taking place, such as expansion of the pre-paid metering systems, which can contribute to lowering running costs and simplifying utility operations. Nonetheless with tariff levels consistently set too low and responsive to political pressure, and with not enough cross-subsidisation from high-end users to cover the losses made when connecting rural areas, the long-term sustainability of rural electrification interventions is not assured.

Judgement criteria:-

- *Electrification interventions integrated into area development programmes (JC 10.1)*

ESMAP has analyzed the role of electrification as an element within a broader change process, and has drawn on several examples from the African continent. Thus ESMAP supports the evaluation team's basic construct for placing electrification within a broader *Energy* context (see the discussion under EQ8) as well as linking rural development to cross-sectoral cooperation. Thus ESMAP, and the evaluation's Theory of Change, argues against waiting for or even expecting "spontaneous positive effects" following electrification. Rather the argument is that electrification needs to be put into a broader development context which includes *infrastructure*

interventions (e.g. transport, water, health, education, communications systems) and *market* development (including: regulatory frameworks; product value chains; banking systems). (Inception Report, Section 3.6)

The Mozambique example of the cotton-ginning factories (in Ribáuè and Morrumbala) which pre-dated the rural electrification interventions, illustrates how the existing potential in an area can respond to both improved, more efficient and cheaper electricity as well as exogenous factors (improved cotton prices) to accelerate development. If banking and ICT systems could be improved in parallel, this would make an even bigger impact, as it would open the way for more productive spin-offs, and social development (more employment). (Desk Study & Mozambique Case Study, EQ9 and others)

Parallel investments not linked to electrification programmes (but to a certain extent dependent on them) have made a major impact on the daily lives of people. The best example of this is the rapid development of the mobile phone market, basically private sector driven and rapidly taken on board by rich and poor alike. In much the same way that the mobile phone has eliminated the need for a network of telephone lines, in the same way the mobile phone may well replace the requirement that banks open branches all over the country, as financial transactions by mobile phone (including bill payments and repayment of loans, etc.) are becoming increasingly common.

Tanzania is already well covered. Further expansion of mobile phone coverage in Mozambique will depend on the extension of the mobile phone coverage zone, presently linked to the electrification of the country's administrative centres through the expansion of the national grid. With the approval of a third phone operator in Mozambique, and continuing construction of base stations, expansion of coverage is increasing rapidly.

Solar recharging is becoming a maturing technology, not only for provision of light but also recharging of batteries, notably mobile phones. The Kenyan experience, which is moving to other East and Southern African countries links provision of solar home systems with mobile phone based payment schemes, which allow for purchased equipment to be paid off over time. This is the same concept that allows for pre-paid meter payments by mobile phone for electricity connections. Unfortunately the technology was not sufficiently mature that pre-paid meters could be installed in the Mozambique case study areas and this is unlikely to happen in the

foreseeable future. The pre-paid meter system depends on a local area wireless internet, which is a significant up-front investment. Thus while EdM now installs pre-paid meters in all new projects, the utility has prioritised those areas where consumption is higher.

- *Existence of development partner exit strategies. (JC 10.2)*

The exit strategies developed by Sida in the case study countries have more reflected a *shift* in strategy than an *exit* from either the sector or the country. This is also true in other Sida programme countries. In Tanzania, Mozambique and elsewhere, there is a move away from direct involvement by Sida in project intervention (as reflected in the 4 case study examples which were examples of the former modality). Moving instead towards: sector budget support; towards capacity building of institutions; towards supporting strategy and policy development of both the energy and the electrification sectors; and towards developing strong working group relationships with both national governments and other development partners. And, to a certain extent, support by Sida to multi-donor programmes (ESMAP, ERAP, EDAP, ENDEV) can also be defined as being part of an exit strategy that allows SIDA to continue supporting the sector without, necessarily, being directly involved.

Thus, for example, at the national strategic level, in Tanzania, institutional support has been provided by development partners (notably by Sida, by other partners as well as through national revenues) to support the establishment of a *Rural Energy Fund* and a *Rural Energy Agency*. This provides support to the expansion of rural electrification without direct involvement by a development partner; and also provides institutional support to the sector as a whole. Building national capacity and strengthening sector institutions also makes the sector more sustainable and less dependent on direct development partner involvement. (Tanzania Case Study, EQ10) The steps being taken to commercialise TANESCO, through the contracting of a management agent, are also examples of a withdrawal of direct development partner involvement.

Similarly in Mozambique, Sida has supported national capacity strengthening through their support to the EdM 5-Year Capacity Building Programme. This support, co-financed by Sida, focuses on capacity building in financial management, control and budgeting, as well as support to EdM's Commercial Department.

As regards rural energy in Mozambique, FUNAE has a similar function to the REA/REF in Tanzania but limited to off-grid renewable energy interventions. FUNAE has an undoubtedly

important role to play in rural electrification, receiving its funds from national taxes and levies, and from development partners such Norad, World Bank/GEF, EU and others. However as there was no evidence of direct Sida financial support to FUNAE there is also no exit strategy.

- *Plans exist to tackle foreseen factors potentially impacting on sustainability. (JC 10.3)*

Oil price fluctuations are seen as being one of the major exogenous factors that frequently impact on the sustainability of (rural) electrification services. Both Tanzania and Mozambique, in addition to their existing hydropower projects and the potential expansion of these, are further attempting to lessen dependence on thermal generation based on *imports* through the exploitation of *national* energy resources (coal, gas, oil).

Both countries are currently developing mega-projects requiring enormous amounts of energy, but this is energy based on *national resources*. The planned investments will link in with the national grid and will increase the overall capacity of the system, but will not solve the problem of those rural areas not yet connected to the national grid. Details on the "mega-projects" are included as Annex 5.

Table 19 Tanzania's emergency situation and the dip in hydro-electricity production

The "emergency situation" in Tanzania, which was discussed elsewhere, required donor funds to purchase diesel on the world market to operate the thermal power plants. The 2011 "dry year" witnessed a sudden dip in hydro-electricity production, with thermal jumping, as a result, from 3% in 2007 to 34% in 2011.[85] This resulted in increased indebtedness for TANESCO as not only did the percentage of power generated by thermal increase but it came at a time when oil prices were high. Donor grants took some of the edge off the financial losses as a result of the rise in fuel costs, but the overall result was continued financial losses for TANESCO with impacts on overall financial sustainability, increasing inefficiency and on ongoing routine operation and maintenance.

- *Plans exist to tackle unforeseen factors potentially impacting on sustainability. (JC 10.4)*

The evaluation found no real examples of drought and disaster relief preparedness. Even though Mozambique has been hit by extreme climate related events within the last decade (Cyclone Eline and Cyclone Hudah) and hydropower production in Tanzania dropped

[85] Out of 561 MW of installed hydro capacity, only 120 MW was available in 2011. Millennium Challenge Account, 2013, pp. 25–26, and pp. 55–56.

significantly because of low water levels in the dams (drought linked to upstream deforestation and poor rainfall). (Inception Report, Section 3.6). The discussion of the implications of seasonal variations in hydropower production in Tanzania, and in particular the implications of the 2011 "dry year", was discussed (see Table – above). Similarly in Mozambique, over-reliance on dams in the Zambezi basin to produce hydropower can have power availability impacts during drought periods when water flows to the basin are reduced; these risks are likely to increase with climate change.

Mozambique legislation obliges each project has to carry out an Environmental and Social Impact Study (ESIS) and obtain an Environmental License, before starting construction. These studies normally take into consideration climate related events, selecting best options for construction but cannot predict the severity of "extreme" climate related events. There are cost implications also when integrating certain levels of risk. Both during the ESIS and during the project design, climate related events are considered. However these impact studies are more focused on a particular intervention than on the required national power requirements and international obligations (to the Southern African Power Pool). (Mozambique Case Study, EQ10)

Nonetheless, with tariff policies consistently at levels below cost-recovery (both in Mozambique and in Tanzania)[86] no financial reserves are built up within the utility to address unforeseen events, climatic or otherwise. The difficulties of arriving at a financially sustainable situation, let alone generating sufficient funds to mitigate unforeseen events, is illustrated by the 2010 riots in Maputo and other cities in Mozambique, which happened in response to proposed across the board increases in electricity and water tariffs, the removal of the fuel subsidy, and increases in food prices as a result of drought and the sharp fall of the metical. The government was forced to re-evaluate; with the implications for EdM being that every new loss-making rural connection further indebts the utility.[87]

[86] Refer to the conclusions in Millennium Challenge Account, 2013 (for Tanzania) and Norplan, 2013 (for Mozambique).

[87] See also the analysis of EdM financial performance in Norplan, 2013, pp 21–25.

6 Key Issues and Lessons Learned

The Theory of Change as developed for this evaluation (see diagram in Chapter 2) has argued that for electrification to have an impact on poverty reduction, the outputs resulting from electrification interventions need to be combined with other complementary interventions in order to arrived at the desired impacts. Consequently, this chapter, based on the analysis contained in the Evaluation Questions chapter (chapter 5) highlights a number of key issues and lessons learned that attempt to answer the question: "what works, under which circumstances and why?"

6.1 ACCESS AREA FOCUS OR HOUSEHOLD CONNECTION FOCUS

What this evaluation has shown is that *households don't need to be connected in order to benefit* from electricity. In addition, the evaluation suggests that people living in poverty will benefit from electrification when:

(i) Suitable (e.g. three phase) and reliable (no power cuts, no spikes or brown outs) power is available for productive processing; and

(ii) Public services (schools, health, water, street lights) are sustainably connected,

The spin-off benefits from these are probably more attainable for people living in poverty than the benefits from a household connection which, despite targeted subsidies (see below), many will still not be able to afford. The "public service" benefits provided through the private sector are also much appreciated – through the value-added that electricity gives to shops, restaurants and bars.[88]

In both Tanzania and Mozambique generating capacity is increasing but remains behind demand. In Tanzania the access rate has stagnated at approximately 10% of the population as numbers

[88] The value-added of bars with cold drinks (beers) and longer opening hours can, of course, be disputed.

connected have exceeded the population growth only marginally.[89] The same applies elsewhere, with notable exceptions, such as Vietnam. This raises the issue of whether the most appropriate solution to addressing the needs of people living in poverty in rural areas is to attempt to connect a maximum number of rural households, spreading a thin network of low load connectivity nationwide, within a context where there is already a generating capacity gap, where power cuts, power shortages and an unstable power supply are features of the existing system, and where each new connection is a financial burden on a power utility already operating at a loss.

This suggests that an *area focus* with more limited ambitions would benefit poor people – and would serve more people if the focus also included off-grid connections as well as grid extensions. Staying with this focus – that is, *productive sector* and *public services* connectivity – this evaluation also confirms what other studies have underlined, namely that:

(i) Rural households are capable of paying for consumption as well as judging what they can afford; and

(ii) Subsidies to support initial connection can assist more households in connecting during the construction phase and, by so doing, increase the project's cost-benefit ratio.

While acknowledging that *political* targets have been set in policy documents which target household connections, balancing low-load evening peak consumption (mostly for lights) with day-time provision of electricity to the private and public sector makes more *economic* sense than trying to maximise solely the number of *household* connections.

The provision of rural electrification is, in many cases, not financially viable and becomes increasingly less viable if the approach chosen remains that of connecting, through extensions of the national grid, even more remote rural areas with increasingly low population densities. Yet political priorities remain and are important. The short and medium term solutions to filling the electrification gaps on the national map is to prioritise the connection of all the country's administrative centres (as is happening in Mozambique and Tanzania). This is sensible for political reasons, even though connecting administrative centres remains a financial and technical challenge

[89] *Joint Country Evaluation of the Strategy for Swedish Development Cooperation with Tanzania 2006–2010*, 2010, p. 18.

because of the low-load long-distance factors. Grid extensions are, therefore, not always the most appropriate solution to connect distant centres, and even more distant communities. Stand-alone diesel systems remain the simplest and most familiar alternative, with the advantage that maintenance of this technology holds no mysteries, and a small local grid can easily be hooked up to the national grid, if and/or when this finally arrives.

Renewable technologies (solar, wind, pico-hydro[90]) are becoming more attractive as the technology matures but isolated grids based on renewable energy carry with them the challenge of operation and maintenance, the provision of spare parts, as well as the challenges of decentralised financial management and local tariff structures. The mini-hydro technology (such as pico hydro) is probably the most advanced, but this only becomes a better option than stand-alone diesel when the non-technical aspects as well as the technical aspects are in place. As renewable technologies mature (mini-hydro, solar, wind) the issues around technical sustainability will decrease, but the non-technical issues (management, tariff structures) will remain.

Building institutional capacity is an important element in tackling non-technical issues. Sweden's experience with institution building – with examples of the REA and the REF in Tanzania – can be drawn on to support both on-grid as well as off-grid electrification, and renewable as well as non-renewable systems.

These approaches require a change in the mindset of how one looks at rural electrification. Increasing the number of household connections should not be seen as the main target for rural electrification programmes, as even in the long term, electricity for all is an unattainable objective. Or, to be more precise, "a house connection for each household is an unattainable objective".[91] Evidence shows that, even in areas with access to electrification and with sufficient system capacity, there are households that, for various reasons, choose not to connect. These tend to be the households of "people living in poverty".

[90] Pico hydro is a term used for hydroelectric power generation of under 5 kW. It is useful in small, remote communities that require only a small amount of electricity – for example, to power one or two fluorescent light bulbs and a TV or radio in 50 or so homes.

[91] The statement applies, in particular, to the evaluation's definition of "rural electrification"

Spreading the benefits of electrification to households living in poverty also includes spreading the benefits to households living geographically remote from any potential grid extension, as well as those living within distribution areas, but without the financial means to afford a connection. These challenges need to be addressed by: looking at other technologies besides grid extension for basic household energy requirements; and supporting public and private sector connectivity (within a broader administrative area such as a district and with a range of options, not just grid extensions).

6.2 TARIFF POLICIES AND PAYMENT PRACTICES

Targeted tariffs, adjusted payment modalities and subsidized connection costs for poorer households will contribute to helping an increased number of less-well off households connect during the initial construction phases; and, if these measures are maintained, to lay the basis for other less well-off households to accumulate sufficient resources to consider connection in the future.[92] The evaluation has also shown that the utility will continue to connect customers after hand-over of the construction phase, as there is an ongoing demand. However:

(i) Poor households are least likely to be able to afford a connection, no matter what subsidies are in place – and are even less likely to be able to connect after hand-over to the utility as this often comes with increased costs and administrative delays; and

(ii) If public institutions such as educational and health facilities are not connected during construction, they are unlikely to be connected afterwards.

Notwithstanding willingness and ability to pay for services, enough revenue needs to be generated to cover running costs, plus maintenance plus depreciation and new connections – and (ideally) even new investments to improve quality and reliability over time, and to expand into new areas. This is difficult in a situation where tariff setting remains a *political* exercise and not an *economic* one. Lack of sufficient national financial resources results in continued external

[92] This can include: spreading the cost of connection over a longer period; integrating costs into monthly payment; developing micro-credits, etc.

dependency on investment funds, while undermining the financial sustainability of the whole system.

The setting of uneconomic political tariffs is often combined with substantial non-technical losses. As regards payment practices, the utilities studied in the two case study countries both have to deal with significant non-technical losses in respect of the public sector (through non-payment and late payment of bills, etc.), but also private sector avoidance of payment and households tampering with the meter.[93]

The example of rural electrification in Vietnam, which combines realistic tariff setting (including cross-subsidisation to encourage connections in rural areas and connections by poor households) together with a "culture of payment", has been the basis for the success of rural electrification in Vietnam. It is these kinds of experiences that need to be replicated, especially issues related to governance and payment practices. The case studies and the desk study have illustrated a definite level of impunity linked to non-payment, late payment and partial payment; as well as downright corruption (from flawed tender procedures to tampering with meters).[94]

In social terms, when the system runs at a loss because of a flawed tariff regime (with political rather than economic tariffs; and institutionalised acceptance of non-payment and late payment) the State is effectively subsidising the rich at the expense of the poor.

[93] The recent *"Impact assessment of rural electrification projects in Mozambique"* concludes that: "The provision of rural electricity services is in many cases not financially viable and, therefore, EdM has a strong incentive to avoid distribution grid extension in rural areas". Norplan, 2013, p. 28.

[94] Moves in Tanzania to crack-down on the corruption endemic within TANESCO are a move in the right direction, as is "naming and shaming" (such as in the articles carried in the *East African*). The legal system exists – through the Criminal Procedure and Civil Procedure codes – but equally important are transparency related issues. The stated intention to *"invite journalists to witness the crackdown on electricity thieves"* is helpful particularly if this targets the largest debtors: *companies, factories and institutions*. The East African. August 2012: http://www.theeastafrican.co.ke/news/Tanesco+in+drive+to+recover190m+US+dollars+in+debt+/-/2558/1482486/-/aqhy23/-/index.html

6.3 POVERTY IMPACT AND THE INCREASE OF WELL-BEING

Electrification has been shown to have an impact on poverty through improved public services and through increased employment as the business/productive sector is connected. However, even the very simple (although costly) step of bringing electric lights into an area that previously depended on kerosene/candles/batteries and generators to provide light will have a major impact on perceived quality of life. Nonetheless, directly isolating electrification as a factor and attributing changes in measureable poverty levels is virtually impossible, certainly in this evaluation's case studies.

Even the much longer term evaluation work done in Vietnam – in 2002, 2005 and 2008 – arrived at more-or-less the same conclusion, namely that it is difficult to be definitive about the direct poverty reduction impacts of electrification although "there appears to be some evidence".[95]

Overall poverty levels in both case study countries have shown little change over the evaluation period. The notable change in poverty levels was in Mozambique around the beginning of the evaluation period, but this change in poverty level can mostly be attributed to the ending of the long civil war.

As regards the case study districts, impacts are also restricted geographically. Only in that part of the administrative/local government area within the utility service area close to the distribution lines, was it technically possible to connect potential consumers. This limited the potential benefits of the electrification interventions, as only public sector services, the business sector and households

[95] In parallel with the investment activities in Vietnam, technical assistance has supported two objectives: the institutional and organizational development in the Ministry of Industry and Trade, EVN, its PCs and LDUs; and the *evaluation of the impacts of rural electrification*. In the latter work, the World Bank has partnered with other bilateral donors, notably the governments of *Sweden* and New Zealand. The central plank (sic) of this work has been to conduct three panel surveys—in 2002, 2005, and 2008—to analyze the impacts of electrification over the longer term. (IBRD/WB, p. 6) However, "from survey results, it is difficult to be definitive about the direct poverty reduction impacts of electrification, but there appears to be some evidence". Vietnam, (IBRD/WB, p. xvi)

within the service area could be considered for connection.[96] The vast majority of rural households remain without a connection, many of them simply too far from the distribution lines to be able to qualify technically for a connection. In addition, the vast majority of rural households are dependent on a combination of small scale agricultural production, income from livestock sales and some informal sector activities, none of which combine to provide the sufficient funds to finance a connection, even where the distribution lines are close enough to technically allow for a connection.

Impacts are further limited by the combination of an unreliable power supply and financial barriers to connection, which hinder a full harnessing of the potential value-added to electrifying the private and the public sector. Frequent power cuts are an indicator of systemic problems and constitute a barrier to small-scale private sector investment in rural areas, although the case studies have also shown that where the *private sector* was connected, businesses increased the number of employees, boosted production and improved profit margins. Apart from the geographical factor (such as schools and health centres located too far from distribution lines to be connected), financial barriers also influence the extent to which the *public sector* contributes to improved rural living conditions. In order for the public sector to provide services, national and local budgets need to provide both investment funds[97] and running costs[98] in order for the public sector to have a sustainable impact on improved living conditions.

However, poverty has many dimensions, not all of them quantifiable. It is clear that bringing electric light into a rural area where previously there was none (or just kerosene lamps and generators) has an enormous psychological impact and symbolic value, bringing the people of an area closer to the rest of the world. At the same time,

[96] The case studies have shown that only a modest percentage of the total number of educational and health facilities in case study districts were actually connected.

[97] Such as: connection costs, internal wiring, electrical appliances, etc. This was a particular problem in Tanzania.

[98] Notably: payment of the electricity bill, but also materials (such as: school books, vaccines, etc.) and staff salaries. In Mozambique this tends to be included in local government budgets and disbursed, albeit tardily; in Tanzania it is a particular problem with, for example, teachers going without salaries for many months during the evaluation's fieldwork period.

the costs of bringing the national grid and low load electrification to every corner of the country are enormous.

Nevertheless, it has been shown that there are statistically significant differences between electrified and non-electrified households in terms of people's ability to make the best use of, for example, the education that they have received.[99] Therefore it remains important to continue efforts to bring light to non-connected households. This can be done in areas where grid connection is possible through measures that favour and specifically target households with less income. Both technical solutions (pre-paid meters, ready boards) and financial incentives (lifeline tariffs, subsidized connections, payment of connection fee over longer period, etc.) can combine to make electricity more easily affordable to poorer households – even if this is just for lights and the most basic appliances (water boilers, radio/TV, cell-phone charger, etc.).

However, even with all the support and subsidies potentially available, and even with a sufficient generating capacity to connect all households, it is to be expected that not all households will be willing or able to connect.[100] Solar-powered lights are increasingly becoming an option for these households and for households in areas too distant for grid extension.

The focus of Sida's involvement in rural electrification has been on grid extension. This limits the impact to those areas where this has happened. Therefore, while grid extensions are the most efficient and effective way to connect rural towns, the existing national grids in most of Sweden's programme countries leave huge swathes of the country far from the distribution lines.

Poverty can be reduced if, in addition to providing electric light to an administrative centre, that also health and education facilities are electrified as a matter of course, and that the mobile phone network is brought into the area. Better health care and educational opportunities; and the possibility to communicate with the outside

[99] See for example, the evidence quoted in: *State and People, Central and Local, Working Together: The Vietnam Rural Electrification Experience*. IBRD/WB, 2011. p. xvi.

[100] The conclusion from Vietnam – *where 25% of HH in connected areas did not want to be connected* even though the system capacity exists – is important; these families have also done the maths – they are not able to pay – and, hence, are not willing either.

world are immediate improvements in the daily lives of people – and can be achieved without a household connection.

The mobile phone "revolution" shows that non-connected households are capable of accessing and managing the benefits of power being supplied to their area, and are able to benefit from new technology without, necessarily, enjoying the benefits of their own household connection. Purchase of phones, managing pre-paid systems and finding electrified locations where their phones can be charged underscores that the benefits of electricity by non-connected households can be harnessed. Lights in the street, and exposure to the outside world, through access to television and radio is another example where bringing light and bringing news and images of the world outside one's home town, contribute to an improved quality of life. It is intangible, as "feel good" is impossible to quantify, but it is also an impact. Better access to the outside world, better communication and provision of light all contribute to increased well-being; also in the absence of quantifiable improvements in material and economic well-being.

6.4 ELECTRICITY WITHIN A BROADER ENERGY CONTEXT

Rural electricity is mainly used for lighting and for powering certain low-load appliances: TV, radio, fans, and the charging of mobile phones.[101] Even connected and non-poor households in rural areas that, in principle, could switch to using electricity to prepare food, continue to use biomass for cooking. The same is the case for the service sector – restaurants will continue to use biomass for cooking. Similarly in Vietnam, with over 90% rural connections, households continue to use biomass in cooking; the situation in South Africa is comparable – one of the most highly urbanised nations in Africa continues to depend heavily on biomass not only for cooking but also for space heating.

In this context, the development partner can, of course, choose to maintain a narrow focus on *electrification* interventions (limiting their inputs, for example, to funding infrastructure, providing institutional support or providing sector budget support) while leaving the

[101] This is probably also the case in *urban* settings but was outside the scope of the present evaluation.

broader *energy* sector to be handled by others. In terms of the Theory of Change this would imply that a development partner, such as Sida, for example, could focus its interventions purely at the *output* level, and leave all complementary interventions necessary to reach the *outcome* level to national governments and other bilateral partners. In practice, most development partners spread their interventions. However, the coordination within and between sectors and between interventions, indispensable to give the extra value-added, is not always there.

Connection to the national grid, and the replacement of stand-alone fuel-based generating systems supplying a small distribution area, can have a positive localised environmental impact through a shift away from polluting forms of energy (diesel, kerosene, petrol). However, the connection to the national grid of a few rural towns does not make a huge difference on the national cleaner energy balance sheet seen within the context of the construction of new generating capacity to tackle national energy shortages. This extra capacity is necessary to meet increased national demand, but uses fuel, gas, coal, etc., while the percentage of hydroelectric power supplied to the national grid continues to decrease.

Also at the local level, while stand-alone diesel systems are eliminated, the non-sustainable use of biomass puts continued pressure on the forest resource. In principle, this is a renewable resource, but only if managed correctly. The evaluation has not looked at the forest-resource part of the fuelwood value chain but only at household energy use. Therefore the assessment of the biomass value chain is outside the scope of this evaluation. Nonetheless, any reduction in the absolute amount of fuelwood used for cooking and space heating must, logically, have an impact on the forest resource.[102]

However, at the household level, broadening the narrowing focus on electrification to a broader emphasis on energy, particularly any reduction in use of biomass through increased use of improved stoves which are culturally acceptable, locally available and affordable, can have positive *gender* and *environmental health* impacts at the household level. The evaluation's focus has been on the environmental health

[102] Some studies suggest that the opening up of forest areas for agriculture and grazing, rather than cutting trees for fuel, is what has the major impact on deforestation. However (SEI/Renetch. 2012) also underscore the non-sustainable use of the forest resource to provide biomass for cooking.

implications within the household in respect of the continued use of fuelwood, in particular, and biomass, in general, in the kitchens; and also the continued use of kerosene for light. It is in the kitchen that important *gender* impacts will be observed. Replacement of kerosene by electric lights (or solar home systems) is an important factor in reducing indoor air pollution,[103] as is finding alternatives to open fires and traditional stoves for cooking. In the absence of a change in cooking practices, electrification has a more favourable health impact on men than on women as their contact with household air pollution is reduced in areas outside the kitchen. The kitchen, meanwhile, remains the preserve of women (and girls and, by default, babies) and the case studies have also shown that a significant number of connected households may even continue to use kerosene lights in the kitchen.[104] Improved cook stoves can achieve dramatic health benefits, as well as burning more efficiently and reducing consumption of fuelwood between 40% and 60%.

Sweden, potentially, can have significant impact within the broader energy sector (where electrification is but one output) if more value-added could be drawn from its broad involvement in the energy sector itself, in order to add more value at the *outcome* level. Sida already has considerable experience within the broader energy sector through, for example, business-to-business innovations within renewable energy (e.g. solar systems for charging mobile phone batteries), work done with clean cookstoves (including work by the Stockholm Environment Institute), work done on energy policy (such as SEI/Renetch), as well as involvement in a number of multilateral energy networks (such as ESMAP). [105] This experience would benefit from being more coordinated and integrated.

[103] In this context, solar-powered lights are increasingly becoming an alternative source for lighting, as the technologies become more mature, more robust and cheaper.

[104] Chronic exposure to smoke from traditional cooking practices is one of the world's biggest – but least well-known – killers. Penetrating deep into the lungs of its victims, the smoke causes a range of deadly chronic and acute health effects such as child pneumonia, lung cancer, chronic obstructive pulmonary disease, and heart disease, as well as low birth-weight in children born to mothers whose pregnancies are spent breathing smoke from open fires and traditional cookstoves. http://www.cleancookstoves.org/our-work/the-issues/health-impacts.html

[105] There may also be other support programmes and financing arrangements of which this evaluation is not aware.

6.5 GENDER

Outside the home

Although men would undoubtedly benefit as well, arguably, women would benefit more from the improvements that electrification can bring to public services. These advantages include: lights in clinics (safer child birth) but also a cold-chain for vaccines (particularly for mother-and-child and under-five clinics which are normally the woman's responsibility); improved piped water supply (better water quality, less water-related illnesses and less time spent collecting water); electricity in schools (allowing for evening classes); streetlights (more safe to move at night). In order for this to make an impact, these facilities all need to be connected and all need to function. The studies of situations where electricity has been provided for a longer period, and where there has been intensification within the connected area (studies from Zanzibar and Vietnam included in the Desk Report) suggests that this is indeed the case. This evaluation's case studies (based on interviews and focus group discussions) would tend to support these conclusions, despite the difficulty of quantifying and attributing given the very modest improvement in public services in the case study areas. Providing access to education for girls is one of the most important ways to have an impact on gender roles. Electrification can support this by providing interventions which can contribute to alleviating women's workload, improving their health situation through better medical facilities, lighting up an area to improve safety at night, and providing electricity to educational establishments thus improving the quality of the education being provided.

Inside the home

Women in developing countries are usually the ones primarily responsible for kitchen-related functions. The fact that electricity has not changed cooking practices to any great extent means that women (as well as babies, both genders, and girls) continue to face health risks from sooty kitchens – particularly respiratory tract infections, etc. Thus, while there are improvements within the home that positively affect the whole family, the case studies show that these improvements do tend to favour men more than women. Particularly in relation to health risks because, while electric lights continue to replace kerosene/candles, there is very little change in cooking

practices. Figures are hard to obtain but it is observed that men spend more time in a rooms lit by electric lamps, watching TV, etc. Meanwhile, women (and girls and babies) continue to work in the kitchen, albeit with better light (if the household is connected and has put electric lights in the kitchen), and continue to be more exposed to household air pollution than men. They also have less time at their disposal to sit around the house as, besides their kitchen responsibilities, collecting water and firewood remain daily chores, which invariably are the responsibility of the woman of the house. The replacement of kerosene by non-polluting forms of light (electricity or solar home systems) and the reduction in the use of biomass for cooking (through improved cookstoves or alternatives, such as gas) can combine to have major positive health impacts on those most exposed. (See also Annex 7)

6.6 APPROPRIATE ADMINISTRATIVE LEVEL

Many power utilities are highly centralised with little decentralisation or deconcentration of administrative, financial or decision-making levels. The Vietnam evaluation argues strongly for involving the local level more. This includes: involving households (all households, even those who do not necessarily expect to be connected but who can, nevertheless expect benefits) in planning activities; involving local authorities in planning and management; involvement of private sector in decentralised financial administration of the electricity sector.

Experience from other sectors, such as the water sector, has underscored the importance of finding a lowest appropriate level. This is an established "good practice" and a principle inherent in, for example, Tanzania's National Water Policy (of 2002) where elimination of conflicts of interest are sought through clear division of powers, management of water services at the lowest appropriate level, cost recovery and integrated approach (in this context, to water resources management).

This evaluation only observed the negative aspects of too much centralisation in the electricity sub-sector, such as, for example, centralised purchasing systems for replacing poles; centralised management of connection fees; public institutions not wired and not connected; local authorities unable to pay electricity bills; etc. The proviso, which is always attached to finding the lowest appropriate

levels, is to also keep the links with the higher levels. Thus, the lowest appropriate level should not be given the responsibility without also having the means (such as financial and human resources, as well as the necessary legal and administrative competences); and decisions made at higher levels which impact lower levels should not be made in isolation (e.g. investment decisions made at a higher level which have recurrent costs implications at a lower level).

7 Conclusions

7.1 OVERALL CONCLUSIONS

There are two fundamental conclusions that have been advanced as a result of the research undertaken in this evaluation.

- The first is that households that are not connected can still benefit from electrification, either through non-tangible benefits resulting from the electrification of an area, as well as through increased rural income generation and through better access to public services.
- The second is that an area-based multi-sectoral approach provides a more appropriate strategy for improving the well-being of rural communities and households than an isolated single-sector intervention, which assumes positive results rather than being a participant in the process.

In this context, this evaluation argues that rural electrification needs to be seen as an integral element in an area (or district) economic and social development strategy, rather than an isolated "electricity" intervention for its own sake. Research shows that the best results for rural-electrification occurs when "electrification" is seen as a strategy that is positioned as part of a larger effort to develop a region or area.

These case studies have shown that despite the fact that development partners' initiatives in rural electrification achieve their expected outputs, these outputs need to be paired with the outputs of other interventions in order to meet their higher-level outcomes. The evaluation argues against waiting for or even expecting "spontaneous positive effects" following electrification and seeing electrification instead as an integral element in a development process.

7.2 CONCLUSIONS ACCORDING TO THE EVALUATION CRITERIA

The evaluation has concluded that:

1. Relevance

Sida's interventions specifically, and donor-financed support generally, are strongly aligned with stated national electrification priorities, but that donor-financed programmes tend not to be specifically designed nor targeted to improve the conditions of people living in poverty. Increased impact on poverty reduction could be attained if development partners specifically targeted the poor and their needs rather than targeting a technical objective (such as the number of connections).

2. Efficiency

International experience, including Sweden's, shows that the decision to undertake rural electrification is almost always politically driven and is not undertaken as the result of the search for a positive return on investment. Nevertheless, cost-effectiveness can be improved by creating conditions for drastically increasing the number of connections, especially at the early stages of an electrification project, in order to build a revenue base to enable the project to be more cost-effective. Grid extensions remain the most efficient design for rural electrification where large numbers of households and productive enterprises elect to connect, and where the generation and transmission/distribution capacity of the power utility is not compromised. Nevertheless, there will be a cut-off point where it will become cheaper to use off-grid sources to reach distant low-load communities

3. Effectiveness

Sida's expected intervention results for rural electrification at the *output* or induced output levels are generally achieved as planned, but achieving higher-level outcomes and impacts depends on complementary interventions and contextual factors that are not generally built into the design of the interventions.

4. Impact

The critical assumption used by Sida and other donors when assessing the potential for electrification to improve living conditions in

rural areas almost always includes the ability of national power utilities to generate and distribute a reliable power supply. All other social and economic improvements are dependent on this condition being met. Intervention designs treat this assumption as an externality and outside the scope of the intervention; but this evaluation has shown that weak generation capability and poor transmission/distribution systems seriously hinder the extent to which "improved living conditions" are attained. Development partner interventions generally do not manage this important risk. Moreover, the impact of electrification on poverty is difficult to isolate from other factors and difficult to quantify.

5. Sustainability

Even at the present levels of rural electrification, serious sustainability issues already exist. This is so both in relation to the capacity to produce and distribute sufficient good quality power, as well the financial sustainability of utilities constrained by politically-motivated tariff-setting. Tariffs set at below cost-recovery levels combined with unacceptably high non-technical losses (chiefly unpaid bills) affects utility sustainability. The result is in an inability to undertake adequate maintenance on the power system and an inability to plan ahead for capital infusion where needed. On another issue, electrification alone will not satisfy the energy needs of both connected and non-connected households which continue using biomass for cooking and for heating. While this has environmental health impacts within the household, biomass use also impacts on the forest resource and its sustainability.

Nonetheless, based purely on the continued willingness of potential clients to connect and the capacity of both utilities in the case study countries to continue connecting new customers, there is a basis for long-term sustainability. Judged purely on whether Sida's interventions have reached their targets for number of connections, the evaluation has shown that these have been largely surpassed in the years following the interventions; and continue to increase. The challenge therefore is to link this on-going willingness and ability to connect to a sustainable financial model for the utility producing and supplying the power. Despite the success in achieving and surpassing targets for numbers of connections, sustainability is at risk if each new rural connection contributes to increasing the utility's financial losses.

8 Recommendations

The Evaluation's recommendations are split between overall recommendations to Sida as well as specific country recommendations destined for decision-makers working with the Tanzania and Mozambique energy programmes. The overall recommendations are contained in this chapter; while the recommendations relevant for the electrification/energy programmes in the two partner countries are included in the respective country reports (and as Annex 6 in this report). It is also worth noting here that while many of the recommendations may be challenging, they are neither new nor surprising. For example, the essence of many of the recommendations made by Åkesson and Nhate in 2006[106] for the Ribáuè/Iapala area (also a case study for this evaluation) overlap, at the general level, with many recommendations from this evaluation.

Preamble

The focus of the recommendations is on Sida and what Sweden can do to improve the lives of people living in poverty through their support to rural electrification, specifically, and the energy sector, generally. Many of the recommendations are made based on the conclusions contained in this evaluation that also non-connected rural households can benefit from electrification.

It is *recommended* that:-

Area based approach

1. An area-based approach is followed when developing rural electrification and rural energy programmes, and that this approach is inspired by planning and decision making methodologies, such as those developed as part of the Strategic Environmental Assessment toolbox.

Note. The approach suggested is based on the use of participatory decision-making processes relating to specific contexts (geographical area, sector, institutions) and developing alternative scenarios to support decision-making.

[106] Åkesson &Nhate, 2006. *Study on the Socio-Economic and Poverty Impact of the Rural Electrification Project Ribáuè/Iapala (Nampula, Mozambique).*

These scenarios include a zero option where the assumption is made that business continues "as usual". The zero option serves as a baseline against which alternatives can be weighed. The advantage of the SEA approach is also that it can be applied, for example, narrowly to electrification or, more broadly, to energy; with geographical limitations (district, province, region or nationally), etc… An area-based approach will: enable identification of poverty pockets; carry out a gender analysis; map public services with their needs and requirements; identify opportunities for small and medium-scale enterprises; and, most importantly, tie the various target groups into a holistic development perspective for the area by taking complementary ongoing and planned interventions into consideration.

The area-base approach will also include both a review of the technology options (grid extensions; pico-hydro; provision of lighting and refrigeration using solar, etc.) as well as a review of the institutional options (e.g. links to the grid and the national utility; involvement of Independent Power Producers, etc.)

The Stockholm Environment Institute has already worked on applications of Strategic Environmental Assessments within the energy sector.107 A useful example of the approach in the case study countries is the Strategic Environmental Assessment of Transport Options for Corridor Sands (Mozambique, Ministry of Coordination of Environmental Affairs, 2003)

Public Institutions

2. When rural electrification programmes are planned priority focus should be on making sure that key public institutions are connected and that this be done proactively. This should include connections, meters, internal wiring and, where relevant, electrical equipment.

   Note. If public institutions are not included in the first (construction) phase they frequently remain unconnected as national budgets are insufficient to cover this when the initial contractors have left, or there is insufficient priority given to rural areas in the national budgets to provide the necessary capital costs. Improved and functioning public institutions and services in rural areas – education, health, water, public lighting – will contribute to improving the conditions of women (and girls) living in rural areas.

3. During the planning phase, local authorities and key public institutions (connected as per previous recommendation) are assisted to prepare budgets to ensure that funds for recurrent expenditures can be accessed, so that the real consumption costs for electricity use can be met through the appropriate budgets – even if this includes elements of user payment.

[107] http://www.sei-international.org/mediamanager/documents/Publications/Policy-institutions/SEA.pdf

Note. The payment of the electricity bill should be a matter of principle, as should cutting off the power following non-payment. There is a strong willingness to pay for services when they are reliable and when they really provide a service; this is part of the implicit contract between power supplier and consumer. Connection of public institutions should be a proactive planning activity, and not an after-thought. In many ways, local authorities are the lowest appropriate level for the management of many services and they need to be empowered.

Manufacturing, small industry

4. As part of the planning phase, the potential for supporting the development of productive activities (agricultural processing, irrigation, small-scale manufacturing, etc.) and small-scale enterprises is assessed, and a sufficient and reliable supply of energy is put into place to allow the private sector to connect and expand. A parallel system of credits or micro-credits could be included to help productive enterprises in this regard.

   Note. It is considered more important to connect potential generators of employment than to focus on connecting as many households as possible. Non-connected households benefit from employment generation; productive enterprises contribute more to an overall cost benefit of the intervention than low load households using lights during the evening peak. However for productive enterprises to consider investing they need to be guaranteed both a reliable supply and one that provides enough power (minimum three-phase)

5. An assessment is made of the productive potential of an area so that when plans are made to electrify that area, parallel support activities and services to allow enterprises to develop are also mobilised.

   Note. This includes infrastructure (better transport and access), improved communication (ICT, mobile phones), credit and banking facilities, etc. An area-based approach would be designed to maximise the potential outcomes resulting from interventions in electrification.

Targeting improved household access

6. A national contextual package of financial support to enable more households to access electricity is prepared, with the objectives of making connection costs and low-load electricity for poorer households affordable, while supporting efforts to develop a sustainable institutional model based on decentralised decision-making (where appropriate), realistic tariffs (instead of political tariffs) and national technical standards.

   Note. The contextual setting is important, as what may be possible, for example, in Tanzania may not be possible, for example, in Mozambique.

In purely economic terms, attempting to intensify the number of connections within a given area makes sense and, therefore, so too does the objective of connecting as many households as possible.

Improved development partner coordination and institutional support

7. Sida continues to actively broaden its energy agenda in development partner working groups and joint energy sector working groups to specifically include *all aspects* of rural energy provision, including a focus on the strengthening of institutions dealing with rural energy and rural electrification, as well as the national transmission system and generating capacity.
8. Sida seeks complementarity with other development partners in order to develop more comprehensive programmes that include, for example, electrification and energy, forest resource management and the fuelwood value chain, SME development, education and health sectors, governance and decentralisation, etc.
9. Sida continues to provide institutional support to ensure that potential partner institutions (e.g. national utilities, power producers and suppliers, specialised energy agencies) develop the means to sustain their roles subsequent to the exit of the development partner.

   Note. The evaluation has noted that Sida has already started to implement a number of these recommendations. The Paris Declaration underlines the importance of development partner division of labour and cooperation within and across sectors. As regards the energy sector, it is important that partners and governments start to look more widely than primarily a focus on generating capacity and grid extension. It is also important that capacity building remains a focus with all institutions dealing with rural energy and rural electrification (including local authorities).
10. In line with national development priorities, Sida assists national governments with an analysis of the rural electrification gaps on the map and the development of strategies to also connect these areas on a sustainable basis, potentially through other means than grid extensions.

    Note. An examination of the Mozambique and Tanzania national grids reveal huge areas which are unlikely to be covered by expansion of the grid; alternative approaches are necessary to address rural electrification needs in these areas. Low-cost approaches to grid extensions are options (e.g. SWER); as are isolated diesel systems and mature renewable energy technologies. The latter should be considered as favoured options, especially where it become cheaper to use off-grid sources of supply to reach distant communities.

11. Better monitoring systems be developed but these should focus more on outcomes and impacts while not neglecting better output monitoring.

    Note. The present evaluation includes outcome and impact in its scope, but has been constrained by a paucity of quantitative baselines studies on which to draw conclusion. Setting a target for the number of households to be connected does not actually show whether rural living conditions have been improved it just shows how many connections have been achieved. For example, an *output* monitoring focus on connecting a large number of households on low load electricity subject to frequent power cuts (and being successful at this) may well end up creating a completely non-sustainable power supply system with a negative *outcome* (i.e. unsuccessful in that the situation with a high number of low-load connections can result in a non-sustainable power supply and recurring system losses). A monitoring system that only looks at *outputs* will have difficulties initiating remedial action to influence the *outcome* level, and will not be able to draw any conclusions in respect of poverty reduction at the *impact* level.

Broader energy sector focus

12. Sida expands its focus within the energy sector to also focus on household energy in the broadest sense, including energy options for households that will not be connected to grid electricity;
13. Sida seeks synergies within its own organisation, within the broader energy field in Sweden, as well as by drawing on more strategic work with multilateral organisations and research institutions to enhance its work in the energy field.

    Note. There is considerable Swedish funding in the energy sector but more can be done internally within Sida to learn from these experiences, in order to build improved or best practices and to integrate these into Sida's energy interventions. This includes learning: from Sida's country programme experience; from relevant in-house interventions in the energy field; from best practice experience; from innovations coming from the private sector; as well as by drawing more on strategic work with multilateral organisations and Swedish research institutions, etc. Examples of an expanded focus would include: improvements to cook stoves to reduce household air pollution (and mitigate wider environmental impacts on the forest resource) as well as alternatives to polluting forms of indoor lighting; business-to business experiences with energy innovations (such as work with biomass pellets, solar powered lights and mobile-phone chargers, etc). A broader energy focus is also considered to, comparatively, benefit women more than men- both as regards both environmental health spin-offs but also in respect of time or money spent on biomass – in the sense that if less biomass needs to be used, the time spent collecting will be reduced or the costs of purchase will decrease, and hence impact on gender roles within the household.

Annex 1: Terms of Reference.

Terms of Reference for an Evaluation of Sida Financed Interventions for Increased Access to Electricity for Poor People, with Case Studies in Tanzania and Mozambique
2012-06-21

1. BACKGROUND

Sweden's international development cooperation aims to contribute to an environment supportive of poor peoples' own efforts to improve their quality of life. The Swedish Government has set three thematic priorities for these efforts: (i) Democracy and Human Rights; (ii) Gender equality and the role of women in development; and (iii) Environment and Climate.[108] In addition, all development cooperation should take as points of departure, the two perspectives under the Policy for Global Development (PGD) i.e. the rights perspective and poor people's perspectives on development.

Recently, the Swedish government issued the "Policy for Environmental and Climate Issues in Swedish Development Cooperation 2010–2014". The overarching objective of this policy is: *a better environment, sustainable use of natural resources, stronger resilience to environmental impact and climate change in developing countries, and limited climate impact.* One of the five focus areas of the policy is "*Increased access to sustainable energy sources*". Under this energy access component it is stated that

> *Good and secure access to cost-effective, sustainable and healthy energy solutions, both on the local and national level, plays an important role in the achievement of several millennium goals, including those that contribute to poverty reduction, gender equality and greater influence for women, and good health and environment.*

The Swedish government has also raised the demands on Sida to follow up and analyse the results of its development cooperation.

[108] The thematic priority 'Environment and Climate' includes four focus areas: (i) adaptation to climate change; (ii) energy; (iii) environment and security; and (iv) water.

Sweden has a history of long-term commitment to rural electrification as a means to achieve sustainable development. Since the end of the 1990s, Sida has financed several rural energy and electrification initiatives in Sub-Saharan Africa, including grid extensions in Botswana, Eritrea, Ghana, Lesotho, Mozambique, Tanzania and Uganda, and off-grid solar photovoltaic (PV) systems in Zambia and Tanzania. In Asia, a major rural electrification scheme in Sri Lanka has been financed with a concessionary credit, and in Vietnam a 5-year capacity building program to enhance off-grid installations in remote rural areas has been implemented. The total project volume of Sida support for electrification (of which 90% in rural areas) between 1995 and 2010 was approximately 1.5 billion SEK, of which approximately 1 billion between 2000–2010.[109]

In connection with energy sector reform efforts in Tanzania, Uganda and Zambia, Sweden has actively supported the establishment of Rural Energy/Electrification Agencies (REA) and Rural Energy/ Electrification Funds (REF), intended to pool funding from various sources. The rationale for this institutional set-up is to offload the national electricity companies the commercially non-viable task to electrify rural areas, and to have a centralised organisation that provides subsidies and support to different stakeholders engaged in increasing access to modern energy services. Sida financing has recently been provided to the REFs in Zambia and Tanzania, and thereby shifted the implementing modality from project support to support managed by the REAs in these two countries.

The overriding objective of all Sida interventions is poverty reduction. Rural Electrification is expected to contribute to economic and social development, including improved the delivery of public goods such as health services, education, water supply, information, business development and increased productivity. Moreover it is expected to benefit the environment through a shift from polluting forms of energy (diesel, kerosene, petrol) to more environmental-friendly forms of energy.

In response to the new government policy, Sida intends to formulate a set of Guidelines for activities in access to electricity, including on the design and how to assess and follow-up such programmes. It is envisaged that it should comprise operational and brief

[109] Ann Kämpe, Formative Evaluation of Sida's Support to Rural Electrification, Preparatory Desk Study, Final Report 2011

descriptions of key challenges, core issues to consider, examples of what works and what doesn´t and references to in-depth methodologies. It shall provide operational checklists in relation to Sida's different roles as financier, analyst and dialogue partner. Consultancy services for this will be procured separately and are not considered in these Terms of Reference.

Some evaluations in the field of electrification have been carried out previously, and are listed in Annex 5 of the preparatory desk study (see below). However, as no comprehensive evaluation of the support to rural electrification has been made previously, Sida has decided to initiate an evaluation, to draw conclusions and generate lessons from Sida's efforts to promote access to electricity for poor people.

A preparatory desk study for the evaluation was carried out in 2011.2 The report includes an overview of Sida's rural electrification portfolio, looks at the objectives at different levels of selected projects, and highlights major lessons from a sample of evaluations, studies and guidelines related to poor people's access to electricity.

2. OBJECTIVE OF THE EVALUATION

With the overall purpose of further improving Swedish cooperation, the forthcoming evaluation is to present conclusions and lessons in respect to what works, under what circumstances and why, to promote poor people's access to electricity and thereby contributing to better living conditions.

The principal intended users of the evaluation is Sida's Department for International Organisations and Policy Support (INTEM) and Department for Program Cooperation (PROGSAM), who will draw on the evaluation as an input to the planned Guidelines and for further methods development work.

Another target group are the national partner organisations and the Swedish Embassies in the two countries studied, for use in their dialogue, as an input to planning and as a basis for follow-up and reporting.

The intention is also that the evaluation can be used in the upcoming development of new country strategies, primarily in Tanzania and Mozambique where the studied projects are situated but also in Zambia.

A broader target group are all other persons engaged in Sida's electrification programmes (Sida staff, consultants, national stakeholders) and who may learn from the evaluation.

3. EVALUATION CRITERIA AND EVALUATION QUESTIONS

The evaluation shall include a description of the programmes with respect to their context, content, processes and financial and institutional arrangements.

It shall further present evidence on the results of the cooperation, and draw conclusions on factors having contributed to success/failure. To this end, a review shall be made of the strategies and approaches that were applied by Sida and its partners, whether they have been successful or if possibly other strategies would have rendered better results. The evaluators shall also consider contextual factors. Socio-economic development is always the result of many factors and the interplay between electrification and such factors should be analysed.

Special attention shall be given what may constitute risks in relation to successful electrification programmes.

The assessment shall be based on the five standard evaluation criteria of OECD/DAC (Se OECD/DAC Glossary for definitions). The principal evaluation questions under the different evaluation criteria are the following:

Effectiveness

1. To what extent have the objectives of the electrification programmes met their objectives, focusing on intended outcome and impact?
2. What factors, internal and external to the programmes, have influenced the fulfilment of objectives (positively or negatively)?

Impact

3. To what extent have the programmes assessed contributed to socio-economic development and poverty reduction?
4. Have there been any positive or negative, intended or unintended effects beyond those reflected in the explicit objectives of the interventions?

Relevance

5. To what extent have the interventions conformed to the needs and priorities of target groups and the policies of the partner countries?

6. To what extent have the programmes been in line with the policy of the Swedish government, implying among other things special attention to poverty reduction, the rights based approach, gender equality, greater influence for women, and good health and environment? 4
7. How has electrification programmes interacted with other factors to achieve socio-economic development and poverty reduction?

Sustainability

8. What type of impact has been observed at different points of time after completion of the programmes?
9. What is the likelihood that the results of the programmes studied will be sustainable?
10. What are main risks to sustainability observed, taking the technical, financial and institutional dimensions into account, and how can they be dealt with?

Efficiency

11. What have been the costs of the results achieved?
12. Are there noticeable differences between the programmes studied and, if so, what are the reasons for this?

The evaluation questions are to be elaborated further, in dialogue with Sida and the national partner organisations, during the inception phase.

Based on the findings, the evaluation team shall formulate conclusions and present "lessons learned" and recommendations in respect to the following:

(i) How shall *electrification programmes* be designed to best contribute poor people's access to electricity (taking contextual differences into account)?

(ii) How can Sida as a donor, *support electrification* most in the best way and what are considerations the Agency should take when planning the support?

4. SCOPE, FOCUS AND DELIMITATIONS

The broader evaluation object is Sida's efforts to promote poor people's access to electricity at large.

The evaluation shall be based on:

1. Field evaluations of a sample of interventions in Mozambique and Tanzania,

2. A desk review of Sida's experiences of electrification programmes, based on evaluations and reviews and monitoring reports (in Mozambique, Tanzania, Ghana, Lesotho, Uganda and Zambia).
3. A desk review of international experiences based mainly on evaluations of programmes financed by other donors (taking in those indicated in the Preparatory Desk Study as a starting point)

Observations, conclusions from the different parts of the evaluation shall be synthesised into a main report.

The time period to be covered by the evaluation will be from 2000 to 2012.

4.1 Field Studies

The evaluation shall comprise in-depth evaluation of four selected rural electrification projects financed by Sida – two in Mozambique and two in Tanzania – including visits to the respective national electricity utilities in Maputo and Dar es Salaam, the respective energy 5 ministries and other principal stakeholders, including local government agencies. Interventions to be assessed are:

Mozambique:

- Ribaue/Iapala rural electrification, Nampula Region (1997–2000)
- Morrumbala rural electrification, Zambézia Region (2001–2004)

Tanzania:

- Grid extension in Serengeti District (2003–2008)
- Makambako substation and network expansion in Njombe District (2004–2007)

Brief summaries are found in the preparatory desk study.

Mozambique and Tanzania were chosen as Sida's largest energy programmes are found there. The projects have been selected on the basis of constituting the most long-lasting electrification programmes in the two countries, which should make it possible also to study longer term impact. In the case of Ribaue/Iapala there will also be a possibility to follow up an earlier evaluation.

The evaluators shall assess the interventions as described under section 3. In doing so, follow-up of the baseline information in the socio-economic studies made during the preparatory phase of the projects, and of previous evaluations, shall be made.

Focus shall be on the selected programmes but these should also be seen in the broader national context in each country, taking national energy policy and regulatory and institutional frameworks, tariff structure and subsidy schemes into consideration.

4.2 Desk Review of Swedish Experiences

In addition to the field studies, the evaluation shall summarise and analyse the observations, conclusions and lessons learned, related to the evaluation questions, as reflected in monitoring reports, reviews and evaluations of the projects financed by Sida in Uganda, Botswana, Ghana, Mozambique, Tanzania and Lesotho. This will be an input to, and should be reflected in, the synthesis report.

4.3 Desk Review of International Experiences

In order to put the evaluation of Sida's rural electrification project portfolio in a broader context, observations and lessons from rural electrification interventions financed by other organisations and donors shall be identified as well. A tentative selection of evaluations and studies of relevance for this part of the evaluation is found in the Preparatory Desk Study. This will again be an input to, and should be reflected in, the synthesis report.

5. METHODOLOGY AND IMPLEMENTATION

5.1 Inception Phase: Development of detailed evaluation approach and methodology

Prior to the start of data collection an inception report shall be presented. It shall include 6

- A model for analysis of the electrification programmes in the form of a generic theory of change,
- A further elaboration of evaluation questions and of how evaluation criteria will be applied,
- An overall evaluation design showing how evaluation questions will be answered,
- An account of baseline data identified,
- An account of primary and secondary data sources and of how data will be analysed,
- A discussion on evaluability and attribution, including how the consultants will to deal with the contextual complexities and various factors contributing the socio-economic development
- A basic analysis of stakeholders, influencing and/or affected by the four programmes directly or indirectly[110],

[110] Such as such as schools, health clinics, small businesses, local households, government representatives, national electricity companies from the responsible ministry, the national electricity company, local government, civil society groups, etc.)

- An account of how stakeholders will participate in the evaluation (who, how, when, why),
- Possible key issues to be further looked into in the evaluation,
- Possible delimitations to be agreed upon with Sida,
- A detailed work programme,
- A budget up-date (if required)

To this end, a review of background documents for the four selected programmes shall be made (project documents, decision memoranda, socio-economic baseline studies, environmental impact assessments, monitoring reports, previous reviews, etc.). This will require dialogue with Sida and national stakeholders for guidance and clarifications.

With the assistance of local consultants in the respective countries, identification of persons to take part in the interviews and group discussions shall be made, including planning of date and venue. The national electricity utilities – Electricidade de Mocambique (EdM) in Mozambique and TANESCO in Tanzania – shall be involved in the planning and be able to offer guidance. In Tanzania, the Rural Energy Agency (REA) should be involved and consulted by the evaluation team. These organisations will also facilitate contacts with local authorities in the project areas.

The inception report shall also draw on the findings of the desk studies and the earlier mentioned preparatory desk-study.

A draft Inception Report shall be presented to Sida and the main counterparts in Tanzania and Mozambique at a workshop for discussion (thus a visit by the consultant is to be planned for). The Inception report shall be approved by Sida prior to the initiation of the evaluation exercise. A Final Inception Report shall be submitted within one week of the receipt of comments on the draft form Sida and national counterparts.

5.2 Desk Reviews

In parallel with the inception phase, the evaluation team shall carry out the desk study of Sida evaluations and reviews and of international experiences respectively. The purpose of doing it in parallel is so that findings can be used to formulate hypotheses to be tested by the evaluation, and as an input to the further formulation of evaluation questions.

The choice of documents to be included in the reviews is to be done in consultation with Sida. 7

Sida (PROGSAM and INTEM) will provide the evaluation team with digital and in some cases paper copies of reports.

5.3 Field visits

The evaluation of the projects in Mozambique and Tanzania shall be made in line with the evaluation plan and methodology agreed with Sida as presented in the Inception Report. It is foreseen that it will involve interviews, focus group discussions, and statistical analysis. Triangulation and the use of mixed methods for data collection and analysis will be considered a strength.

5.4 Reporting

Findings and conclusions from the field studies in Mozambique and Tanzania and the two desk studies shall be presented separately as stand-alone reports. In addition, a main report, synthesising findings from the different component reports, shall be prepared. The main report should have an emphasis on the overall findings, conclusions, lessons and recommendations.

For all reports, a draft shall first be presented to Sida and key stakeholders for comments. Comments shall be provided no later than two weeks after submission of the draft report. A final draft for Sida's approval is to be prepared by the consultant no later than two weeks after receipt of comments.

The main report shall be written in English and adhere to the OECD/DAC Glossary of Key Terms in Evaluation and Results Based Management. It should not exceed 40 pages, excluding annexes (in which country findings may be presented). Format and outline of the report shall follow the guidelines in *Sida Evaluation Manual "Looking Back, Moving Forward"* – Annex B, Format for Sida Evaluation Reports. The complete evaluation manual including annexes is retrievable from Sida's home page.[111]

The reports must be presented in a way that enables publication (in black and white) without further editing. A report format in word will be furnished by Sida. After approval, the report will be published in the series *Sida Evaluations*. Sida also intends to share the final version of the evaluation digitally with the major stakeholders to the evaluation.

[111] 4 http://www.sida.se/sida/jsp/sida.jsp?d=118&a=3148&searchWords=looking

The evaluators are expected to maintain a continuous dialogue with Sida and the national counterparts throughout the evaluation process, both for the management of the evaluation and as a way to promote learning.

Towards the end of each field visit the evaluation team shall present preliminary findings to concerned stakeholders including the Swedish Embassies, EdM (in Mozambique) and Tanesco and REA (in Tanzania).

After completion of the synthesis report, one seminar in Tanzania and/or Mozambique and one in Stockholm shall be held, with the participation also of Sida staff and stakeholders of other countries working with electrification. 8

6. TIME SCHEDULE

The evaluation should start no later than 8 October 2012 and a final report should be submitted no later than 30 April 2013.

Total time input is expected not to exceed 50 person weeks. *Indicatively,* this would allow for approximately 2–3 weeks for each of the desk studies, 5–6 weeks for the inception phase including inception visits to Mozambique and Tanzania, 6–8 weeks for the field studies per programme, and 6–8 weeks for preparation of the two country reports and the synthesis report, and 1–2 week for dissemination and follow-up (person weeks).

7. THE TEAM

The evaluation shall be carried out by a team of evaluation experts with competence specified in the Invitation to Tender. One of the evaluation experts shall take on the role as Team Leader. The team shall have representation in the two case countries and include persons with in-depth knowledge and understanding of Tanzania and Mozambique culture and societies.

8. ROLES AND RESPONSIBILITIES

The evaluation shall be a joint undertaking by Sida/UTV, PROGSAM, INTEM, the Swedish Embassies in Tanzania and Mozambique as well as the major partner organisations in the two countries.

UTV has the overall responsibility for management and quality assurance of the evaluation. A management group shall be formed with representatives from each of the above entities. The role of the

group will be to guide the consultant's work, including giving feedback on the inception, draft and final reports.

INTEM, PROGSAM and the Swedish Embassies will provide the consultants with the documentation they need for the evaluation. The Swedish Embassies will further facilitate the consultant's contacts with relevant national stakeholders. The national partner organisations will facilitate planning of fieldwork, contacts and collection of data, including furnish necessary documentation, statistics etc.

The consultant will have the full responsibility for the implementation of the evaluation, in line with to the principles of independence and impartiality.

Annex 2: Evaluation Questions and Judgement Criteria Matrix

This annex gives an overview of the Evaluation Questions and their Judgement criteria.

The evidence collected under each judgement criterion is drawn from the Desk Study and the two country case studies, which are presented as separate volumes to this evaluation.

The evidence collected under each judgement criterion has been summarised from the evidence collected in the three above-mentioned reports and provides the basis for the response to each Evaluation Question.

The function of the judgement criteria is to provide the basis for answering the evaluation questions and to structure the analysis process, determine the nature of the data to be collected and the analysis which needs to be carried out. Thus the logic is that the assessment contained under each judgement criterion is linked to a specific Evaluation Question together with the remaining judgement criteria under that Evaluation Question, and these combine to provide the basis to answer the formulated evaluation question.

The number in brackets after each Evaluation Question refers to the Evaluation Question in the Evaluation's Terms of Reference on which the final Evaluation Question text is based – see Terms of Reference (included as Annex 1). The Evaluation Question text was approved as part of the Evaluation's Inception Phase.

RELEVANCE – The extent to which a development intervention conforms to the needs and priorities of target groups and the policies of recipient countries and donors.

Evaluation Questions 1 To what extent are the interventions aligned with the stated needs and priorities of target groups and the development priorities and policies of partner country governments? (5)	
Judgment Criteria	**Indicators**
1.1. The Sida interventions in rural electrification are consistent with the partner country's Energy policies and strategies, and its electrification policies and investment plans.	• Energy Policy; Electrification policy; included in PRSP • **Environmental sustainability** integrated in the design of the interventions.

1.2. Stakeholder analysis and target group engagement activities were undertaken as part of the preparation process and as an element of local ownership of the planning process, and this was incorporated in the design of the interventions.	• Stakeholder engagement – who participated (gender; types of organizations) and during which stage of the project cycle (during preparation and design? Further along in the process?); evidence that needs expressed by stakeholders were included (local priority settings). • Community consultation looking at capacity to use and pay for electricity (including gender analysis – who pays?), likely load growth • Evidence that different alternatives were considered – technology and technology cost alternatives, tariff structure, etc. • Market – product mix analysis – different kinds of customers and different supply options with focus on domestic supply options
1.3. Sida interventions were harmonized with those of the other development partners both in the country and in the sector.	Desk: • WB, EU and AfDB Country Strategy Programmes. (NB. WB and EU normally have an analysis of all donors working within a particular sector). Field: • Existence of Energy and Electrification Sectors "divisions of labour" (as defined by OECD/Paris Declaration); Are there SWAp? • Role of lead donor vis-à-vis other donors (e.g. Sida is lead donor in the Energy sector in Tanzania and a leading donor in Mozambique)

Evaluation Question 2 To what extent have electrification programmes been designed to improve the conditions of people living in poverty, also taking the various contextual factors into account? (7)	
Judgment Criteria	**Indicators**
2.1. The Sida interventions in rural electrification are consistent with the partner country's PRSP	• Compliance of Sida interventions with PRSP/PARPA; analysis of PRSP/PARPA over time. • Reference to PRSP/PARPA made in Sida planning documents. • Monitoring of implementation of the MDGs – notably MDGs 1, 3, 4,5 and 7.

2.2. Sida interventions in the electrification sector included a design process geared towards improving the living conditions of the poor.	• A governance, gender and poverty analysis; • Technology scenarios that include a focus on the choices that poor HH have; • Technology scenarios that place poor HH within a context of what is feasible for the utility to supply (system capacity) with system demand – and the place of poor HH in that context. • Institutional capacity of the power utility (or electrification agency) to manage connections – and new connections. • Existing energy use and potential environmental impacts/benefits; • Social impact studies and issues around HIV/AIDS (which is a major problem in Eastern and Southern Africa, particularly around large infrastructure projects) • Conflict analysis (e.g. In Uganda and Mozambique Sida has made a conflict analysis – dating back to 2003. For example, **the Morrumbala area was in the zone affected by the internal conflict**). Important for linking LRRD (linking relief rehabilitation and development) into planning.

EFFICIENCY – The extent to which the costs of a development intervention can be justified by its results, taking alternatives into account.

Evaluation Questions 3 To what extent have rural electrification interventions been cost-effective, i.e. what has been the relation between costs and the results achieved? (11)	
Judgment Criteria	**Indicators**
3.1. The interventions provided power at a cost per unit that was lower or equal to that which would have been realized by the main alternatives studied.	• Analysis of different financial and administrative options (including tariffs and connection costs) targeting poor households. • Key ratios on outputs (e.g costs/connection) • Analysis of different technology options (including low cost technologies for low load connections – SWER, prepaid metering, etc.) – comparison between the four case study areas/distribution zones. Using WB or AfDB "best practices" as basis for comparison; No full cost-benefit analysis carried out.

	Costs cover: project implementation costs and operation costs (including tariffs and connection costs); and also comparison of time and money – costs over-runs and time over-runs. This should also include a reflection on the fact that certain technologies may have higher investment costs; but may be more sustainable or more poverty focussed in the long run. Also that system capacity may take into account a longer or shorter design horizon.
3.2. The interventions are carried out within their planned schedule and budget	• Monitoring reports reflect disbursements. • Disbursement timing against schedule
3.3. The investment required per unit of delivered electricity is within the range predicted.	• Investment plans included in feasibility studies • Investment plans monitored and adjusted during implementation following reviews. • Mechanism within the utility to measure costs per unit.
3.4. The investment required per cost of delivered units is within the range experienced by other development partners in similar interventions.	• Comparative studies exists by other development partners with which to compare • Comparative studies done by utilities in the region with similar conditions (e.g. ESKOM South Africa)
Evaluation Question 4 How have programme designs and implementation modalities contributed to achieving efficiency? (12)	
Judgment Criteria	**Indicators**
4.1. Appropriate technical solutions have been chosen which take into consideration the socio-economic situation of the **target group**	• Willingness and ability to pay studies (with disaggregated statistics); • Needs identification studies; • Gender analysis and analysis of who is responsible for decision-making; • Choices made balance appropriate technical solutions for the identified load – including connections to public and business consumers; as well as domestic connections (including poor households and their potential to connect).
4.2. Appropriate technical and financial solutions have been implemented which reflect the capacity of the power utility to manage the intervention.	• Existence of design studies which analyze institutional capacity (in addition to infrastructure). • Capacity analyses which reflect technical capacity of utility to maintain the interventions.

4.3. The implementation design have taken into consideration the local employment resource base (including gender disaggregated capacity) and reflect the results of risk analysis regarding external labour (i.e. bringing in outside labour force); HIV AIDS, etc.	• Human rights aspects – customer relations; • Decisions on tariffs; • Involvement in planning/decision-making • Labour force study – existing employment. (Unskilled likely to be contracted locally). • Labour force study related to technical support to HH in respect of internal wiring, basic HH electrical maintenance, etc. • HIV/AIDS contingency plans.
4.4. Intervention designs have been developed together with other development partners in the energy and electrification sector. **(External Complementarity; programme versus project support).** **External complementarity.** The Paris Declaration is very strong on the subject of donors working together – however, at the level of efficiency, this would be more a comparison between Sida's approaches compared to other donors.	• Evidence that development partner "division of labour" aspects have been taken into consideration; • Evidence that Sida interventions are part of the overall priorities and interventions for both the (i) energy and (ii) the electrification sectors. • Chosen intervention modalities – discussions on project versus programme support; and role of lead development partner on the sector.
4.5. Intervention designs have been coordinated with other Sida interventions in the context of Sida's country support strategy, and have followed Sida guidelines. Other Sida interventions would relate to **internal complementarity**, for example the work on cooking stoves by SEI, funded by Sida Sida guidelines: environmental sustainability, environmental and social impact studies; strategic environmental assessments (if Sida has guidelines for these)	• **Internal complementarity,** i.e. how have Sida's electrification programmes been complementary with other Sida programmes and policies (in environment, in gender, in transport, HIV/AIDS, etc.). Has this contributed to achieving results – or hindering implementation. • How have **environmental** challenges been tackled? Have EIA's taken place and what has been the result of these – how have they fitted into the implementation modalities. Is there any experience with doing strategic environmental assessments and looking for alternative solutions? • Evidence that Sida has learnt from environmental and social impact studies, evaluations, etc., and has used this knowledge in modifying its intervention modality approach; and in modifying its overall approach at sector and national level.

EFFECTIVENESS – The extent to which a development intervention has achieved its objectives, taking their relative importance into account.

Evaluation Question 5 To what extent have electrification programmes achieved their stated immediate and medium term objectives? (1, 2)	
Judgment Criteria	**Indicators**
5.1. Reliable continuous power supply is available to all legally connected consumers.	• Analysis of distribution between sub-sectors of consumers (different types of domestic consumers; public institutions; businesses) • Power supply operational and providing electricity
5.2. Defined Maintenance procedures are in place and financed in a sustainable manner (tariffs in place; consumers paying bills; maintenance takes place; lines cleared regularly; depreciation of infrastructure covered, etc.).	• Utility maintenance manuals and existence of as-built drawings • Utility maintenance records (both locally and aggregated at regional and national levels) • Utility financial records (both locally and aggregated at regional and national levels) • Procedures in place to recover bad debts • Procedures in place to identify and tackle illegal connections • Procedures in place to tackle theft of equipment (poles, power lines, transformers, etc.) • Qualitative feedback from consumers on utility performance.
5.3. Public sector consumers connected These would include: street lights, water supply, schools, health centres, public administration, post office, police – army;	• Inventory of public sector – connected and non-connected within the case-study area. • Analysis of public sector consumption records; and payment records. • Qualitative feedback from "the public" on the public sector service provided.
5.4. Commercial/private sector consumers connected	• Inventory of commercial/private sector consumers connected (from utility records) • Inventory of any commercial/private sector consumers using electricity but not connected to the utility (i.e. illegal connections or own supply). (Note: high number of "own supply" could suggest a lack of efficiency on the part of the utility – such as frequent load shedding, unreliable supply, voltage and frequency fluctuations, etc.)

5.5. Households connected (also in relation to HH not connected and some kind of poverty/gender profile)	• Number of HH connected – in total for the utility; but also in relation to the number of HH not connected. • Disaggregated information about HH composition. • Type of meter; HH consumption pattern (from the utility – how much does HH use, including seasonal variations; and payment for electricity (regular? But also what type of metering: meters read and bills sent; prepaid meters, etc.) • Analysis of electrified HH energy use – multiple fuel use. (number and type of connection; electrical appliances, etc.) – including PV or own generator • Analysis of non-connected HH and their energy use (biomass; candles; kerosene; lanterns with batteries;) • Quantified targets as stated in the project documents.

IMPACT – The totality of the effects of a development intervention, positive or negative, intended and unintended.

Evaluation Question 6 To what extent has better access to electricity affected socio-economic development and the living conditions of people living in poverty? (3, 4)	
Judgment Criteria	**Indicators**
JC 6.1. The nature and quality of public services has improved.	• Quantitative and qualitative indicators (schools open in the evenings; clinics open at night for emergencies; 24/7 water supply; street lights give feelings of safety, etc. • Number of connections and bills being paid; focus group and other interviews on appreciation of public service improvements.
6.2. Local jobs have been created and local economic development has taken place.	Jobs created (or jobs lost) in: • Cottage industries; • SME; • Large scale (plantations; cotton mills, etc.). • Economic diversification (broad-based growth) • Private sector jobs in electrical maintenance and in sale of electrical appliances.

6.3. HH energy consumption patterns have changed during the evaluation period.	• More HH connected – and evolution in use of appliances – and change in the balance between "fuels". This could be for both connected and non-connected HH. • Small scale production at HH level (cottage industry). • Connection and consumption costs following connection have increased (or reduced) the percentage of HH income that families spend on energy.
6.4. HH Time management has changed over evaluation period as a result of electrification.	• Lights in evening (where: in the kitchen/living room/bedroom); watching TV; fetching water easier; less firewood used; less time spent cooking; school in evenings; hanging out in bars, etc.)
6.5. Environmental impact on surrounding forest resources has had impacts on HH budgets and time management.	• Household use wood and charcoal; whether it costs more or takes more time to gather; whether they use less – e.g. improved cooking stoves, ...)... NB – see also JC 8.4. which also touches on this on the resource side; whilst this indicator is more focussed on HH. However 8.4 now also focuses more on the distribution area itself rather than on the state of the fuelwood resource.

Evaluation Question 7 To what extent has there been an impact on poverty at different points in time after the completion of the interventions; and to what extent has electrification contributed to this? (8)	
Judgment Criteria	**Indicators**
7.1. International statistics (HDI/WDI indicators and national statistics reveal a decrease in poverty during the evaluation period.	• Quantitative – HDI/WDI indicators; National Statistics Bureau; local development plans • Qualitative: HH surveys (•More time spent on studying as a result of light; social activities as television); access to internet and other media), • Health indicators, school results, girls going to school... • What HH are not connected vs connected (sex, age, family structure) • What HH pay their bills? (sex, age, family structure) • What HH pay how much? (sex, age, family structure)

7.2. Non-connected HH have benefitted from electrification of their "area". (i.e. this should be those households who could potentially have been connected; but also those who use the services in the area but maybe live outside the immediate zone)	• Child mortality; • Morbidity and mortality statistics – e.g. related to illness attributed to use of "dirty fuels" – woodsmoke, kerosene ingestion, etc. • Girls versus boys in schools; school pass rates; • Indicators linked to water supply; • Indicators linked to HIVAIDS; • Indicators linked to employment; • Possession of cell-phones, literacy, access to information (i.e. internet).
7.3. Connected HH have benefitted from electrification in their area.	• Poverty ranking of households. Are poor HH connected or is it only those HH more well-off. Characteristics; capacity to make monthly payments; what energy choices are made. • Are poor HH connected or are benefits accruing to poor people indirect (e.g better access to services and more employment opportunities). • Cottage industries could impact on poorer households.
7.4. Businesses have benefitted from electrification in their area (notably through increased employment)	• Comparison between number of businesses connected during the project period – compared with 2012. • Analysis of employment trends – quantitative if possible; otherwise qualitative discussions with sample of businesses.

SUSTAINABILITY – The continuation or longevity of benefits from a development intervention after the cessation of development assistance

Evaluation Question 8 To what extent have electrification programmes contributed to changing energy consumption patterns in a sustainable way and what are the environmental consequences? (4)	
Judgment Criteria	**Indicators**
8.1. Households show trend towards replacing firewood/charcoal cooking and kerosene/paraffin lighting with cleaner fuels – electricity (or gas).	• Consumption of firewood and charcoal; and kerosene/paraffin (including seasonal changes).

	Fuel-wood prices are seasonal so need to take that into account also – and overall fuel-wood prices can have gone up as a result of loss of the timber resource (or non-management of the resource). Use of fuel can also reduce through using fuel-efficient stoves; also influence of price structure (fuel wood; el tariffs; lighting fuel and gas
8.2. Environmental health improvements from reduction in indoor air pollution (i.e. less smoke from cooking and heating with fuel wood; and less smoke from kerosene lamps for lighting) are being reduced and maintained.	• Drop in pneumonia deaths (acute lower respiratory infections – ALRI) for under fives. • Drop in chronic obstructive respiratory diseases (disaggregated data – men women; boys girls) • MDG 4 (reduce child mortality) and MDG 5 (improve maternal health) • Reduced reported incidence of fires (as a result of decreased use of fuel wood, kerosene, candles, etc.)
8.3. The service sector – including hotels, guesthouses, bars – tend to increase the share of cleaner fuels in their energy use.	• Sample of service sector connections and analysis of energy use since connection (quantitative) • Combined with site visit (quantitative/qualitative) focused on present energy use and changes in energy use over time.
8.4. Use of biomass within the Households is decreasing and there is a reduction in the non-sustainable utilization of forest biomass for cooking and heating.	• Evidence of change in cooking patterns (e.g. change to improved stoves; fewer cooked meals.) • Evidence of renewable harvesting of biomass • Evidence of continued reduction of forest cover. • (Difficult to attribute any change in e.g. forest cover to reduced use of fuel-wood in cooking – but nevertheless probably useful to see what other programmes there are and if there has been any attempt to work together. However focus of the fieldwork will be on what happens within the electrification distribution area. If reports exist on biomass harvesting and reduction of forest cover, then these will be cited but it will not be a principal focus of the fieldwork.)

Evaluation Question 9 To what extent are the established electrification services sustainable during the life cycle of the intervention and after the exit of the development partner?	
Judgment Criteria	**Indicators**
9.1. Energy is supplied continuously	• Power supply operational and providing electricity • Adequate generating capacity • Load shedding – frequency (as a result of capacity demand exceeding supply capacity) • Theft and illegal connections controlled
9.2. Maintenance procedures are defined and are in place and functioning.	• Mechanisms exist for ensuring that bills are paid and what happens when bills are not paid? Who pays the bills and who doesn't? • Existence of maintenance procedures. And are there gaps in service provision because the utility cannot repair breakdowns to the distribution network or to the HH connections (external not internal)? • Evidence that projects have included institutional capacity components of utilities, and of relevant key stakeholders (ministry, regional departments)
9.3. Depreciation of existing infrastructure is covered.	• Cost recovery structure in place and functioning (based on life time considerations). • Sufficient funds being generated for O&M; and for depreciation
9.4. Technical and institutional capacity exists to maintain distribution lines and to connect new customers.	• Plans exist for connecting new HH, institutions and businesses – • Sufficient funds being generated to connect new consumers and expand the local network. • Structure of agency responsible for electrification links in with the utility responsible for providing the service on a continuous basis (e.g. is there a rural electrification agency and does it link with the utility for management of the system; and extension of the system) • Institutional capacity exist to adjust tariffs, manage customer relations, manage financial administration and handle funds • Anti-corruption measures in place within the institutions as well as management of losses through illegal connections, etc.

9.5. Sufficient capacity exists to accommodate increased demand	• Analysis of future trends has taken place and system has capacity to increase connections and has the institutional procedures to manage them (supply capacity exceeds demand capacity). • Project did take demographic and economic forecasts into account in their design in order to absorb increasing demand through the lifetime of the project (including utility institutional capacity. whether being utilities or physical infrastructure)
Evaluation Question 10 What are the main factors (technical, financial, institutional, developmental, international) that contribute to determining long-term sustainability (after the life-cycle of the intervention)? (9, 10)	
Judgment Criteria	**Indicators**
10.1. Area development and investment programmes exist where electrification is part of the enabling environment (rather than an outcome in and of itself)	• Regional/district development plans and programmes where the productive use of electrification is seen as an **input** into a development programme rather than an **output** or an outcome in and of itself. • Evidence of working across sectors in order to identify and promote the productive use of electricity. • Focus on HH socio-economic development and business/employment development; and the broader development context (other programmes) – the systematic approach where electrification is included in a broader development context.
10.2. An exit strategy exists whereby the State, the Utility and other Development partners in the electrification and energy sector have prepared long term support plans.	• Sida Exit strategy • Existence of long-term support plans to the electrification (and energy sector) by national authorities (the national political level and the utility level) • Existence of long-term support plans to the electrification (and energy sector) by other development partners. • Connection targets include new connections – including new domestic connections.

10.3. Plans and strategies exist for taking into account **foreseen** macro exogenous and endogenous factors that may affect the anticipated sustainability of rural electrification services.	• Evidence that the utility at strategic level reacts to foreseen events through new investments, tariff revisions, etc. • Evidence that parent Ministry makes policies for the sector and is capable of accessing investment capital. • Industry regulator working with utility and ministry to make adjustments • Increased focus on Renewable Energy Technologies that can contribute to reducing elements of dependency on oil imports which are subject to price fluctuations.
10.4. Plans and strategies exist for taking into account **unforeseen** macro exogenous and endogenous factors that may affect the anticipated sustainability of rural electrification services	Indicators including: • macro economic trends as fluctuations global oil prices and financial crises for instance; • political shocks; • demography including urbanization; • climate change; etc.

Annex 3: Methodology

Introduction

The evaluation was structured around four distinct phases: moving: from the wider context first (i) Inception and (ii) Desk phases, then (iii) focussing on the narrower, more restricted context of the Field phase case-studies in Tanzania and Mozambique, and back to (iv) the wider context (the Synthesis Phase). The synthesis phase has been structured so that the conclusions and recommendations can serve as inputs into Sida policies and guidelines.

Each phase produced specific evaluation outputs which are also available as stand-alone documents:

- Desk Review Report of Sida Experiences with Rural Electrification in selected Countries and Global Experience from Programmes financed by other Development Partners
- Country Report Mozambique
- Country Report Tanzania

This annex summarises the methodology, which is contained in more detail in the Inception Report and which is further detailed in the Country Reports in respect of the fieldwork approach.

The Evaluation period defined by Sida covers the period from 2000 until 2012. This period was used as a guideline for both the desk and the field studies.

Evaluation Framework

The Evaluation Framework is built around ten evaluation questions. These were based on a number of draft evaluation questions contained in the Terms of Reference (see Annex 1) and re-formulated and finalised during the Inception Phase. Sida formally approved the final ten evaluation questions. The ten evaluation questions have been formulated and categorized according to the OECD/DAC evaluation criteria. The ordering of the questions follows the logic of the project cycle – starting from project design (where *relevance* comes in) and ending with the withdrawal of the development partner (which refers to *sustainability*). As future Sida guidelines for the Electrification (and Energy) Sector will, most likely, be linked to the different stages of the project cycle, a re-ordering of the evaluation

questions, according to this sequence will also make reporting more clear and presentation more user-friendly.

The Desk Report and the Country Reports all followed the evaluation question structure in their reporting, thus providing the basis for the Synthesis Report; as well as a basis for cross-referencing between reports. The judgement criteria, which were formulated to provide the basis for responses to the evaluation questions, were used to develop the fieldwork research instruments and also form sub-chapter headings in the chapter of Synthesis Report which responds to the evaluation questions. The matrix of evaluation questions and judgement criteria – approved by Sida during the Inception Phase – are contained as Annex 2.

Evaluation Phases

The evaluation passed through four phases.

- The *Inception Phase*, the initial phase of the assignment, laid the foundation and set the direction for the overall evaluation process. The output of this phase was an inception report. .
- In parallel to the Inception phase, the *Desk Phase* studied and analysed experiences of Sida and other donors supporting electrification interventions. The desk phase fed into the drafting of the inception report, and provided a basis for the Tanzania and Mozambique country case studies. The outputs of the desk phase were a single report (in two volumes) covering Sida Experiences with Rural Electrification in selected countries and global experience from programmes financed by other development partners. The Desk Report further benefitted from additional inputs in parallel to the field phase, and was finalised towards the end of the field phase.
- The preparations for the *Field Phase* started at the end of the Inception phase. The field work methodology is detailed in the case study reports. This covered: selection of methods to be used, sampling and survey methods, design of field manuals and translation of these into local languages, identification of local field assistants, and a detailed time plan for field work. For each of the two country studies a *presentation workshop* of the findings and conclusions was held, with participation from Sida and key stakeholders.
- The *Synthesis Phase* completed the cycle. This phase was used to synthesise and combine findings, conclusions and recommendations from the desk and field phases. The format and outline of

this report is defined by the evaluation question framework and matrix, and follows the guidelines in the Sida Evaluation Manual "Looking back, moving forward".

Fieldwork Phase and choice of case studies.

The fieldwork phase was implemented by in-country teams based, respectively, in Mozambique and Tanzania, supported by research assistants, as well as professional staff from EdM (Mozambique) and TANESCO and REA (Tanzania). The fieldwork kicked-off with Inception Workshops attended by key stakeholders, which provided the platform for detailed fieldwork preparation. At the end of the field phase, a second stakeholder workshop was held to discuss the results of both the fieldwork case studies as well as the interpretation of fieldwork results in the draft of the Synthesis Report.

The fieldwork methodology and the case study approach followed are further developed in the country reports. In this annex it is important to highlight that the actual choice of both countries in which fieldwork should take place, and the projects to be studied as part of the fieldwork were pre-identified by Sida, on the advice of the respective Swedish Embassies.

Two countries were chosen for field studies – Tanzania and Mozambique. These countries have a long history of development cooperation with Sweden – both as regards support to interventions in the energy and electrification sector, as well as broader support to other sectors. For this reason, therefore, the focus of the evaluation's fieldwork has been on the following four projects, all of which are extensions of the national grid.

Two projects in Mozambique:-

- Ribaue/Iapala rural electrification, Nampula Region – 1997–2000,
- Morrumbala rural electrification, Zambézia Region – 2001–2004;

Two projects in Tanzania:-

- Grid extension in Serengeti District – 2003–2008;
- Makambako substation and network expansion in Njombe District – 2004–2007.

Any gaps as a result of this pre-selection were to be covered by the Desk Phase where Sida also had the responsibility of providing assistance to the evaluation team in respect of identifying relevant documentation – particularly in relation to Sida support to the sector.

Field methodology and case study approach

The field methodology was (further) developed following the Inception Meetings in March 2013, covering: sampling, design of field manuals (questionnaires and interview guides for use in the field), identification of stakeholders (national and district level), list of interview persons/entities at national and district level, identification of local field assistants and translators (where needed), a detailed time plan for field work, and the detailed costing of the exercise.

The fieldwork methodology attempted to find a balance between sound data collection and rapid generation of outputs – within the evaluation budget and the timeframe set by Sida. The field studies remain inputs into the overall evaluation – it is not the case study projects, as such, that are being evaluated, nor audited. Instead data collected from the case studies served as inputs into the overall evaluation of Sida support to the sector. This had consequences for the design of the fieldwork, which was kept more simple than would be the case for a full-scale project evaluation.

The fieldwork in the case study areas is based on a mixture of quantitative and qualitative methodologies; as well as, at the household level, spreading data collection between connected and non-connected households. The framework for all data collection – whether quantitative or qualitative – was based on the evaluation question-judgement criterion matrix. (See Annex 2)

The quantitative data questionnaire was designed to elicit responses from: (1) households (both connected and non-connected); (2) businesses/private sector; and (3) public institutions. Some parts of the questionnaire were identical to allow for consolidation across data sets; and all quantitative data was captured in excel making it manageable for all team members.

Quantitative data was cross-referenced with qualitative data which used: focus group discussions; structured and semi-structured interviews, and field observations – plus documents and statistical data from existing sources.

Generalisation from case study data

The mixture of quantitative and qualitative data from the case studies allowed for the drawing of particular conclusions with respect to the case study countries as well as more general findings relating to rural electrification. Thus, for example, the generally accepted fact that EdM as a utility is a better functioning utility than TANESCO

is borne out by both frequency of power cuts as well as levels of damage to electrical equipment emerging from the quantitative data,

The structuring of the evaluation around the Evaluation Questions and the judgement criteria also allows for the integration of Desk Study data, together with Case Study data at enough level of detail to be able to answer the evaluation questions; and to draw conclusions.

Stakeholder participation

Stakeholder participation has been an important element of the evaluation. This included:

- The Inception Meetings in Stockholm with the members of the reference group based in Stockholm, joined by Swedish Embassy staff in Mozambique and Tanzania on video conference (January 2013); and
- The final report back seminar in Stockholm on the evaluation's conclusions and recommendations (November 2013)

At the national level, two formal stakeholder workshops were held: the first, during the Inception Phase (March 2013); and the second, as part of the report-back exercise (September/October 2013).

In Mozambique and Tanzania national level stakeholders included:

- The Swedish Embassy,
- The utility, rural electrification agencies, the regulator, the Ministry
- Key development partners.

The formal stakeholder group was complemented by a more diverse group in the case study areas, including:

- The utilities and implementing agencies at implementation and operation and maintenance level in the 4 case-study areas.
- The public sector (local government, schools, health clinics, decentralised agencies of government, …
- The business sector (small business; large-scale businesses; …)
- Non-state actors – NGOs, civil society groups, community groups, women's groups
- Households (Connected households and Non-connected households)

Annex 4: Maps of the national grid in Mozambique and Tanzania

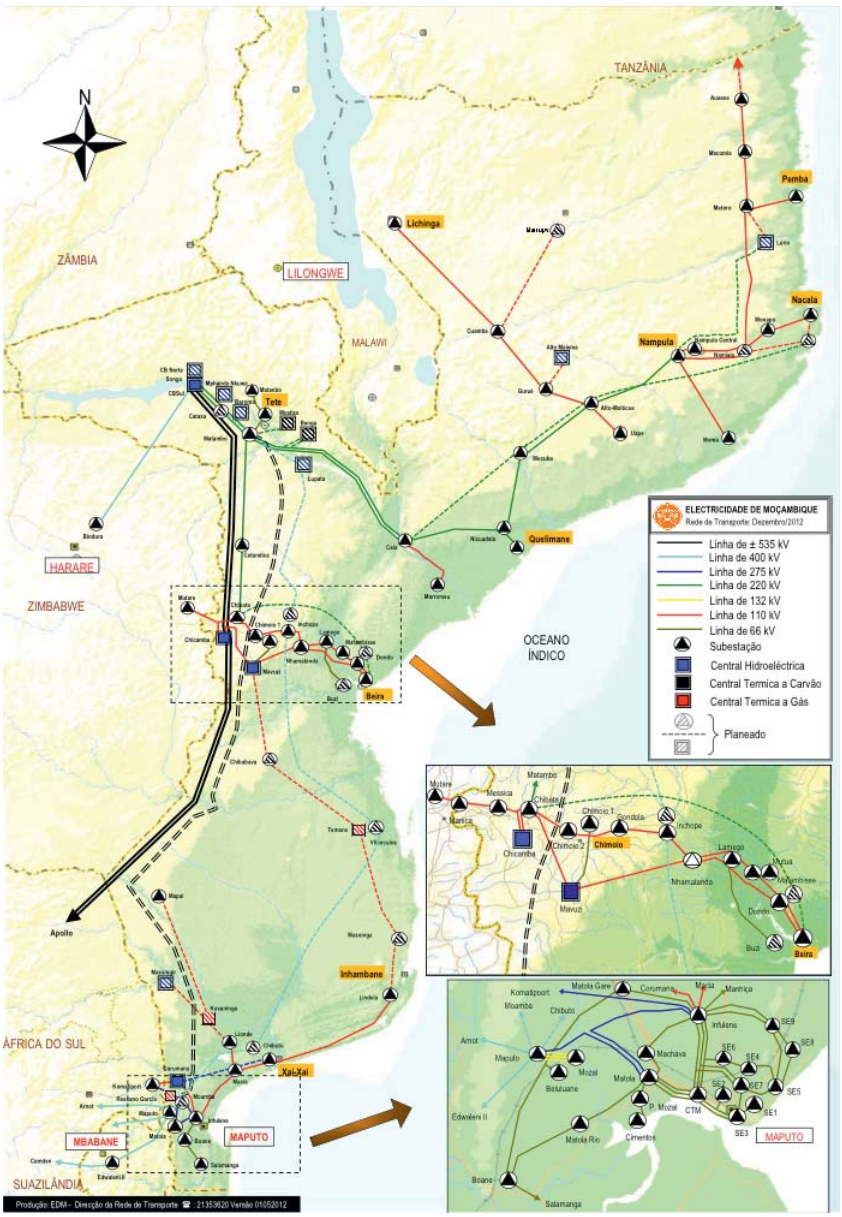

Figure 5 Map of the national transmission grid – Mozambique

Source: EdM Annual Statistical Report 2011.

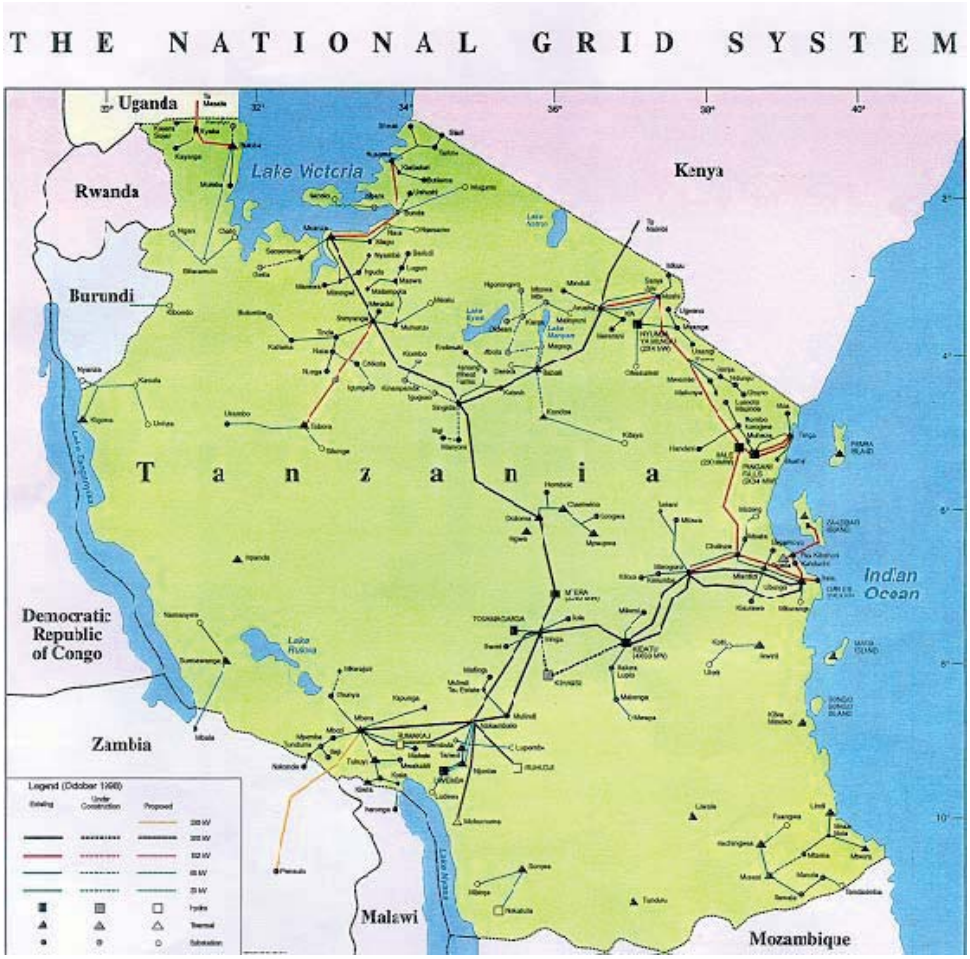

Figure 6 Map of the national grid – Tanzania

Annex 5: Mozambique and Tanzania Country Context

This annex gives the country context of the two case study countries

A common characteristic of both Tanzania and Mozambique is that high economic growth and impressive macro-economic performances have not been translated into poverty reduction. Thus, while Tanzania's GDP growth rate has been impressive in the recent past, the incidence of income poverty did not decline significantly. The target of the Mkukuta (PRSP) is a reduction to 24% by 2010. Instead, the number of poor people in absolute terms actually increased from 2000/01 to 2007 with 12.3%.[112] Tanzania's macroeconomic success has not been felt by the majority of the rural population, who are still living in extreme poverty.

In respect of Mozambique, the assessments found that the poverty headcount declined sharply in the period from 69% in 1997 to 54% in 2003 (which would be consistent with the end of the civil war in 1994) but remained practically the same in the recent period from 2003 to 2009 (from 54.1% to 54.7%). Yet, while the economy showed sustained high growth rates, there is little evidence that the income distribution has changed dramatically. With the economy growing at some 8% each year during the period from 1997 to 2009, the average annual reduction of the poverty headcount of 1% is small. [113]

ANNEX 5.1 MOZAMBIQUE COUNTRY CONTEXT

The section on Mozambique draws heavily on the Country Desk Report for Mozambique (Desk Report. Volume 2: Annex 4).

5.1.1 Economy and institutions

Since the end of the civil war,[114] the Mozambican economy has undergone immense structural changes and has grown at an impres-

[112] Figures taken from Tanzania National Bureau of Statistics *Household Budget Surveys* 2000/1 and 2007; and Economist Intelligence Unit Country reports.

[113] The figures and conclusions for Mozambique are taken from: Boom, 2011: ***Analysis of Poverty in Mozambique.***

[114] Fighting in the civil war ended in 1992; and the country's first multi-party elections were held in 1994.

sive pace. The transition from a central planning system to a market economy has helped raise the country from being one of the poorest in the world, around 1990, to a level of GDP/capita in 1999 of 230 USD. The GDP has grown significantly during the 00s – in recent years at around 7%. By far the largest part of the population lives in the rural areas and is engaged almost exclusively in the agricultural sector. Yet in 1999, agriculture, livestock and fisheries together contributed only about one third of GDP, while services contributed with 44%, and industry with 24%, of which manufacturing made up approximately 13%.

Mozambique has vast and largely untapped natural resources including: about 12,500 MW hydro potential, 127 billion m^3 of natural gas reserves, and 13.1 billion tonnes of proven coal reserves. Until the end of the 1990s the energy sector was characterised by decline, disruption and initial post-war reconstruction. Since then the energy sector has developed rapidly. The reform process of the

The Mozambique electricity transmission sector

Three large companies control and operate the national transmission systems in Mozambique:

Hidroeléctrica de Cahora Basa (HCB) started operations in 1974. HCB owns and operate the dam and the 2,075 MW hydropower plant in Tete province, the 535 kV HVDC (high voltage direct current) transmission line to South Africa, and some 220 kV transmission lines in the Central Region. Since April 2012, GoM owns 92.5% of HVB and the Government of Portugal 7.5%.

The **Mozambique Transmission Company** (Motraco) began to operate in year 2000. Motraco owns and operates the two 300 km 400 kV lines and substations that extend from South Africa across Swaziland to Mozambique. Mozal supplies the Mozal smelter and EdM's southern grid network. The capacity of the Motraco system is about 1,200 MW. Mozal is incorporated in Mozambique and is a shareholding company owned by Eskom of South Africa, SEC Swaziland, and EdM Mozambique.

Electricidade de Mozambique (EdM) is a government-owned company. EdM was transformed into a public company in 1977 with the responsibility for generating, transmitting and distributing electricity throughout the country. EdM is administratively under the MoE. EdM generates electricity from its hydropower and thermal generation plants, and purchases electricity from HCB and trades power with neighbouring countries.

The overview of the national transmission grid is included as Annex 4.1

energy sector has been ongoing since the late 1990s – encompassing a gradual liberalisation and commercialisation of the previously state-controlled structure. MoE is responsible for national energy policy and planning, and for overseeing the development of the energy sector, i.e. the power sector, renewable energy, and liquid fuels. The National Directorate of Forestry and Wildlife (DNFFB) within the Ministry of Agriculture (MADER) is responsible for the management of Mozambique's forests and the regulation of wood fuel supply.

Apart from the above-mentioned three large companies, the Mozambique Energy Fund (FUNAE) was created in 1997 with two main objectives: to promote and implement low-cost energy supply to poorer urban and rural areas; and to promote energy conservation and sustainable management of energy resources. FUNAE has a broad-ranging mandate, which includes: a) development of low cost forms of energy supply using traditional and modern fuels, decentralised grid electrification, and stand-alone energy systems; b) promotion of energy end use efficiency; c) financing low-cost development of energy supplies including various financial instruments such as loans, subsidies and guarantees; and d) project identification, preparation and implementation.

The National Electricity Council (CNELEC) was established as a regulatory body for the electricity in accordance with the Electricity Act of 1997. Re-established in 2008 with support from the WB Energy Reform Access Project (ERAP), it was charged with: assessing EdM's performance in relation to its Performance Contract with GoM; and developing the methodology for setting tariffs. In practice, it is EdM that proposes tariff revisions based on transmission system requirements (staffing, maintenance responsibilities, depreciation of equipment, new investments, etc.) to the Ministry of Energy, which looks at the justifications as well as the possible political consequences of tariff increases. The potential consequences of tariff increases are illustrated by the public reaction to across the board price increases proposed by Government in 2010 – including electricity, water, and fuel – which sparked violent demonstrations in Maputo. Interestingly the demonstrations were organised through a mobile phone SMS campaign.

As a consequence of these demonstrations, there have been no substantial tariff increases since 2007, and present tariff levels still do not adequately cover system requirements. In September 2010 some small adjustments were made, which reduced social and domestic

tariffs, while balancing these off with small increases in agricultural and commercial tariffs, and low-voltage big consumers, plus medium and high voltage consumers. (EdM Annual Statistical Report, 2009 & 2011). The consequence is that tariff levels remain unsustainably low, hardly sufficient to cover the real cost of generation per kWh, and the room for cross-subsidies which previously existed has evaporated, as the marginal costs of generation have increased.[115]

The 1997 Electricity Act enabled private sector involvement in generation, transmission, and distribution. At present efforts are ongoing to establish Independent Power Producers (IPP).

5.1.2 The Energy situation

Wood fuels

At the end of the 1990s, around 95% of the population relied on wood fuels, i.e. fuel wood or charcoal, as their sole source of household energy consumption. Even though this percentage is likely to decrease as access to electricity is broadened, the largest share of the energy demand at both household and national levels will continue to be met by wood fuels for years to come. In rural areas, households collect fuel wood for own consumption mainly. In urban areas, traders supply wood fuels that, in principle, operate on the basis of a license system. The use of charcoal or firewood for cooking is the dominant practice throughout Mozambique for all income groups.

Petroleum products

Almost all petroleum products consumed in Mozambique in 2000 were imported. LPG and kerosene were mainly substitutes for wood fuels in urban areas. Kerosene was quite commonly used for lighting purposes. The use of LPG was mainly limited to the Maputo and Beira areas. The reasons for this was that the distribution system for LPG, and to some extent for kerosene, did not function well and the availability of these energy sources was therefore not always reliable. In addition, the initial costs of new equipment are high and LPG is generally sold only in large quantities, thus demanding higher outlays. The costs of liquid fuels import in year 2000 amounted to USD 115 million. The liberalisation of the liquid fuels distribution sub-sector opened the door for competition and led to both modernisation and expansion of sales points as well as the entrance of new private companies in the market.

[115] Norplan, 2013: Executive Summary and discussion on pp. 16–20.

Electricity

In 1998, around 85% of the country's electricity production came from hydropower with the remainder from diesel oil, natural gas, import and stand-alone solar power systems. Although the liberalisation of the energy market opened up for private operators in power production and distribution, EdM supplied almost all (97%) of the electricity distributed in Mozambique. A few private operators were emerging, but it was expected that EdM would continue to dominate the transmission and distribution of electricity for years to come.

Mozambique: electrification of district capitals and public services.

The declared aim of the 2000 Rural Electrification Strategy Plan was that all district capitals should be electrified and connected to the EdM operated national grid by year 2014. Of Mozambique's 128 district capital towns, almost all were connected by 2013 – while the remaining 16 were scheduled to be connected before the end of 2014. (Agencia de Informacao de Mocambique-2013). Outside the national grid, FUNAE remains involved in connecting isolated administrative posts, schools and hospitals. In some cases using stand-alone diesel, leaving the responsibility with local government's to buy fuel and organise maintenance. The preferred option, however, is using solar – linking in with the solar panel factory being constructed in near Maputo, close to Mozal, providing an in-country supply (funded through a Government of India line of credit).

While the policy of unified EdM-tariffs throughout the country (applied with only a few exceptions), was socio-economically fair and justifiable, it remains financially unviable to electrify remote areas. If private operators (including EdM) shall be given an incentive to undertake electrification in isolated systems with a limited number of commercial customers, the problem of unified tariffs and financial feasibility needs to be addressed. (Source: Desk Report and Moz. Case Study).

5.1.3 Sida support

As noted above, all Sida supported rural electrification projects studied as part of this evaluation are based on extensions of the national grid, supplied by hydropower, and implemented by the national power utility Electridicade de Mozambique (EdM). Sida has as part of other projects supported the formulation and/or updating of energy generation, transmission and distribution master plans. Sida's financing has been on a grant basis to the Government of Mozambique (GoM), which on-lends to the investment funds to EdM.

Sida rural electrification projects in Mozambique between 1997 and 2010

	Project period	Approved financing (in MSEK)
Napula province, Ribáuè district: Extension of the national grid in the Ribáuè/lapala area to connect in first stage 1,000 households, 25 SMEs, a number of commercial consumers, health centres, and schools.	1997–2000	51.0
Zambezia province, Morrumbala district: Connection to the national grid enabling about 1,300 households, 35 SMEs, and a number of commercial customers to be connected	2001–2004	47.0
Niassa province, Gurué-Cuamba-Lichinga transmission line and local distribution networks, including substations and a diesel generating set.	2001–2006	120 + 189 MNOK
Sofala, Manica and Tete provinces: Extension of the national grid enabling 2,500 households, 104 SMEs and a number of commercial consumers, health centres, and schools to be connected. Lighting installed in public centres.	2003–2010	204.1 + 33.5 MDKK + 50.0 MNOK
Niassa province, Mechanhelas, Meterica, Maua and Marrupa districts: Extension of the national grid from the substation in Cuamba, enabling 950 households, 35 commercial and 20 public consumers (schools and health clinics) to be connected during the first two years. Lighting installed in public centres.	2005–2011	52 + 41 MNOK
Source: Kämpe, 2011		

As part of the present evaluation, quantitative and qualitative fieldwork was carried out in Ribáuè district and Morrumbala district.

5.1.4 Mozambique Mega Projects

Among large projects where works have already started include the $500mn railway line connecting the northern Nacala port with coalmines of Moatize; the construction of Nacala International Airport in Nampula province by Brazilian firm Odebretch; the rehabilitation of Beira port, which also serves landlocked Malawi and Zimbabwe; an expansion of hydroelectric production at the Cahora-Bassa dam in central Mozambique; the building of a power line

backbone between the Cahora-Bassa Dam and Maputo; and the upgrade of the road network (currently only one-third of Mozambique's roads are paved).

About $1bn is allocated for electrification programme – with new power stations planned across the country.

Other mega schemes in the pipeline are the $5bn coal-mining projects in northern Tete province by China's Kingho miner; a huge oil refinery (estimated cost $5bn) in Nampula province – where the US-based Ayr Logistics has expressed an interest; and new generation capacity of 6,000 megawatts (MW) planned in Tete province, as well as 2,400 MW from the Mpanda Uucua hydro plant on the Zambezi River. Also, a transmission line is planned to connect the vast northern and southern regions.

The most successful foreign venture to date is the $2.5bn Mozal aluminium smelter – just 17km from Maputo. The smelter uses Aluminium Pechiney AP35 technology to produce over 500,000 metric tonnes a year aluminium ingots and is supplied with alumina by the Worsley refinery in Western Australia.

The shareholders are BHP Billiton, Japan's Mitsubishi Corporation, Industrial Development Corporation of South Africa and the Mozambique government – holding 47 per cent, 25 per cent, 24 per cent and 3.9 per cent stakes, respectively, in a project that has made Mozambique one of the world's leading exporters of aluminium.

In 2009, foreign-owned projects led by Mozal Aluminium accounted for 12 per cent of GDP.

Mozambique is contemplating new financing options to boost infrastructure projects, including private finance initiative (PFI), public-private partnerships (PPPs), external sovereign bond issues, syndicated loans and co-financing from bilateral export credit agencies.

(Source: African Review of Business and Technology; http://www.africanreview.com/financial/economy/mozambiques-economic-future-and-the-multiplier-effect)

ANNEX 5.2 TANZANIA COUNTRY CONTEXT

The section on Tanzania draws heavily on the Country Desk Report for Tanzania (Desk Report. Volume 2: Annex 5).

5.2.1 Economy and institutions

Tanzania has experienced rapid growth the last decade but even if annual per capita income has increased from about USD 308 in

2000 to USD 457 in 2010, Tanzania is still defined a Least Developed Country. Using the international poverty line (purchasing power parity USD 1.25/day), an estimated 68% of the population lived in poverty in 2007 – a marked decline from 84.6% in 2000. In absolute terms, however, the number of poor people has increased. The target of Tanzania's PRSP is a reduction to 24% by 2010. Instead, the number of poor people in absolute terms actually increased from 2000/01 to 2007 with 12.3%. [116] Tanzania's macro-economic success has not been felt by the majority of the rural population that still live in extreme poverty.

The economic structure of Tanzania has evolved gradually over the years since the late 80s from a centrally planned socialist economy to a fairly liberalised economy. Tanzania has experienced one of the highest rates of economic growth over the last decade and is today one of the fastest growing economies in the region. The impressive aggregate growth rates are partly a result of stable political leadership and commitment to sound macro-economic and fiscal policies, including economic liberalization and an expanding public sector; and partly the result of the growth of extractive industries. Growth accelerated from 3.5% on average in the 1990s to 7% on average in the 2000s. Growth in tax revenues, foreign aid, and debt relief created space for an expansion in public spending, which increased from less than 16% of GDP in 2000 to almost 28% in 2009. The drivers of growth over the past decade have been mining, construction, communications, and the financial sector.

While the majority of the population lives in the countryside, urbanization rates are high, draining rural areas of younger people and further reducing development potential. The majority of the Tanzanian poor live in rural areas and rural poverty remains pervasive and deep. Tanzania has not made adequate progress in raising incomes in rural areas. Lack of access to technology, credit, water, and power resulted in stagnant productivity and a high vulnerability to shocks, leaving many rural households in the same or weaker position as at the beginning of the decade. [117]

Tanzania's power sector is – and historically has been – heavily dominated by the monopolistic state-owned, vertically integrated national utility, *Tanzania Electricity Supply Company Ltd* (TANESCO)

[116] Figures taken from Tanzania National Bureau of Statistics *Household Budget Surveys* 2000/1 and 2007; and Economist Intelligence Unit Country reports.

[117] This section is based on the Desk Report with references to Winther (2008), Ahlborg (2012), World Bank (2011), etc.

which generates, transmits and distributes almost all electricity across Tanzania. In 2008, the total installed power production capacity was 1100 MW, but due to climatic conditions with little rainfall, breakdown of installed infrastructure and mandatory shutdown for maintenance, only 630 MW, on average, was being produced. This has affected the availability of supply, especially to the rural areas, since the focus during times of short supply, has been to provide electricity to the business/industrial/–political centres of the country (Dar es Salaam, Dodoma, Arusha, etc.).[118]

TANESCO had a generation mix of 39% thermal to 61% hydro in 2007 as compared to 60% thermal to 40% hydro in 2006, when there was a drought. In addition, TANESCO owns generation facilities for transmission and distribution A few Independent Power Producers (IPPs) and electricity imports from Uganda and Zambia feed the grid as well. The electricity system is composed of both the main grid system supplying power to the major cities and towns, and a number of isolated systems of mostly isolated diesel generators, supplying power to five regional and several district headquarters that are remote from the main transmission and distribution grid.

Reforms in the power sector have seen a certain commercialisation of TANESCO, with Government entering into a management contract with an external company. Persistent poor performances within the energy sector have led to reforms and a new Energy Sector Policy in 2003, with the Electricity Act of 2008 paving the way for further reforms envisaged to break up the monopolistic status of TANESCO.

In the context of the energy sector reforms, the multi-sector (energy and water) regulatory agency, Energy and Water Utilities Regulatory Authority (EWURA) was established to improve the regulation of the state utilities. EWURA's mandate includes licensing, tariff quality, environment, consumer protection, and dispute resolution. All tariffs, except those charged by large (above 10 MW installed capacity) grid-connected IPPs and very small electricity suppliers in isolated off-grid areas, are regulated by the EWURA, while generation tariffs for large IPPs are subject to negotiation.

Specifically to promote rural electrification the Rural Energy Act was introduced in 2005. With the Act, a Rural Electrification Agency was established and charged with the oversight and management of a Rural Electrification Fund, from which electricity producers

[118] Comment provided by the Swedish Embassy in Tanzania.

and distributors can apply for grants covering the capital costs of developing rural electrification systems. The sources of funding for rural electrification include national budgetary allocations for rural development, levies on the costs of energy products like petroleum fuels, and interest charges on government accounts as well as grants from development partners. REA is free to provide financing and technical assistance not only to TANESCO but also to any rural electrification developer, including nonutility power developers such as rural communities and independent power suppliers.[119] To further promote rural electrification, the Tanzanian government has adopted relief systems such as government subsidies to IPPs or the utility and "lifeline" tariffs that supply a limited quantity of energy at a subsidized rate. As part of general reform efforts to improve financial sustainability, Tanzania's lifeline tariff, which used to provide relief to commercial and domestic consumers indiscriminately for the first 100 kWh of electricity, has been revised to target small domestic consumers who use less than 50 kWh.

5.2.2 The Energy Situation

The Joint Country Evaluation of the Strategy for Swedish Development Cooperation with Tanzania 2006–2010 paints a rather discouraging picture of the energy sector when it states that "*Despite substantial investments and many commendable efforts in the power sector for more than the last thirty years, the situation is one of a shortage of power, leading to unmet demand, load-shedding and unreliable supply of electricity in urban areas, and a lack of access to electricity in most rural areas (Sida 2010: 19).* Energy resources exist. Tanzania possesses a high potential for hydro-power, natural gas and coal energy. Exploitation of the natural gas along the coastline is in operation and renewable energy sources, apart from large hydro, are also being promoted, as a means of supplying power to rural areas lying far from the national grid. Still, commercial energy is scarce and unreliable, and considered a barrier to both industrial growth and general advancement.

The large majority of poor people – and, in fact, also middle-income, continue to use bio-energy for cooking and for space heating. The continued reliance on bio-energy covers different energy sources, principally wood and charcoal, but also energy crops of

[119] As part of its 2013 work programme, the REA was preparing a rural energy investment prospectus designed to provide a basis for planning rural energy investments, which will include off-grid and renewable energy investments/solutions.

different kinds and agricultural residues. Poor households have no extra disposable income, and resources are prioritized to cover basic needs; while more affluent households see no real reason to change cooking practices, even when the household is connected and basic lighting installed. Studies (for example Ahlborg 2012:8) suggest that expenditure on electricity is likely to be limited to replacing what is currently spent on kerosene and batteries. Most household energy consumption continues to be spent on cooking, with the bulk being provided by biomass energy sources. Only about 1% of households use electricity for cooking. This is reflected in the fact that about 90% of energy consumption comes from traditional biomass resources ("Combustible renewable and waste"), which has not changed significantly from 2000 to 2010. Biomass is the main source of energy for rural areas where more than 70% live – but also for urban and peri-urban areas. Recent work (SEI/Renetch) on energy markets in Tanzania has concluded that not only is charcoal the single largest source of urban household energy but that the proportion of households in Dar es Salaam using charcoal has *actually increased* to over 70%.[120]

The bulk of the very limited supply of electricity that has been made available to the rural areas of Tanzania has, so far, mostly been obtained through extensions of the national grid. However, the cost of the extensions has become increasingly prohibitive, as attempts have been made to reach the more remote locations. Moreover, currently (2013) there is insufficient system capacity to allow for major increases in system demand such that the existing system capacity and transmission network could probably not support changes in the pattern of household electricity use (i.e. now mostly for lighting). Meanwhile, supply of three-phase electricity to rural areas to support productive activities is also hindered by the (above-mentioned) load shedding and unreliable electricity supply.

5.2.3 Sida support

Sida is one of the highest contributing development partners to the energy sector in Tanzania and has, in recent years, funded a number of rural energy projects. Sweden's commitment in the energy sector was SEK803.9 million for the period 2006–2010; this is an increase of 133% compared to the previous period (Sida 2010: p.29). Sweden has been the largest donor in that period and its assistance rests on three pillars: institutional support, rural electrification and

[120] SEI/Renetech, 2012. Vol 1; Page 6. Half of Tanzania's charcoal is consumed in Dar Es Salaam – approximately 500,000 tons in 2009.

renewable energy. The table below gives an overview of Sida support during the period 1985 – 2010.

Rural electrification interventions in Tanzania financed by Sweden during the period 1985 – 2010[121]

	Project period	Approved financing (in MSEK)
Serengeti rural electrification	2003–2008	50.0
Urambo rural electrification	2003–2007	50.0
Ukerewe rural electrification	2005–2008	30.0
Simanjiro rural electrification	2006–2008	27.0
Makambako-Njombe rural electrification	2004–2007	48.0
Makambako-Songea (credit 226 MSEK)	2008–2012	504.0
PV Market Development	2002–2007	27.0
Rural Energy Agency TA	2008–2013	14.0
Rural Energy Fund (pooled funding)	2010–2013	203.0

It is worth noting the addition of the 132 KV Makambako – Songea Project which has an allocation of TZS 3.8 billion for Financial Year (FY) 2011/12 following severe delays that led to the removal of the project in the budget in FY2010/11. In addition, there are two projects on rural energy funded by Sida in the FY2011/12 budget: REA and REF (and Capacity Development to REA). The Rural PV Market Development project has been finalised during FY2010/11.

Sweden has been very consistent in advocating basket funding of rural energy through the Rural Energy Fund (REF). Sweden is the first donor to support this fund with SEK 200 million, which marks a step forward in carrying through the energy sector reforms in the rural energy sub-sector. In addition, Sweden financed two Trust Funds managed by the World Bank, in support of the new sector institutions (EWURA and REA), and new approaches such as the Tanzania Energy Development and Access Project (TEDAP). Basket funding is being introduced with regard to Sector Budget Support for rural energy through the REA and the REF.[122]

As regards institutional support, Sida has been a major contributor to REA and REF; in fact, the REA and REF project is co-funded by

[121] Source: Kämpe, 2011.

[122] See also: Orgut 2010: Joint Country Evaluation of the Strategy for Swedish Development Cooperation with Tanzania 2006–2010.

the GoT and Sweden. The project aims at strengthening REA/REF in promoting and facilitating access to modern energy services in the rural areas of mainland Tanzania including: electrification of district headquarters and other rural energy projects; strengthening evaluation and submission by REA of proposals to Rural Energy Board for consideration and approval; preparation of contracts for signing with project developers of the approved projects; monitoring implementation of rural energy projects; evaluating proposals from project developers; and monitoring and evaluating rural energy projects.

In respect of off-grid and renewable solutions – such as Solar PV – Sida also supported a five-year PV market development project (mentioned in the table above). The project was not included in the case studies. The Swedish Embassy provided the information in the text box below.[123]

Achievements of the Tanzania Solar PV project8

The project had the following results:-

i) Rapid growth of the market, far beyond expectations,
ii) The number of active dealers outside Dar es Salaam increased substantially,
iii) The stock of trained technicians has expanded,
iv) The solar association (TAREA – Tanzania Renewable Energy Association) has become a capable institution catering for the needs of corporate and individual members,
v) A process and organisation (SIRG – Solar Industrial Reference Group – a group comprising large PV wholesalers) has been established to address quality issues in the sector,
vi) Awareness raising was carried out to prepare the market,
vii) Distribution channels were promoted by linking large town suppliers with upcountry dealers.

A key tenet – apart from directly supporting market actors – was to enhance the capacity of the institutions having a core as well as a supporting function in the market. The Ministry of Energy and Minerals (MEM) was the Client and project owner with overall responsibility for policy.

5.2.4 Tanzania Mega Projects

Tanesco awards Mtwara Power Plant to Symbion-GE

The Tanzania National Electrical Supply Company (Tanesco) signed a $1 billion contract with the US consortium of Symbion Power (Symbion) and the technology company General Electric

[123] Source: as reported by the Swedish Embassy (Tanzania), 2013.

International (GE) for the team of the Mtwara Power Plant and the expansion of the electrical power national grid in the south of the country. Together with Mozambique and Kenya, Tanzania is among the countries of the East Coast Africa to join the club of the top 10 largest exporter of liquefied natural gas (LNG) in the world. According to the last discoveries, Tanzania holds 41.7 trillion cubic feet (tcf) recoverable reserves of natural gas.

In parallel, 50% of the inhabitants, mostly in the countryside, have not yet access to the electricity while the power consumption is growing very fast in the cities causing power shortage and blackouts to the second largest economy in East Africa.

Currently Tanzania is consuming 1400 MW coming from gas-fired power plant for 35% and the rest from hydro-power and local diesel power generators. With 7 to 8% growth per year, Tanzania needs to invest in substantial power generation projects to close the gap. With most of the gas fields being explored and developed in the Mnazi Bay offshore southern Tanzania at the border with Mozambique, Tanzania is willing to develop the most industrial regions of Mtwara and Dar es Salaam along the coast upper in the north through a 532 kilometres gas pipeline.

Symbion and GE to build Mtwara Power Plant in 2014

For the Mtwara Power Plant project, Tanesco and Symbion signed a Public Private Partnership (PPP) in February 2013 in order to start the design of the plant, with construction starting in 2014 and commercial operations in 2017.

With Tanesco and Symbion, leading the interests in the projects GE joined the Mtwara Power Plant project to provide the team with its technology expertise to facilitate and speed up the execution of the project. Requiring $1 billion capital expenditure, the Mtwara Power Plant project will include:

- 400MW gas-fired power plant to be located in Mtwara
- 650 kilometers power line from Mtwara to Songea to extend the existing national grid from Makambako to Songea

The Mtwara Power Plant is expected to supply a:

- $500 million and 300 million tonnes per year cement plant for the Nigerian Dangote Group
- $360 million urea plant for the UK listed Wentworth Resources Company.

Source: 2B1st Consulting, June 2013.

Annex 6: Recommendations from the Country Case Studies

This annex contains the recommendations respectively from the Mozambique country case study and the Tanzania country case study. These recommendations have also fed into the overall recommendations of this evaluation. A similar structure has been followed for all three sets of recommendations and, logically, there is also a certain overlap and repetition, especially between the recommendations made at country case study level.

ANNEX 6.1: RECOMMENDATIONS – MOZAMBIQUE COUNTRY CASE STUDY

This annex presents a range of recommendations, which have been formulated for Mozambique bearing in mind the two overall questions guiding this evaluation:

1) How shall electrification programmes be designed to best contribute to poor people's access to electricity (taking contextual differences into account)?

2) How can Sida as a donor support electrification in the best way and what are considerations the Agency should take when planning the support?

The recommendations listed below fall within the framework set by the "Energy Strategy" approved by the Council of Ministers in June 2009 (Resolution nr. 10/2009). They are also in line with the "Low Cost Rural Electrification Plan" for Mozambique, (LCREP) drafted in October 2007.

It is *recommended* that:

Adapting solutions to fit local situations

1. Separate and distinct activities and project inputs for different target areas are planned in order to respond to local situations rather than adopting a "one-size-fits-all" blue-print approach.

   Note: In rural areas more people and institutions are reached in towns and villages (as opposed to rural hamlets and settlements where the population is more dispersed) because of denser concentration of people, businesses and institutions. Both the more densely populated areas and also the more

dispersed ones shall be considered for rural electrification, considering the most appropriate alternative for each area. Electrifying a district should then mean that most villages and settlements would be included, and not just those whose suitability is defined by their closeness to the grid.

Defining the target group

2. When rural electrification programmes are planned, the target group and intended beneficiaries should be clearly defined, in order to have a strategy on how to reach the poor, both directly and indirectly.

   Note: This entails that "the poor" within the area defined for provision of electrification should be clearly defined by stating which segments of the population the intervention(s) seek to reach, linked to an identification of poverty pockets within the area. By stratifying the various segments and having clearer target groups for households to be connected by an intervention, the issue of infrastructural and financial support to facilitate and encourage a higher number of users.

3. Within a defined area, a broad range of energy/electrification interventions for different target groups are planned and implemented in order to improve access to modern energy services to as many people as possible.

   Note: The stratification of target groups will also highlight which segments of the population, the intervention cannot reach directly, and in those cases it is recommended to apply other means of electrification, e.g. solar home systems; and small solar panels, which can charge cell phones and provide lighting.

Targeting improved household access

4. The barriers to connection faced by households, such as connection fees to be paid, additional costs related to type of dwelling and distance to distribution lines, monthly consumption budgets, etc., should be identified and interventions consequently targeted directly to ensure more households can afford to connect.

   Note: Many people in rural areas cannot afford to finance installation and connection costs and even sometimes consumption costs due to limited financial capacity and irregular incomes. The interventions to be considered include: (1) Initial 100% connection of all houses in the project area; (2) Provision of all households with "ready-boards", consisting of a meter, a socket and a light-bulb/bulbs; (3) Application of social tariff and (4) Application of CREDELEC pre-payment system. In order to achieve this, a financial package needs to be developed which will allow for payment over time by low-income households but which also reflects an overall analysis of the utility's financial health and tariff policy to ensure that the interventions do not threaten the long term financial viability of the utility. The analysis done by Norplan (2013) concluded that under present tariff levels, EdM loses more money each time

a new connection is made in the rural areas. This situation needs to be avoided if long-term sustainability is to be achieved.

Local government and Public Institutions

5. Alignment and coordination with local level government financing and district development plans is ensured. In this context, the role of the local government (the districts) is central role in the process of participatory development planning,

   Note: If not before, at the time of the environmental and social impact studies and public consultations, the involvement of the local authorities and other stakeholders has to take place. Planning activities also need to consider gender equity as well as implementation of programmes to mitigate the effects of HIV/AIDS.

6. Proper alignment and involvement with local government is ensured when implementing the electrification programmes, including arrangements and agreements in relation to maintenance of public investments and maintenance costs through inclusion in annual budgets.

   Note: If ownership and responsibility by local government is questionable then it may be necessary to consider other ways of providing the services. For example the payment of electricity for public light and its maintenance has to be discussed, making it clear what institution is going to be responsible to pay these costs. Equally ensuring that all public institutions within a local government area have prepared proper budgets and have made correct financial arrangements to ensure regular payment of the electricity bill should form part of a local government's planning and budgeting responsibilities.

Synergy and coordination with other sectors

7. Synergies are planned and developed between electrification and other sector interventions at the lowest appropriate levels.

   Note: The rural electrification programmes should ideally be integrated with complementary investments in other types of infrastructure: roads network, transport system, water, private sector development, telecommunications, banking, financial system, etc.; creating mutual reinforcing dynamic for development. Although such an integrated approach requires strong institutional arrangements and collaborative inter-agency environment, it provides far greater opportunities and benefits for the regional development. Synergies need to take place at different levels, from the highest policy coordination levels to the lowest implementation levels (which can also be at sub-district level). In all cases, potential synergy scenarios need to be linked to appropriate decision-making bodies at the appropriate levels.

Appropriate power supply for all consumers

8. Availability of three-phase power supply in areas, where there is potential for business expansion requiring three phase supply, is

either ensured during the initial intervention, or provided within a planned design horizon.

Note: Where appropriate the electrification programs shall use low-cost technologies, based on the Low Cost Rural Electrification Plan (LCREP) jointly produced by EDM and FUNAE: However, the design of the project shall be with adequate flexibility to upgrade the network easily, as and when the load increases.

9. Initial network design with anticipated load networks are combined with flexible measures linked to the original network design to easily upgrade the network to meet increasing demand.

Note: The network should be designed for the correct, actual load flows, with flexibility to upgrade it easily, as and when the load increases.

Promotion of productive uses of electricity

10. During the intervention's planning phase, the promotion of productive uses of electricity is pro-actively linked with complementary energy access programs so that they result in the productive use of the newly available energy services.

Note: Bringing electricity to rural communities can increase opportunities for local entrepreneurs to generate income by modernizing production methods and raising the value of production. Linking new investments in electrification with an active promotion of income generating activities and local job creation should already be initiated during the planning phase and should not be left as an after-thought; nor as an assumption that development of the productive sector will happen automatically.

Promotion of productive uses also contributes to the financial viability of the electricity infrastructure in rural areas. In general, contrary to the use of electricity for lighting and domestic appliances, its adoption for production does not happen on its own or rapidly. This reality makes it important to include activities in rural electrification projects that address barriers to and encourage the adoption of electricity for income generation activities.

Monitoring and evaluation of Electrification projects

11. The M&E of electricity interventions is strengthened.

Note: M&E framework for electrification interventions need to be improved, and this would also include setting targets with long-time perspectives, for example targets 5, 10 or 15 years. Better monitoring systems need to be developed but these should focus more on outcomes and impacts while not neglecting better output monitoring.

ANNEX 6.2: RECOMMENDATIONS – TANZANIA COUNTRY CASE STUDY

This annex presents a range of recommendations for Tanzania, which have been formulated bearing in mind the two overall questions guiding this evaluation:

1) How shall electrification programmes be designed to best contribute to poor people's access to electricity (taking contextual differences into account)?

2) How can Sida as donor support electrification most in the best way and what are considerations the Agency should take when planning the support?

It is *recommended* that:

Defining the target group and area

1. When rural electrification programmes are planned, the target group and intended beneficiaries are clearly defined, and stakeholders thoroughly analysed, in order to have a strategy on how to reach people living in poverty, both directly and indirectly.

   Note: This entails that "the poor" within the defined area should be clearly identified as part of initial scoping studies (including gender disaggregation, economic activities and survival strategies, geographical spread, etc.) by stating which parts of the population the intervention(s) will seek to reach. By stratifying the various segments and having clearer targets for which households fall within those groups households that are willing and able to connect within the parameters defined by the intervention, the issue of poles and connection fees can be dealt with in a more focused manner, ensuring that poles are put in those areas, where the potential customers are. The stratification of target groups within the same area will also highlight which segments of the population, the intervention cannot reach directly, and in those cases identify other means of electrification, e.g. solar home systems, which can charge cell phones and provide lighting.

2. Within a defined area and with respect to improving access to modern energy services, separate activities and project inputs are planned for different target areas.

   Note: More people and institutions are reached in towns in rural areas (as opposed to rural hamlets and settlements) because of denser concentrations of people, businesses and institutions. To reach more people, it is more cost-effective to electrify these more densely populated areas, and consider alternatives for more isolated rural areas (for example solar or other forms of energy). Electrifying a district should then mean that most villages would be included, and not just those whose suitability is defined by their closeness to the grid.

Reducing barriers for access

3. The barriers of connection fees and additional costs should be identified and interventions consequently targeted directly to ensure more households can afford to connect.

   Note: The subsidy is a good start, but even when the connection fee is reduced significantly, most households cannot afford to connect. As this evaluation has shown, the household's costs for a subsidised connection fee are recouped after one year. Providing households with a loan, or arranging that the fee be paid back in instalments each month during the first year, will allow more households to connect (which will also contribute to a more cost-effective intervention).

4. The electrification of public institutions is prioritised in order to ensure that the majority of public services are improved in a given area.

   Note: The evaluation found that following the introduction of electricity, all citizens, including the poor, enjoyed the benefits of electricity as both private and public sector services improved. However, it was found that a relatively low number of public institutions were electrified, and it is important to step up the number of institutions to be electrified in a given area in order to increase the access and benefits to non-connected households.

Local government and Public Institutions

5. Alignment and coordination with local level government financing and district development plans is ensured.

   Note: The evaluation found that introduction of electricity was appreciated highly by district authorities, but coordination with district government in planning of the interventions did not take place. In one case the introduction of electricity in the district was not even mentioned in the district development plan. Incorporation into district development plans is crucial if capital and recurrent budgets are to be adjusted to accommodate new interventions, as well as their operation and maintenance (including payment of the electricity bill).

6. Proper alignment and involvement with local government is ensured when implementing electrification programmes, including arrangements and agreements in relation to maintenance of public investments and maintenance costs through inclusion in annual budgets.

   Note: If ownership and responsibility by local government is questionable then it may be necessary to consider other ways of providing the services. For example this evaluation has shown that investing in streetlights failed, as bills for consumption were not paid. In such cases, alternative lighting sources could be considered, for example solar for streetlights.

Appropriate load for business development

7. Availability of three-phase power supply in areas, where there is potential for business expansion requiring three phase supply, is either ensured during the initial intervention, or provided within a planned design horizon.

   Note: The evaluation found in several instances, that villages were complaining about lack of three-phase electricity, since they wanted to embark on establishing businesses but could not do so because of lack of three-phase. The situation may also arise where least-cost connections to a new area to meet an initial demand, for example, for lights and other low-load uses, is adequate during an initial phase but where new investments (for example in the private sector) require more capacity. The network should be designed for the correct, actual load flows, with flexibility to upgrade it easily, as and when the load increases.

Synergy and coordination with other sectors

8. Synergies are planned and developed between electrification and other sector interventions.

   Note: It is important to consider synergy effects between electricity and other sector interventions, for example water, private sector development, local government development, education and health. This should help ensure that appropriate solutions are put in place, which meet the needs and demands from other sectors. The issue of three-phase and business development is one example; another one is the need for three-phase for improved reticulated piped water supply services.

Inform stakeholders and beneficiaries about the advantages of electricity

9. Appropriate information and knowledge of the benefits of electricity are disseminated and shared with citizens in an area to be electrified.

   Note: During the evaluation process, the team talked to various beneficiaries who repeatedly reported that electrified lighting meant savings from reduced costs for buying kerosene. It was not found that people were aware of the health gains of replacing kerosene and candles with electrified or other modern form of providing light. This is an area which can be addressed through awareness campaigns / customer information about the health advantages of shifting away from traditional forms of lighting (kerosene, candles) to more modern lighting (electric lights, solar home systems).

Monitoring and evaluation of Electrification projects

10. Sida's M&E of electricity interventions is strengthened.

    Note: The M&E set-up of the two cases investigated in this evaluation has been very limited. M&E framework for electrification interventions need to be improved, and this would also include setting targets with long-time perspectives, for example targets 5, 10 or 15 years. Better monitoring systems need to be developed but these should focus more on *outcomes* and *impacts* while not neglecting better *output* monitoring.

Annex 7: Household Air Pollution and the links to kerosene lighting and cooking with biomass.

Introduction

This annex examines the environmental health issues resulting from household air pollution emanating from kerosene lighting and cooking with biomass; and then relates these more global issues to the more detailed findings of the Mozambique and Tanzania case studies.

Issues around household air pollution (HAP)

The World Health Organisation (WHO), in their work on indoor air pollution and health, summarise a number of "key facts" in respect of household (indoor) air pollution and the health hazards linked to this, as follows:-[124]

- Around 3 billion people cook and heat their homes using open fires and leaky stoves burning biomass (wood, animal dung and crop waste) and coal.
- Nearly 2 million people die prematurely from illness attributable to indoor air pollution from household solid fuel use.
- Nearly 50% of pneumonia deaths among children under five are due to particulate matter inhaled from indoor air pollution.
- More than 1 million people a year die from chronic obstructive respiratory disease (COPD) that develop due to exposure to such indoor air pollution.
- Both women and men exposed to heavy indoor smoke are 2–3 times more likely to develop COPD.

Based on this, the WHO concludes, in respect of the achieving of the Millennium Development Goals, that progress made with these issues is important for the following reasons.

- Tackling indoor air pollution will help achieve the Millennium Development Goals (MDGs), in particular MDG 4 (reduce child mortality) and MDG 5 (improve maternal health).
- It will also contribute to gender equality (MDG 3) as well as freeing women's time for income generation that helps eradicate extreme poverty and hunger (MDG 1).

[124] WHO media centre fact sheet on Indoor air pollution: http://www.who.int/mediacentre/factsheets/fs292/en/#

- Finally, clean household energy can help ensure environmental sustainability (MDG 7). WHO reports annually on the proportion of the population using solid fuels for cooking as a key indicator for assessing progress in health and development.

Researchers at the National Institute for Environmental Health Sciences (USA), such as J.Stumpf, have expanded research done on air pollution related to cooking with biomass to also include indoor air pollution resulting from use of kerosene for lighting, as well as the climate change impacts related to the use of kerosene. Stumpf, [125] notes that:

"*Light produced by kerosene lamps is extremely important for the twenty percent of the world's population that lacks access to electricity. Reports have estimated that 77 billion litres of liquid fuel, mostly kerosene, are used annually to light houses without electricity. However, incomplete combustion of the lamp fuel often yields black carbon that absorbs light, thereby heating the atmosphere.*"

And, in respect of the environmental health hazard, Stumpf concludes that:

"*In poor households in developing countries, people live with and inhale the smoke generated from cooking and heating fires. The most recent estimates, which are part of the Global Burden of Disease Study 2010, published Dec. 13, 2012, indicate that approximately four million people die prematurely each year from illness attributable to household air pollution due to biomass and coal cooking fuels alone.*

Work funded by NIEHS (National Institute of Environmental Health Services, US Department of Health) and others, however, is starting to show that kerosene smoke whether from stoves or lamps is an additional important cause of ill health in these poor households."

And that therefore: "*Replacing kerosene lamps is thus important not only for reducing global climate change but also decreasing the risk of adverse health outcomes*".

Thus a successful switch away from kerosene has both positive health impacts, as well as the potential for reducing climate change impacts.

The same is true, in many ways, also for candles. As also noted in the Tanzania country study, candles also have adverse environmental health impacts. Quoting a World Bank report, the country study states the following: "The health risks from candles have only recently been appreciated, since a 1999 Australian study showed

[125] Stumpf, J. 2013. *Climate impacts of kerosene lamps used in developing countries* National Institute of Environmental Health Sciences

that the lead used in candle wicks results in air lead concentrations at levels far in excess of established safety standards. Burning a candle for a few hours in an enclosed room results in lead concentrations sufficient to cause fetal damage or to harm the mental development of children".

The Mozambique and Tanzania case studies

The successful switching away from kerosene (as noted by Apple et al) has the following practical implications:

Changing lighting technologies to achieve increased efficiency and energy service levels can provide ancillary health benefits. The cheapest, crudest kerosene lamps emit the largest amounts of PM(2.5). Improving affordability and access to better lighting options (hurricane or pressure lamps and lighting using grid or off-grid electricity) can deliver health benefits for a large fraction of the world's population, while reducing the economic and environmental burden of the current fuel-based lighting technologies.[126]

Table 20 Energy source for cooking – percentage of HH

	Tanzania	Mozambique
Open fire	58.0	46.9
Traditional stove	54.3	26.9
Improved stove	3.2	36.3
Gas cooker	6.9	0.0
Electric cooker	2.1	0.0

The Mozambique and the Tanzania country case studies indicate a continued dependence on biomass for cooking. Although the differences between the two cases is also worth noting. There are indications that a move from open fires and traditional stoves, to improved stoves has been more successful in Mozambique than in Tanzania. This is the case for all households – whether connected or not. In fact the case studies merely confirmed what was already known but also indicated that, where properly supported, a move towards cooking using improved stoves is possible. Efforts being made in that respect in Mozambique appear to be having a positive effect.

[126] Apple J, et al: *Characterization of particulate matter size distributions and indoor concentrations from kerosene and diesel lamps*. October 2010.

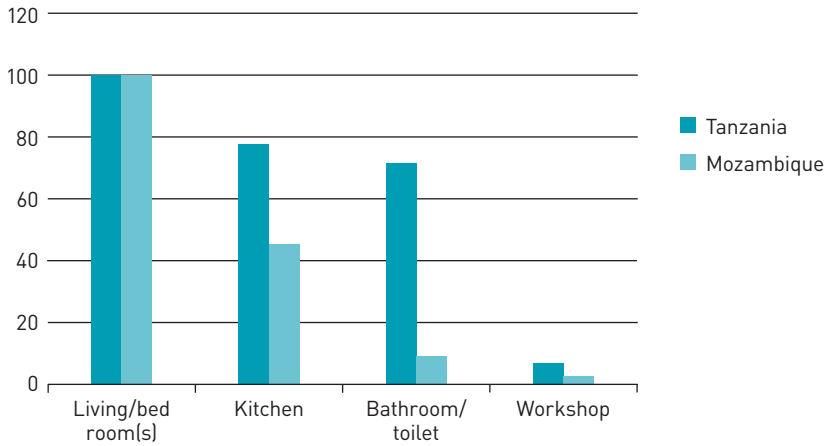

Figure 7 Location of lights in the house

Particularly in respect of electrified households, there also appear to be significant differences between Mozambique and Tanzania. Electrified households in Tanzania continue to use kerosene as their major stand-by source of lighting (60.5%) while in Mozambique only 5% of electrified households do so. In Mozambique, stand-by sources of lights are provided by torches with batteries (27.5%) and candles (80%). In addition, anecdotally, there is some perception that there can be some saving on the electricity bill if candles are used strategically, also when there are no power cuts, which goes some way to explaining the popularity of candles in Mozambique.

The differences between the two case study countries – in respect of back-up lighting choices in case of power cuts – are interpreted as underlining the difference between the provision of a rather reliable electricity supply (Mozambique – EdM) and providing an unreliable supply (Tanzania – TANESCO).

Thus, the contention that indoor air pollution will be reduced, as kerosene for light is replaced by electricity, is clearly dependent on the continuous and reliable provision of power. An unreliable supply is unlikely to have any major health impact as the stand-by source of lighting continues to depend on kerosene.

Gender considerations

Furthermore, electricity distribution coverage is also an issue. Relying on grid extensions as the vehicle to replace kerosene with more environmentally friendly sources of light will leave most rural households dependent on kerosene for the short and medium term.

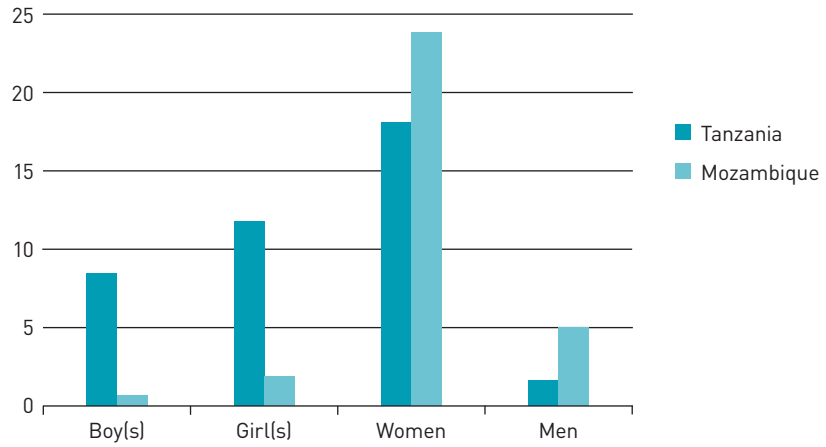

Figure 8 Firewood collection roles

Alternatives, such as solar-powered systems (which also incorporate mobile phone re-charging) are starting to mature. Payment methods, such as payment using mobile phones (such as the M-Pesa system or similar)[127] are also maturing and are becoming an instrument for providing light to households that will not have access to grid electricity anytime soon.

As it is, there is also an interesting finding from both Tanzania and Mozambique that when a household is connected, not only is there no switch away from biomass for cooking, *but there is not necessarily a switch away from kerosene lighting either* – and not just for back-up during power cuts. Although there are some differences between the two case study countries, results from the case studies show that in electrified households only 45% of households in Mozambique have electric lights in the kitchen, rising to 77% in Tanzania, but still less than the 100% recorded for living/bedrooms.

In fact, the study results show that kerosene lights are not systematically replaced even in electrified households; and that the area where women and girls spend a lot of time, is also the space that suffers most from indoor air pollution.

Staying with biomass and gender roles, the study also looked at the distribution of roles within the family with respect to the collection of firewood. Not surprisingly, there is a strong gender split in responsibility. Although there are some variations between the cases from the two countries, the main role for firewood collection falls on

[127] See, for example, http://www.m-kopa.com

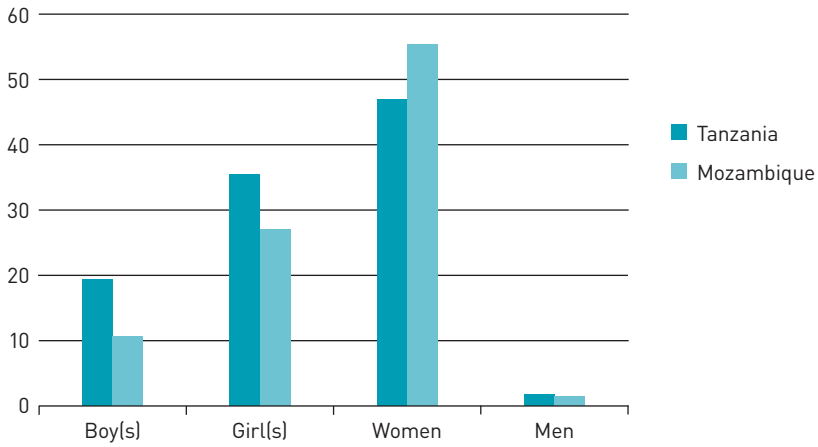

Figure 9 Water collection roles

the women. The assumption would be that if households switched to improved stoves than this would result in less time having to be allocated to this chore (or, in the case of purchase of firewood or charcoal, less money).

The same gender pattern in spread of household chores repeats itself with water collection which is also essentially the responsibility of the women and the girls in the household. Here also, the assumption would be that if a reliable 24/7 water supply system linked to a reliable electricity supply was functioning as a reliable public service, then this would have an impact on the amount of time that women and girls would need to devote to these chores.

While freeing up time from daily chores would not necessarily have an impact on household division of labour, it would certainly contribute to freeing up time for other activities. For girls, this would allow them more time to focus on their education which, at the end of the day, would be the single most important factor contributing to changes in gender roles.

Annex 8: Power supply reliability and the development of the private sector

The Mozambique and the Tanzania country case studies indicate the importance of a reliable power supply for the private sector. This is particularly the case where the private sector invests in productive sector value-added rather than limiting itself to the basic lights-and-refrigerator configuration of the restaurant business that, in many ways, resembles that of household connection.

The results of the fieldwork suggest that the incentive for investing in the productive sector in Tanzania is seriously constrained by the frequent power cuts and the unreliable supply provided by TANESCO. The same situation is not repeated in Mozambique where the power supply by EdM is much more reliable.

In the Tanzanian case study areas, 57% of households reported power cuts as a weekly occurrence (with 29% reporting power cuts on a daily basis). This can be compared with Mozambique where only 2% reported daily power cuts and 28% saying this happened on a weekly basis – and a further 69% reporting power cuts as a rare occurrence.

In respect of Mozambique it may be noted that both service areas where case study fieldwork was done, are at the end of quite a long distribution line, which is not always totally reliable. Nevertheless EdM seems to deal with distribution problems more rapidly and efficiently than TANESCO.

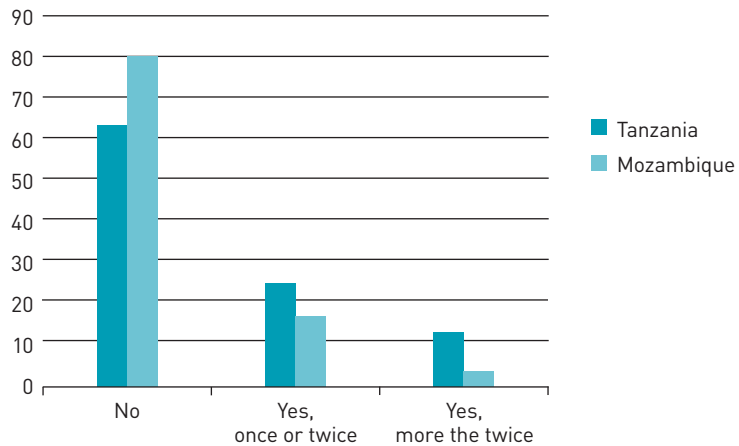

Figure 10 Damages to electrical equipment

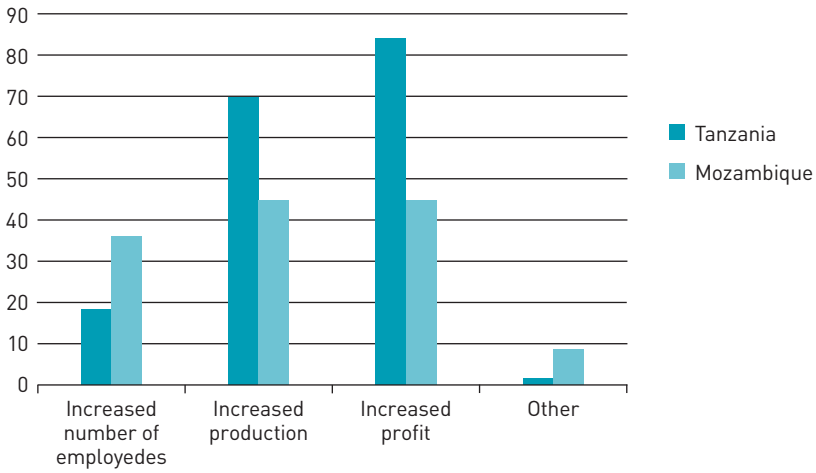

Figure 11 Changes since business connected

This is further illustrated by the question related to stand-by generators, where 22% of private sector customers in Tanzania had invested in a stand-by generator, compared to around 9% in Mozambique. The direct impact of this was also experienced by the Tanzanian fieldwork team which noted that when photocopies needed to be made, the service provider charged double the normal price when being forced to switch to the back-up system during power cuts.

More private sector customers in the Tanzania case study areas reported equipment damage due to power fluctuations than was the case in Mozambique. All questionnaires combined, 37% reported problems with power fluctuations in Tanzania compared to Mozambique (20%) – with 50% of *businesses* interviewed in Tanzania, which reported having had suffered from power fluctuations, also reporting damaged equipment.

In respect of changes since electrification, all businesses reported increases in profit, production and number of employees – which is positive. However, again there were differences between the two countries, with the Tanzanian case studies reporting relatively more profits and increased production than Mozambique; but where the Mozambique case study areas noted an increased number of employees.

More difficult to interpret is the fact that, in Tanzania, more private sector customers reported sharing the same meter with a household connection, i.e. running a small business from one's place of

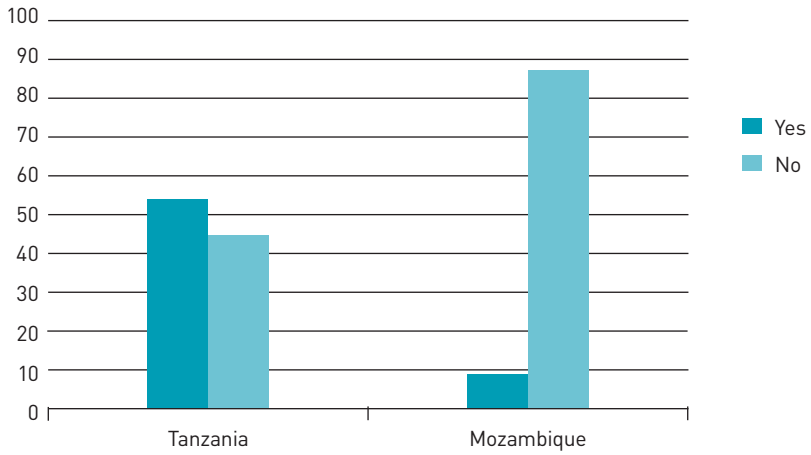

Figure 12 Energy sharing from same meter

residence. In Tanzania 54% of businesses "shared" their meter while in Mozambique this was just under 9%.

Again, it can be an indicator of confidence in the power producer, in that a reliable power supply is necessary for there to be a shift from a cottage-type home-based business to a stand-alone commercial enterprise. As well as a reflection of the high cost of a new connection combined with the well-documented delays within the system to connecting new consumers. (Ref: TZ Case Study)

Annex 9: List of documents consulted

In addition to the stand-alone studies produced as part of the evaluation and the list of reports and studies referred to in the bibliography of the Desk Report, the following reports and studies are specifically referred to in the Synthesis Report.

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Evaluation of Sida financed interventions for increased access to Electricity for poor people

This report evaluates Sida financed interventions for increased access to Electricity for poor people, drawing on international experience and case studies in Tanzania and Mozambique.

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