MATHEMATICA Policy Research

REPORT

# Millennium Challenge Corporation's Electricity Transmission and Distribution Line-Extension Activity in Tanzania: Qualitative Evaluation

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## ACRONYMS

| | |
|---|---|
| ABC | Area Bundles Conductor |
| Camco | Camco Advisory Services |
| COPA | Conditions of Particular Application |
| CSR | CSR Group Africa |
| ESBI | ESB International |
| EWURA | Energy and Water Utilities Regulatory Authority |
| FGD | Focus Group Discussion |
| FS | Financing Scheme |
| GPS | Global Positioning System |
| HMM | Hatch Mott MacDonald |
| IGA | Income Generating Activity |
| M&E | Monitoring and Evaluation |
| MCA-T | Millennium Challenge Account—Tanzania |
| MCC | Millennium Challenge Corporation |
| NBS | National Bureau of Statistics |
| NRECA | National Rural Electric Cooperative Association International |
| Pike | Pike Electric |
| REA | Rural Energy Agency |
| Symbion | Symbion Power LLC |
| T&D | Transmission and Distribution |
| TANESCO | Tanzania Electric Supply Company |
| TZS | Tanzanian Shilling |

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# EXECUTIVE SUMMARY

The Millennium Challenge Corporation (MCC) funded the Tanzania energy project under its first compact with the Government of Tanzania to increase people's access to electricity, with the ultimate goal of promoting economic growth and reducing poverty. The project included the distribution systems rehabilitation and extension activity under which the electricity transmission and distribution (T&D) network was rehabilitated and extended, installation of a new submarine cable connecting Zanzibar's Unguja Island to the mainland, and promotion of solar power systems in the Kigoma region of Tanzania. In addition, MCC initiated a customer-connection financing scheme (FS) that facilitated low-cost electricity connections in selected areas with T&D lines.

This report presents our qualitative evaluation findings on (1) the implementation of the T&D and FS components and (2) the outcomes of electrification as perceived by households, businesses, and other community institutions. The report builds on the baseline report covering the T&D activity and the FS initiative (Chaplin et al. 2012) and deepens our understanding of the types of outcomes that community members associate with electrification. The study findings are intended to help policymakers decide whether to expand electricity transmission lines in Tanzania and other developing countries. The results will also inform our discussion of impacts in the final evaluation report.

Our analysis is based on (1) key informant interviews and focus groups conducted in eight communities across four regions in mainland Tanzania and (2) interviews with stakeholders at the regional and national levels. We collected information from community leaders, household heads, business owners and managers, and staff in schools and health facilities. The communities from which we collected qualitative data were selected to provide a range of perspectives from different regions. Within these communities, we also randomly selected the focus group participants to elicit a range of opinions and perspectives and to gain information that would be representative of the households in the study communities. The respondents discussed the barriers to connecting to electricity, the cost of electricity, the connection process, electricity usage, the benefits of electricity, and who benefits the most from new connections. We also interviewed staff at the Tanzania Electric Supply Company (TANESCO) and the Millennium Challenge Account—Tanzania (MCA-T), who described their perception of the implementation of the T&D activity and the FS initiative. In addition, we observed the target communities and incorporated our own understanding into the analysis based on years of having worked with many of the key stakeholders.

## Key findings

The most notable findings from the analysis of the qualitative data are discussed below.

1. *Lines built.* Under the T&D activity, more than 2,000 km of transmission and distribution lines have been built, providing increased access to electricity for hundreds of communities in seven regions in Tanzania. The activity also improved infrastructure for the local electric supply company.
2. *Management challenges.* Key informants described project management challenges resulting from capacity constraints, the length of the chain of command, less-than-optimal stakeholder engagement during the design phase that led to changes between the

planning and building phases, and problems implementing resettlement and compensation due to weak coordination between key stakeholders.

3. *Suboptimal locations of lines.* Many respondents were concerned that the lines were not optimally placed within communities. The final design did not reflect new housing in the communities. Moreover, concern was expressed that lines followed existing roads too rigidly and thus did not extend to reach many households located far from roads. Respondents were also concerned about the criteria used to determine which communities were chosen. Respondents expressed the need for more explicit criteria to help determine where infrastructure is placed.

4. *Barriers to connecting.* The barriers to connecting to the electric grid were on both the supply and demand side. On the supply side, pole and line placement outside of populated areas, the 30-meter rule about the proximity of lines to buildings, transformer size, TANESCO capacity to serve customers, and material and supply limitations presented barriers to households, businesses, and public facilities connecting to the grid. On the demand side, costs (application, connection, and internal wiring), the application process, extended wait times, housing materials not being suitable for electric connections, and the season when connections were offered all presented barriers to connecting.

5. *Usage costs.* Respondents had less consistent views on usage costs. Some respondents suggested that electricity was cheaper than other sources of energy, such as kerosene or diesel. Other respondents who relied on more basic energy sources, such as candles and batteries before electrification struggled to afford their energy bills after electrification, especially if they tried to use certain types of high-consumption appliances like refrigerators, stoves, and even irons. Some respondents expressed distrust of TANESCO because they had not realized that they would have to pay a monthly fee for electricity in addition to the units of electricity they consume. The lack of trust of TANESCO could be misplaced as this could happen with TANESCO's offer of a low-cost tariff plan without a monthly service charge, but that was only for customers willing to consume no more than 75 kilowatt hours per month.

6. *Uses of electricity.* Among respondents who had connected to the grid, the most common reported uses of electricity were indoor and outdoor lighting, appliances for household chores, charging mobile phones, refrigeration, watching TV and listening to the radio, and starting income-generating activities. A few respondents also reported using electricity for cooking, but others suggested that other energy sources (such as charcoal and firewood) were more affordable than hot plates.

7. *Reported benefits of electricity.* There was consensus on the importance of electricity and the wide range of benefits that accrue to households, businesses, and other community institutions from accessing grid electricity. Respondents reported a range of benefits from using electric lighting, including increased hours of business operations, help with things like poultry production, increased hours for study in the evening, increased family communication, enhanced ability of health workers to serve patients at night, reduced crime, improved safety by protecting people from snakes, and reduced likelihood of fires by replacing candles and kerosene lamps. Other important domestic uses of electricity were for lighting, entertainment, communication, and household

chores. Refrigeration was mentioned as important for storing vaccines and medicines and for business and social uses like cooling drinks and storing food.

8. *Gender differences.* Respondent reactions to benefits of electrification by gender were mixed. Most female respondents agreed that women benefited the most from electricity in the home, which made household chores easier (for example, using electric water heaters or not having to wait in line or walk far to purchase kerosene) and allowed them to complete chores at different times of the day. Men also mentioned benefiting from the ability to watch a TV show or games at home, whereas all would benefit from greater awareness about domestic and world affairs by watching or listening to the news. Both boys and girls enrolled in school were expected to benefit from electricity equally. Health facilities also expected to benefit all who need care, but particularly pregnant women and children.

## Implications for policy and practice

The study findings have implications for building new electricity lines and related infrastructure, encouraging new connections, and for maintaining the existing network in Tanzania.

1. *Benefits of electrification are well recognized.* As discussed above, respondents overwhelmingly expressed positive views towards having electricity. This suggests that there is room for policymakers to help provide more Tanzanians with access to electricity and potentially improve a broad set of outcomes. Although determining how to increase access to electricity in a cost-effective way might still be a challenging issue for policymakers, they may not need to worry about a lack of understanding of the potential benefits as they craft policies designed to increase use of grid electricity. Policymakers in Tanzania could encourage more connections by reducing connection costs, improving the communication and education around the connection process, making the connection process shorter, and strengthening capacity within TANESCO.
2. *Increase TANESCO capacity.* Although TANESCO is in the process of building internal capacity, findings from the qualitative analysis suggest the need to bolster its capacity to maintain the new MCC-funded lines as well as to implement any future expansion of the T&D system. TANESCO could be more effective at installing new service lines and providing maintenance and repair if it built capacity in a number of areas, particularly by increasing the number of electricians in local offices and providing its engineers and technicians with adequate supplies and transport. Capacity building may need to be balanced against the company's financial health, but an assessment of how improved capacity would contribute to the company's financial condition in the future would be useful.
3. *Improve procurement process.* During the procurement process, the implementing entity needs to ensure that the scope of work for implementation contractors is reasonable and that contractors have sufficient capacity and commitment to design and construct new electricity distribution lines well and on schedule. Further, it is important for stakeholders to anticipate competing demands for consultants or contractors operating in distant locations and managing multiple projects.

4. *Improve contracts.* MCA-T should consider various changes to their contracts. In particular they should consider developing a Conditions of Particular Application (COPA) that simplifies processes so that decisions on the ground can be made more quickly and efficiently. They should also investigate methods of reducing the lengthy chain of communication among the implementation partners in ways that balance the need to reduce delays while ensuring project quality. In addition to developing more flexible agreements, MCA-T may want to consider including positive and negative incentives that motivate consultants and contractors to stay on time and implement a high quality project.
5. *Optimize locations of transformers and lines.* The locations of the transformers and low-voltage lines need to be optimized both within and between communities. Considerations should be given to the benefits and costs of serving a new community in planning the locations of new lines.
6. *Optimize involvement of local stakeholders.* Local stakeholders can be optimally engaged at the design stage to ensure that the project benefits from the knowledge of local conditions, local stakeholders such as TANESCO district-level staff, community leaders, and community members can be consulted at the design stage. Such efforts would likely result in a project design that is sensitive to local conditions and reduces the need for large modifications to the plan during implementation.
7. *Improve partner coordination.* Implementation would benefit from improved coordination among partners. Coordination could include sharing of project maps and documents at multiple points in the design stage, consistent use of differential GPS units, and more-complete preparation to ensure availability of materials (for example, mounting brackets) needed for installing new connections. Such preparation would ensure smoother implementation and, ultimately, faster installation of connections for the end users.
8. *Keep community members informed about line locations.* Community members need to be informed where lines will be built. Respondents noted that many individuals built new homes where they were told that the lines would be built, only to find out later that the lines would be built elsewhere. It might make sense to inform community members that the final decision about where lines will be built cannot be made until the lines are actually energized, since even after poles are put up they are sometimes moved. This type of clear communication would reduce the likelihood of potential customers moving to the wrong locations in an attempt to access the new lines, and thus could increase the demand for new connections.
9. *Improve outreach efforts regarding connection process.* Effective sensitization and outreach is needed to inform community members about the connection process and monthly costs. Such efforts will ensure that potential customers are well informed about the process and all costs. Early communication would give individual and institutional customers adequate time to acquire funds needed to cover the costs of connecting. Moreover, new customers may lack clear understanding of the usage costs and may not anticipate all costs. It might be helpful to design a brochure that provides illustrative examples of how much a potential customer should expect to pay for electricity units based on consumption and perhaps even depending on which appliances are used.

Community members would also benefit from clear communication about the difference in application fees between rural and urban areas.

10. *Clarify community selection process.* Greater outreach to share information with communities that do not directly benefit from an intervention may reduce social tension. If interventions are undertaken in selected communities (such as the FS initiative), the selection process should be public and transparent and the reasons for it well communicated to all communities in the area, including those that do not benefit directly from the intervention. This could reduce chances of confusion and social tension in these communities.

11. *Facilitate sharing of lessons learned.* Facilitate sharing of connection lessons across schools and health facilities. Although respondents clearly agree how important electricity is to schools and health facilities, only some of these public institutions were able to connect to the grid. It might be helpful to share with the Ministries of Education and Health lessons on how connected facilities managed to raise funds, in order to inform other local institutions that may want to connect in the future.

## Implications for future data collection for the energy evaluation

1. *Add questions in the follow-up survey:* Findings from the qualitative analysis provide us with a clearer understanding of the outcomes for households and businesses that gain access to electricity. Although these outcomes are broadly in line with what we anticipated based on existing research, having the supportive evidence from Tanzania is reassuring. In addition, some findings are new and will inform development of the instrument for the follow-up community and household surveys. For example, we may decide to add questions regarding the use of lights for chicken farming, the use of electric irons, the presence of electric lights for safety from crime and wild animals, and how electric energy might facilitate interactions between family members.

2. *Consider doing follow-up survey in the fall of 2015.* It is important to note that households and businesses that connected to the electric grid are already recognizing changes in their socioeconomic outcomes. This suggests that if MCC decides to conduct a follow-up household survey in fall 2015, households that connected are likely to have had a long enough time with electricity to experience changes in some of the intermediate outcomes on which the impact evaluation would focus. These include sources of energy, expenditure on energy, time use among adults and children, and hours of business operations.

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# I. INTRODUCTION

To promote economic growth and reduce poverty in Tanzania, the Millennium Challenge Corporation (MCC) funded an energy sector project implemented by the Millennium Challenge Account–Tanzania (MCA-T) under the first compact with the Government of Tanzania. The project components included the distribution systems rehabilitation and extension activity under which the electricity transmission and distribution (T&D) network was rehabilitated and extended, installation of a new submarine cable connecting Zanzibar's Unguja Island to the mainland, and promote solar power systems in the Kigoma region of Tanzania.[1] In addition, MCC initiated a customer-connection financing scheme (FS) that facilitated low-cost electricity connections in selected areas with T&D lines.

MCC contracted with Mathematica Policy Research to evaluate two of the four project components: the T&D network and the FS initiative.[2] The evaluation, which uses rigorous mixed methods, is designed to help MCC understand how these activities were implemented and how they affect the well-being of the target populations.

This report presents qualitative evaluation findings about T&D activity and FS initiative implementation, and describes the perceived changes in outcomes for households, businesses, and the community resulting from accessing electricity. The analysis uses data collected through focus group discussions and key informant interviews in eight communities across four regions in mainland Tanzania. The report builds on the baseline report (Chaplin et al. 2012) covering the T&D activity and the FS initiative, and deepens our understanding of the types of outcomes that community members relate to electrification. Findings presented in this report are expected to inform policymakers for future expansion of electricity transmission lines in Tanzania and other developing countries. The results will also inform the discussion of impacts in the final evaluation report, which will draw on follow-up survey data.

To set the context for the findings, this chapter contains an overview of the energy project, a conceptual framework for the evaluation, and a brief discussion of early evidence on impacts of the project. Chapter II presents the study design, research questions, data sources, and analytic methods. Chapter III describes the respondents' insights on the implementation of the two project components, and Chapter IV discusses respondents' perceptions of outcomes affected by electrification. In Chapter V, we summarize the findings, describe the limitations of the qualitative analysis, and discuss implications of the findings for implementation of similar activities in the future, as well as for future evaluation activities. Appendix A presents the key measures on which the qualitative evaluation focused by study domain. Appendix B presents the study timeline, and Appendix C provides comments from key stakeholders on an earlier draft of

[1] The Zanzibar interconnector activity or cable activity, included installing a 100 megawatt submarine cable between Ras Kiromoni, Dar es Salaam on mainland Tanzania to Ras Fumba on the island of Unguja, Zanzibar, and the rehabilitation and extension of three interconnector and distribution substations (MCC 2013b). The energy project also resulted in the production of a feasibility and design study for a potential hydropower plant in the Kigoma Region.

[2] Mathematica is also conducting an evaluation of the Zanzibar interconnector activity, as discussed in Chaplin et al. (2011).

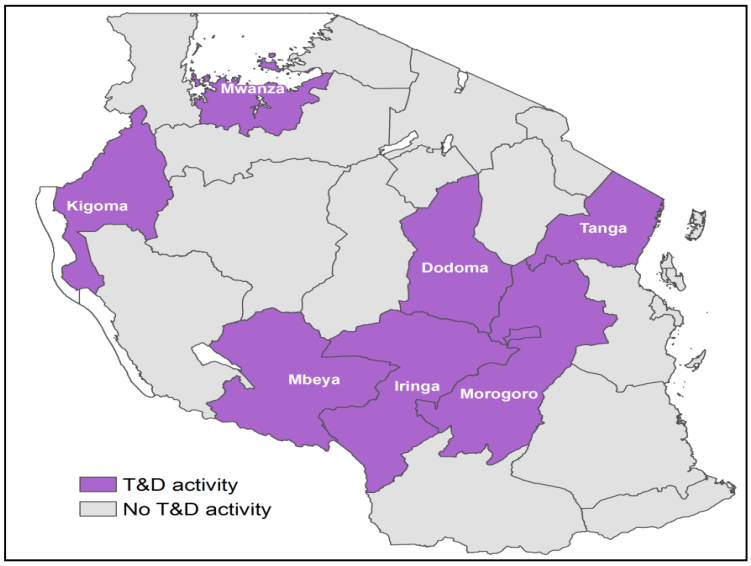
this report and Mathematica responses to those comments. Appendix D provides the English version of the interview guides used to collect qualitative data.

## A. Overview of the energy project in mainland Tanzania

MCC's compact with the Government of Tanzania commenced in 2008. Through this compact, MCC invested about $698 million to address infrastructural barriers to the country's economic growth and poverty reduction. The Government of Tanzania established MCA-T to manage the compact and implement project activities with MCC oversight. The compact funded projects in three sectors: roads, water, and energy.[3] Following is a brief overview of the two components of the energy project.

**The T&D activity.** This activity involved rehabilitating existing electricity transmission and distribution networks and constructing new lines in about 343 communities in seven regions—Dodoma, Iringa, Kigoma, Mbeya, Morogoro, Mwanza, and Tanga—that the government had identified as high-priority areas for investment in electricity (Figure I.1).[4, 5] The approximately $128.4 million investment in the T&D activity represents more than three-fifths of MCC's total commitment to the energy project. The activity was expected to create approximately 35,000 (MCC 2007) new connections for households and businesses, based on the original design.[6]

**Figure I.1. Regions where T&D activity was implemented in Tanzania**




[3] For more details on the early plans for the energy sector project, see Annex I of the compact (MCC 2008).

[4] The T&D activity also included construction or rehabilitation of 24 interconnector and distribution substations.

[5] Communities are either villages, subvillages, or *mitaa* (singular *mtaa*), which are local urban government units within cities.

[6] These estimates exclude the Kigoma region, as that region was originally expected to receive a new hydropower station as well as line extensions. Subsequently, the hydropower plant was replaced by a solar power project. Some new electricity lines were built in Kigoma and the region has since been considered to be a beneficiary of the T&D activity.

**The FS initiative.** For most Tanzanians, the standard fee for connecting to the electric grid is a significant barrier to access. The FS initiative was designed to address this barrier, and thereby enabled the evaluation to provide information on the potential impact of new lines when the connection fee is reduced. MCA-T and the Tanzania Electric Supply Company (TANESCO), supported by MCC, partnered to try to reduce the financial barriers and logistical constraints for residents of 29 randomly selected communities (these communities were selected in July 2012). MCC invested about $2 million to implement the FS initiative, which lowered the connection fee from 320,960 TZS in urban areas and from 177,000 TZS in rural areas to 30,000 Tanzanian shillings (TZS) for all customers in selected locations. Customers still had to pay an application fee of between 4,500 and 5,900 TZS, and for wiring their homes—which can cost as much as or more than the standard connection fee. MCA-T procured connection materials and meters for 6,000 connections for customers who would consume fewer than 75 kilowatt hours per month. Of these, 5,800 connections were made available for individual customers on a first-come, first-served basis; the remaining 200 connections were offered to eligible public institutions in the selected communities. Community members were given between 60 and 90 days to take advantage of the low-cost connection offer. Camco Advisory Services (Camco) undertook a communications campaign to inform households about the low-cost connection offers. As a result of the initiative (which was implemented from February 2013 through June 2014), 1,814 individual customers were connected to the electric grid (about 31 percent of the connections available through the FS initiative).

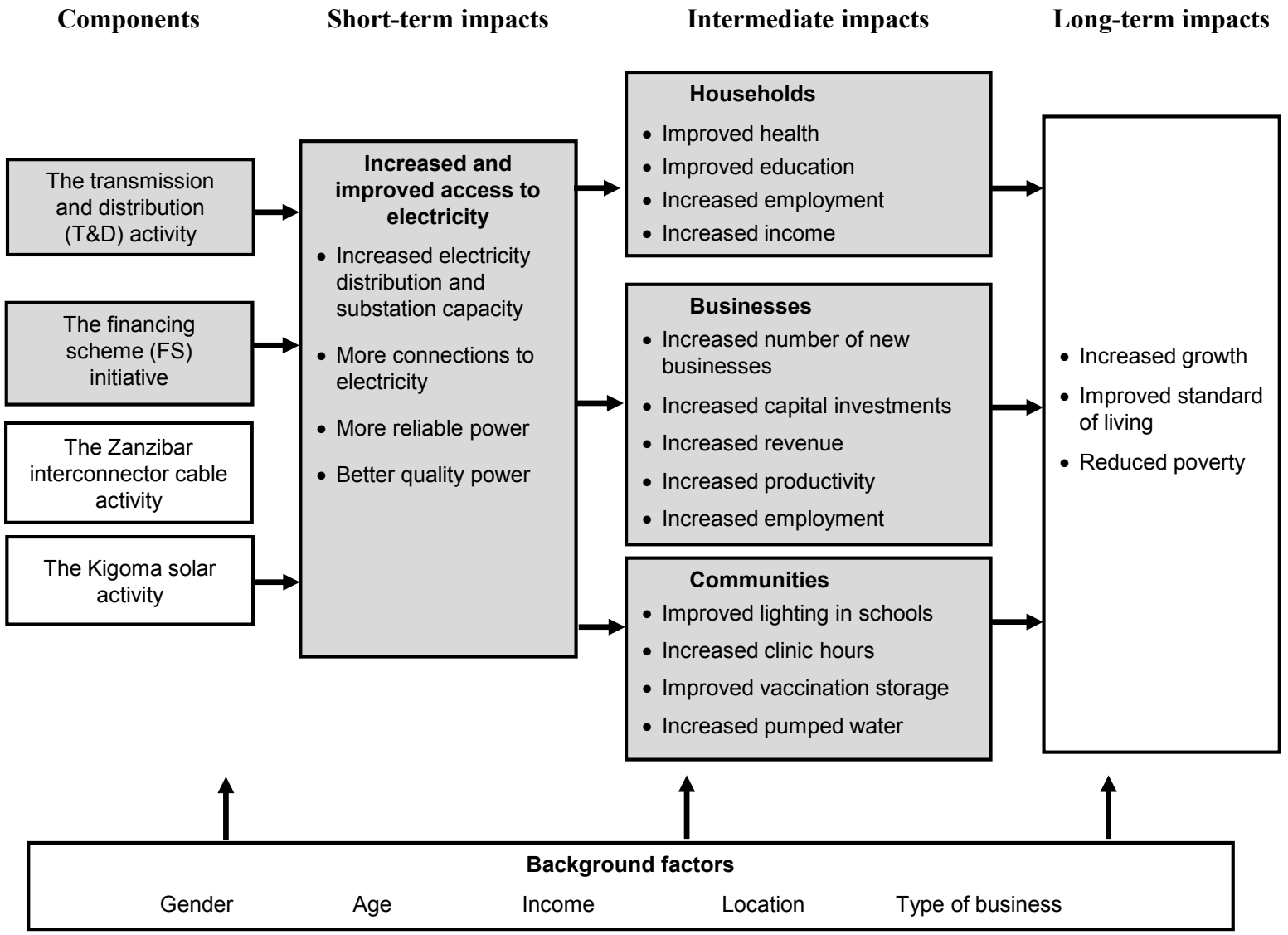
## B. Conceptual framework for the evaluation

A conceptual framework guides the energy project evaluation. MCC and MCA-T developed logic models for each energy sector project activity (MCA-T 2012) that Mathematica consolidated into a conceptual framework (Figure I.2). The boxes on the far left of the figure show the four MCC-funded energy sector activities. The box on the far right shows the ultimate objectives of these activities: increased economic growth, improved standard of living, and reduced poverty. The project activities are designed to achieve these objectives through increased access to electricity in the short term, and through intermediate and longer-term effects on households, businesses, and communities. The shaded boxes in Figure I.1 highlight the energy project components on which this report focuses, as well as the short-term and intermediate outcomes the report covers.

The energy project activities may affect access to electricity in several ways, as shown under short-term impacts in the conceptual framework. First, successful project implementation is expected to increase the reach of the distribution networks and improve the substation capacity. Second, by expanding the distribution network and facilitating lower-cost connections, the T&D activity and the FS initiative may increase the number of households, businesses, and community organizations (such as schools, health facilities, and water utilities) connected to the national electric grid. Third, installing and rehabilitating electricity infrastructure may reduce voltage variations and harmonic distortions, thus improving the quality of the electricity supply.

Improvements in access to electricity may have important intermediate impacts on households, businesses, and communities. Electricity can help improve households' economic opportunities by enabling household members to spend less time doing household chores during the day, consequently freeing up time to work for pay outside the home. Electricity also

**Figure I.2. Conceptual framework for the energy project in Tanzania**



improves information access via radio, television programming, and mobile phone communications, which enables people to become more informed about current affairs, the market prices of goods and services, adverse weather conditions, and opportunities available to them. Electricity may improve health outcomes if it enables households to use less of those types of fuel that can cause health problems, such as charcoal and wood. Finally, it can improve education outcomes by enabling students to spend more time studying after dark.

Electricity can also benefit businesses, especially by enabling them to use machinery such as milling machines and welding equipment that can be operated more cost-effectively with electricity, rather than diesel or other expensive fuels. Similarly, electricity can be used in important and cost-effective ways by facilities that serve entire communities, such as schools (which can benefit from electric lights), clinics (which can stay open longer, use electricity for lighting and refrigeration, and use more sophisticated medical equipment), and water utilities (which can use electricity for pumps and cleaning equipment). For all of these types of uses, grid electricity from the new MCC-funded lines can be far cheaper than electricity produced by the small generators commonly used by businesses, schools, and health facilities that are not connected to the national electric grid.

The box at the bottom of the conceptual framework lists background factors that may affect short-term, intermediate, and long-term outcomes. Impacts of the activities may vary across different subgroups of the population. Women and children, for example, may benefit most from electricity in the house because they spend more time there than men do. Medium-income households may benefit in more ways than low income households because they save money by switching from more expensive energy sources to electricity. Medium-income households are also better able to afford some of the time-saving appliances that enhance quality of life, as well as pay the monthly costs of operating these items. In contrast, low-income households may benefit fewer ways if they cannot afford the connection fee, monthly unit costs, or electric appliances. Furthermore, communities may differ in the benefits they gain from electricity, depending on the number and types of public facilities they operate, whether the local market is electrified and attract new business investments, and whether other infrastructural development activities are implemented in the area. For example, if grid electricity makes the community more likely to get a water project, the benefits to the area will be greater.

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# II. RESEARCH QUESTIONS AND DATA

This chapter describes the design of the qualitative evaluation of the T&D activity and the FS initiative, including the study domains, research questions, data sources, and analytic approach.

## A. Study domains and research questions

The qualitative evaluation team selected a number of research questions in collaboration with MCC and MCA-T. The evaluation was designed to produce insights into the following questions, using data from interviews with key informants at the national, regional, and community levels and from focus group discussions with households. The principal study domains were project implementation (successes, challenges, and sustainability) and stakeholder outcomes (access to electricity, energy costs and benefits, health and education, productivity, and gender.) (Details of the questions in each domain are shown in Appendix A.)

### 1. Questions related to project implementation

- **Implementation:** How were the T&D activity and FS initiative implemented?
- **Successes and challenges:** What are the implementation successes and challenges?
- **Sustainability*:*** How sustainable are the implemented components of the energy project perceived to be?

### 2. Questions related to stakeholder outcomes

- **Connecting:** Why did households, businesses, and community institutions decide to connect or not to connect to the newly available electricity lines and to take advantage of the financing scheme?
- **Outcomes:** What are the potential impacts of increased access to electricity on economic, education, health, safety, migration, and related outcomes? What are the mechanisms by which these changes might occur?
- **Gender:** Do the changes in outcomes from access to electricity differ by gender? Why do these differences occur?

## B. Data

We collected qualitative data about implementation successes and failures as well as perceptions about how implementation affected outcomes of households, businesses, and other community entities. We collected qualitative data one time, after the T&D activity and FS initiative had been fully implemented. The timing allowed key stakeholders and respondents to reflect upon the implementation process as well as upon changes that have occurred since the project was implemented and customers gained access to grid electricity.

### 1. Data sources

We used a variety of qualitative data collection methods and data sources to fully explore our research questions. Table II.1 describes the respondents, the method of data collection (ke

informant interview, focus group discussion, observation, or review of reports), and research questions addressed in the qualitative study.

**Table II.1. Respondents, data collection methods, and research questions**

| Respondent type | Data collection method | Research questions |
|---|---|---|
| MCA-T and TANESCO staff<br>• M&E and energy sector program directors at MCA-T<br>• MCA-T liaison at the TANESCO headquarters and other TANESCO staff at the district level | Interviews | • Implementation of the project components<br>• Informants' perceptions of the program's successes and challenges |
| Household members | Separate focus groups for men and women in each of 8 communities. Household FGDs included both connected and not connected households. Focus groups included 74 men (36 connected and 38 not connected) and 78 women (39 connected and 39 not connected) in the 16 FGDs in the 8 study communities. | • Interest and ability of households to connect to lines; obstacles in getting connected<br>• Perceptions of costs and benefits of accessing electricity<br>• Experiences with and outcomes related to the financing scheme (for communities where it was offered)<br>• How connected households use electricity and why they use it for some purposes but not for others<br>• Women's particular points of view, and differential effects of the interventions on them |
| Owners/managers of an income-generating activity (IGA)<br>• Both formal and informal IGAs inside or outside the home<br>• May or may not have paid employees<br>• IGA owners are a subset of household members<br>• They include male and female IGA owners, both connected and not connected to electricity | Interviews | • Specific effects of the interventions on the IGA<br>• IGA owners' perceptions of the value of electricity to the productivity and profitability of their businesses<br>• Obstacles to connecting<br>• The costs and benefits of electricity related to income generation<br>• Different effects for male and female IGA owners |
| • Community leaders (village/mtaa head), school headmasters, and health facility directors (or other appropriate staff) who are positioned to describe their experience with electricity connectivity in their role<br>• We included both connected and unconnected schools and health facilities, as well as any schools that were located in communities that were offered the FS initiative | Interviews | • Perceptions of the effects of electricity at the community level<br>• The uses and benefits of electricity for schools and health facilities<br>• Perceived effects on education and health outcomes<br>• Quality of lines, power outages.<br>• Other comm. unity-level outcomes such as economic activity and other externalities |

**TABLE II.1 (CONTINUED)**

| Respondent type | Data collection method | Research questions |
|---|---|---|
| Researchers | Detailed observations of community infrastructure using an observation tool to record salient features of infrastructure | • Were schools and health centers electrified?<br>• Was there evidence of illegal connections?<br>• Were there local markets? How large, and were they electrified?<br>• Have new businesses emerged?<br>• What was the location of power lines relative to households and businesses? |
| Researchers | Review of implementation reports and monitoring and evaluation data on implementation and outcomes | • This review supplemented primary qualitative data to answer the research questions and provided some "lessons learned" regarding implementation. |

## 2. Site selection

We collected qualitative data in eight T&D project communities—two from each of four regions: Mwanza, Dodoma, Iringa, and Tanga.[7] These regions were selected purposively by MCC and Mathematica to include a range of different conditions for the qualitative study. Specifically, Mwanza, located on Lake Victoria, has a social and economic profile quite different from other regions in Tanzania, and Tanga is the most industrialized region of the country. Dodoma was suggested by MCC because the engineering model applied to design the line extension (by Pike Electric) was different in Dodoma than the other regions. Finally, we selected Iringa as the fourth region because the baseline household survey suggested that communities in Iringa averaged more households than communities in other regions, providing a larger pool of potential qualitative study respondents from which to choose. One urban and one rural community were randomly selected from each region.

[7] To maintain respondent confidentiality, we have omitted names of the specific communities where we collected data. We do, however, present community background characteristics in Chapter IV to provide context for the outcomes discussed in that chapter.

Data collection took place in those intervention communities where MCC-funded lines had been built. We purposively selected communities to vary on key characteristics, including rural/urban status and those offered and not offered the FS scheme. We also selected communities with businesses and communities that had at least some connected and some not connected households.

### 3. Development of data collection tools, and data collector training

We developed key informant interview guides, focus group protocols and observation tools in English, guided by the study domains, research questions, and the program logic model identified as being of key interest in the evaluation. MCC and MCA-T reviewed the data collection tools and provided feedback, and we revised the tools accordingly. CSR Group Africa (CSR), our local research partner, contracted professional translators to translate the data collection tools into Kiswahili. The translated tools were reviewed during the in-country training, and also by Mathematica researchers.

Together with CSR staff, we conducted a three-day training workshop in Dar es Salaam for the data collection researchers. The training developed a common understanding of the instruments, the data collection protocols, and the supporting systems for field operations. We led sessions explaining the MCC energy project activities, the scope of the full evaluation, and the sampling and recruitment procedures for the qualitative activities, and provided examples of high quality transcripts of focus group discussion (FGDs). The team completed detailed reviews of the qualitative protocols and guides, conducted mock interviews/FGDs, and reviewed the Kiswahili translations of the guides and protocols.

Once trained, the group pre-tested the guides and field procedures in an urban community in the Morogoro region. The teams made courtesy calls to the regional and district offices to obtain the necessary permissions and then met with the community leader, who helped make arrangements for the focus groups and identified a nearby school for the school director interview. The team completed the community leader and school director interviews, screened and recruited households and owners/managers of businesses or IGAs for focus groups, and held three focus groups. After the pre-test, the data collection guides and study procedures were revised; for example, we replaced focus groups for business owners with interviews because business owners were reluctant to leave their places of business during the day.

### 4. Data collection procedures

The field staff divided into two teams, each covering four communities. In each location, the field staff obtained the necessary approvals before proceeding to the community leader. The team asked the community leader for help in conducting observations, identifying the location of schools and health facilities, and identifying IGA respondents. The field teams also walked through the local markets to identify and recruit IGA respondents. Household focus group participants were randomly selected from one of two lists. The field team first asked the community leader to use the community register of households. If that list was not available (which happened in two communities) then the field team used the list of households provided by Mathematica from the baseline household survey conducted in 2011. The team was not able to find all households from the Mathematica list because some households had migrated, and also because it is customary for people to use different names. Consequently when the two lists

were unavailable or ineffective, the team developed a new list of households by walking through the community. When the team had a list of potential participants for the household focus groups, it divided the total number of households by the required number of respondents in order to obtain a sample interval that would yield the sample size needed for the focus group. Once the interval was set, the team, with the assistance of the community leader, identified the randomly sampled households and recruited participants for the focus groups.

In each community selected, we conducted the community observation as well as interviewed the highest ranking elected or appointed community leader for the sub village or village, or his/her deputy if the leader was not available. We interviewed the school director, and the health center staff in each community.[8] We also conducted two focus groups (one for male household members, the other for female) and five interviews with IGA owners in each community. Interviews with MCA-T staff were conducted at the national level only. TANESCO staff interviews included one national-level interview and four interviews with district-level staff, one in each of the four study regions.

The field team completed the community observation tool by interviewing the community leader as well as walking through the community to assess characteristics of the location, such as the total number of businesses, the number of connected businesses, and the condition of the power lines. If there was any conflict between the community leader's answers and what the field team observed, the field staff noted it in the observation tool. We also reviewed implementation reports for the T&D activity and the FS initiative and used monitoring and evaluation data from stakeholders.

Once participants were recruited, the interviewer sought consent to collect data and digitally record the interview. After the interviews, the field staff transcribed all digital recordings into Kiswahili transcripts, which were then translated into English. Finally, CSR staff checked all transcripts with the audio recordings to ensure quality and accuracy before sending the transcripts and the audio files to Mathematica.

## C. Analytic approach

We analyzed the qualitative data by first reading and rereading all transcripts. Next, we developed analytic codes and themes. We created a separate database for each type of transcript (that is, male FGDs, female FGDs, health facilities, schools, community leaders, TANESCO, observation forms, and MCA-T). We asked CSR to check the audio files and translation if we needed more clarity to understand the transcripts. Next, we coded transcripts line by line using NVivo 10. Once coded, we compared the themes and codes by respondent type as well as by region and location. The comparison of data allowed us to identify differing responses and in some cases the reason for the differences, as well as to validate findings based on repeated reports across respondent types and locations.

[8] Only three of the communities we selected for the household focus groups had health facilities. Two were in FS communities and only one of the two was connected to the grid. In order to obtain a total of eight interviews with health facilities, we interviewed five more in other communities that also got new MCC-funded lines: four were connected to MCC-funded lines; one relied on solar power; and three used several energy sources on a piecemeal basis.

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# III. FINDINGS ON THE IMPLEMENTATION OF THE T&D ACTIVITY AND FS INITIATIVE

Implementation of the T&D activity and the FS initiative faced several challenges, but overall the efforts enabled new customers to connect to the electric grid who otherwise might not have done so. We also discuss issues related to sustainability of the investments made under these two components of the energy project.

## A. Stakeholders involved

A large number of key stakeholders were involved in the design and implementation of the T&D activity and the FS initiative. We describe their roles and relationships as a background to discussing the findings. Figure III.1 provides a succinct overview of the roles and relationships among the stakeholders. These stakeholders worked together to carry out various tasks, but respondents noted that it was challenging to maintain clear lines of communication throughout the implementation period.

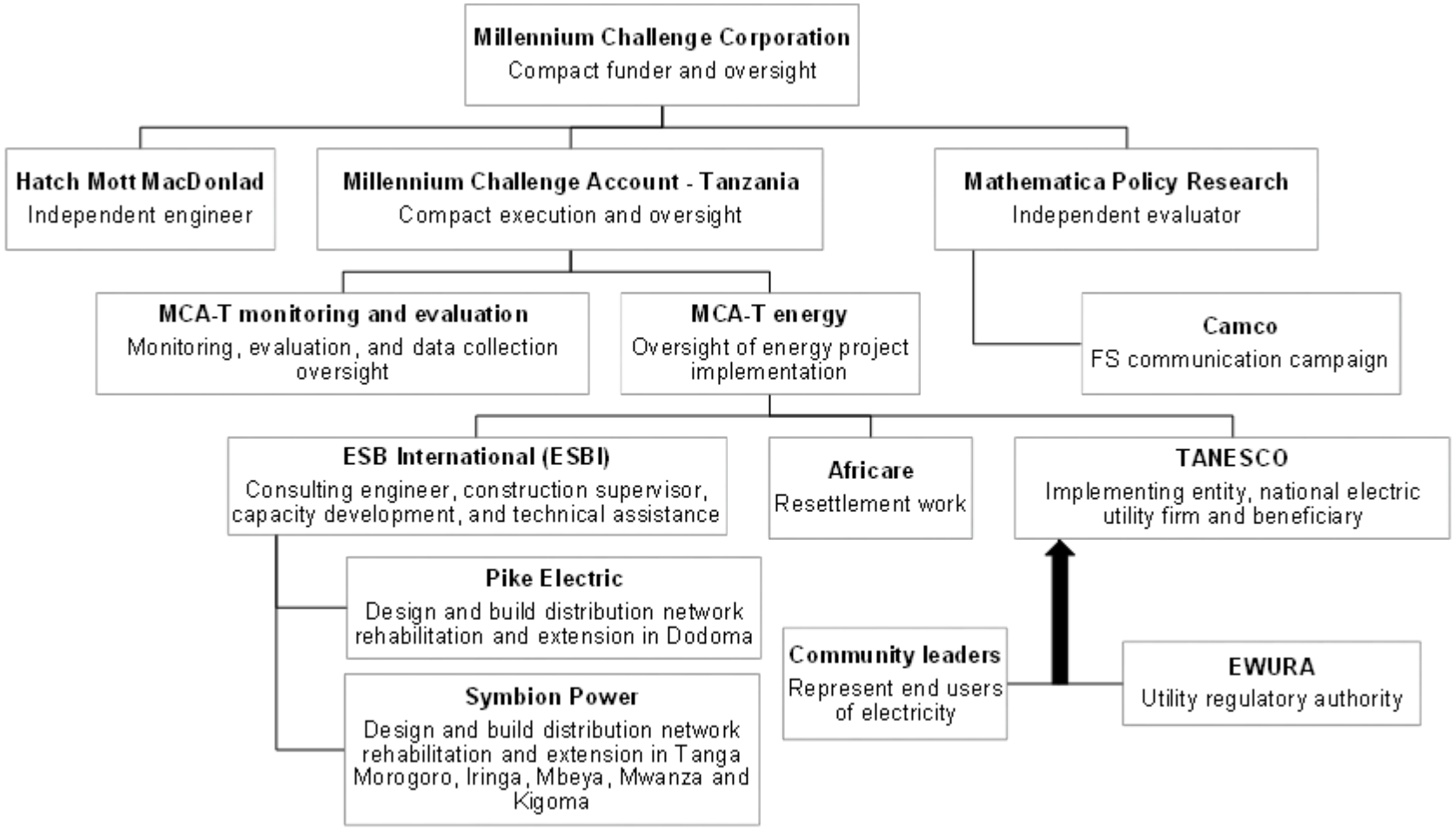
**MCC.** MCC is the U.S. agency that funded the Tanzania compact, which went into force in 2008. Throughout the course of the compact, MCC oversaw the project. MCC contracted with Hatch Mott MacDonald (HMM) to conduct due diligence activities before the project began. During the design and implementation phase, MCC worked closely with MCA-T, and contracted with independent engineers based in the U.S. to provide comments and suggestions on the design and construction of the electricity infrastructure.

**Hatch Mott MacDonald.** HMM was contracted by MCC as the independent engineer to conduct due diligence activities across the six regions of Tanzania (excluding Kigoma) where the T&D activity was originally planned to be implemented. HMM engineers conducted field visits and (in regions where they were available) used existing feasibility studies prepared by TANESCO in 2006. Working with TANESCO, HMM identified 182 projects with the highest expected economic rates of return. These projects were spread across 343 villages and *mitaa* (urban and peri-urban) areas. HMM's due diligence report provided specifications that guided the procurement process, the project design, and selection of the consulting engineer.

**MCA-T.** This agency was created by the Government of Tanzania to manage the Tanzania compact. MCA-T had a number of units, including one focused on implementing the energy project, one focused on monitoring and evaluation (M&E), and another focused on contracting. MCA-T hired the engineering firm that oversaw the T&D activity and the two firms that implemented the activity.

**MCA-T Energy.** MCA-T Energy is the department within MCA-T that oversaw implementation of the energy project. It played several roles. It managed the contract with ESB International (ESBI), the consulting engineer that designed the energy infrastructure and supervised construction. MCA-T oversaw the consulting engineer's activities and communicated with MCC on significant design and implementation issues. MCA-T Energy received regular reports from the consulting engineer as well as TANESCO, the implementing partner. During the construction phase, MCA-T received comments from TANESCO or MCC, then consolidated those comments and submitted them to the engineer to share with the contractor building the

**Figure III.1. Stakeholders involved in the implementation of the T&D activity and the FS initiative**



lines. MCA-T Energy consisted of three MCA-T employees as well as a TANESCO expert designated to the MCC electricity project. All procurements and contracts for the energy infrastructure project were guided by the International Federation of Consulting Engineers (FIDIC) *Guide to the Use of the FIDIC Conditions of Contract for Electrical and Mechanical Works* (1988) (commonly referred to as the *FIDIC Yellow Book*).

**MCA-T M&E.** As the monitoring and evaluation arm of MCA-T, the M&E department provided overall monitoring and evaluation support for the energy sector project, managing monitoring data from TANESCO and the National Bureau of Statistics (NBS) and from baseline surveys conducted by NRECA International. The M&E department also provided training and technical assistance to TANESCO in order to improve the quality of monitoring data.

**TANESCO.** As the implementing entity for the compact, TANESCO jointly reviewed the electricity infrastructure design, verified purchases of building materials in accordance with specifications, and observed construction activities on behalf of MCA-T. Given the terms of the *FIDIC Yellow Book* governing the relationship between the client, engineer and contractor for design and building of electrical and mechanical plants, and in the absence of agreements in a Conditions of Particular Application (COPA), TANESCO did not have direct oversight over the consulting engineer or the contractors. Staff from TANESCO regional and district offices were not involved in the design of the energy project but were responsible for observing contractors and reporting their findings to MCA-T. At the district level, TANESCO's marketing division was tasked with informing and educating communities on the electrification opportunities and the application process. Within villages and urban areas, TANESCO managed the process of installing service line connections, including receiving applications for connections, assessing suitability of the premises for electrification, and installing service lines and prepaid meters connecting the end user to the low-voltage lines.

**Consulting engineer: ESBI.** ESBI was contracted by MCA-T from 2008 as the consulting engineer and construction supervisor for MCA-T and TANESCO. ESBI worked in a technical consulting and project management role to develop and implement all three key components of the energy project. They developed preliminary design, and also reviewed the contractors' final design of the infrastructure that would extend the electricity distribution network in seven regions of Tanzania for the T&D activity. ESBI conducted site and route surveys to determine the placement of overhead lines, substations, and medium- and low-voltage poles. ESBI also prepared detailed maps and the Settlement Action Plan to resettle households that had to be relocated to build the new infrastructure. In 2010, MCA contracted with two international companies to construct the electricity infrastructure. As the consulting engineer, ESBI managed the contractors and acted as an intermediary between the contractors and MCA-T.

**Contractors: Pike Electric and Symbion Power LLC.** The two international companies, with which MCA-T contracted—Pike Electric (Pike) and Symbion Power LLC (Symbion)—designed and constructed the energy infrastructure, including installing transformers, medium- and low-voltage lines, and poles. The contracts were valued at US $17.9 million and $47.7 million respectively (MCC 2011). Given project timelines and capacity constraints, Pike and Symbion subcontracted construction work to local companies. In some instances, these subcontractors further subcontracted tasks to additional companies, particularly for installing low-voltage poles and wires.

**Africare.** MCA-T contracted with Africare to recommend which households to financially compensate for land or housing that were affected by the placement of the MCC-funded electricity poles and lines. Compensation was important when infrastructure had to be placed on farmland, or housing had to be demolished and rebuilt. Africare gathered community stakeholders, explained the compensation plans, administered questionnaires in the communities to assess the value of the land, and told community members to prepare for connections by modernizing their houses.

**Energy and Water Utilities Regulatory Authority (EWURA).** EWURA is an independent agency established to regulate the electricity, petroleum, natural gas, and water sectors in Tanzania. It handles tariff review, licensing, performance monitoring and quality, safety, and health and environmental standards. EWURA had no direct involvement with implementing the MCC-funded energy project but has a critical role in ensuring the longer-term success of the investment; it is charged with ensuring that the electricity company is financially viable. In October 2013, TANESCO submitted to EWURA an application for a multiyear tariff increase that was expected to improve TANESCO's financial condition. EWURA approved the tariff adjustment in December 2013.

**Camco.** Camco was subcontracted by Mathematica to support the implementation of the FS initiative. Working with MCA-T, TANESCO district-level staff, and the community leaders, Camco carried out a campaign to inform community members about the low-cost connection opportunity offered under the FS initiative, including information about the benefits of connecting to electricity, and the application procedures. Camco staff met with community leaders, organized community events to inform communities about the FS offer, distributed posters and brochures, and went door-to-door to some households. They were also responsible for announcing the deadline for the FS offer for each community and documenting the total number of connections TANESCO installed under the initiative.

**Community leaders.** Villages, subvillages, and mitaa are the local administrative units in Tanzania, and each of them has an elected council, including a chairperson and members of the council. Although these community leaders were not involved during project design, they were asked to help once implementation began. This included help with sensitizing community members about the new lines and the financing scheme (where applicable). Community leaders encouraged citizens to attend meetings to learn how to apply, save money for connection costs, and improve roofing materials to meet TANESCO requirements for a connection. Some community leaders supported the connection process for the entire community by collecting application forms from TANESCO and delivering them to interested community members, and also by transporting wire from markets to the village. Community members also went to these leaders to express grievances when they were frustrated by delays or locations of poles and wires.

## B. T&D activity: implementation successes and challenges

Despite challenges, the T&D activity successfully built new lines, giving a large number of people in Tanzania access to the national electric grid.

## 1. Project implementation and successes

During the T&D activity, more than 2,000 km of transmission and distribution lines have been built (MCC 2014). By the end of 2013, Pike had installed 400 km of medium- and 400 km of low-voltage lines, 4,000 medium- and 80,000 low-voltage poles, and 84 distribution transformers (substations) in one region. Symbion constructed over 1,300 km of overhead power lines and 26 substations across six regions in Tanzania (Symbion 2014). The T&D activity design anticipated that the activity would create approximately 35,000 (MCC 2007) new connections for households and businesses.

When asked about the strengths and successes of the T&D activity, most respondents reported that the project resulted in many new connections among households and businesses. Respondents from MCA-T, TANESCO offices, and community leaders described how people were connected who had never expected to access grid electricity in their lifetimes. Community leaders reported that people connected to the MCC lines "are happy and satisfied." Respondents from TANESCO district offices and community leaders said these connections are stimulating building and construction businesses, grain-milling businesses, and small industries, which are creating new jobs.

TANESCO respondents reported that the MCC project improved TANESCO's infrastructure and provided new equipment. For TANESCO, "It was beneficial to work (even minimally) with international contractors." One respondent said, "Their involvement [contractors] was very helpful. They did what we could not do. We have crude tools and they have great equipment." TANESCO officials reported that the transformers are of good quality, holes for electricity poles were dug properly, poles were generally installed well, and the project materials and supplies were mostly up to standard so they will reach their full lifespan.

The final impact analysis planned under this evaluation will provide a comprehensive assessment of project successes in improving the well-being of the people who are able to take advantage of the new lines.

## 2. Implementation challenges

Informants pointed out a number of challenges to implementation. These included capacity constraints and a long chain of communication that affected overall project management, less-than-optimal stakeholder engagement during design that led to corrections between the planning and building phases, and problems with resettlement and compensation due to weak coordination between key stakeholders. The following discussion of challenges to implementation may provide useful lessons for similar future endeavors.

### a. A long communication chain and capacity constraints made overall project management challenging

The compact projects were implemented with MCC oversight over MCA-T, which was responsible for overall project management. MCA-T and TANESCO respondents described a "tripartite approach" to the management structure for the T&D activity whereby MCA-T oversaw the consulting engineer ESBI, who oversaw project contractors Pike and Symbion, who in turn were charged with building the new infrastructure. At the same time, TANESCO acted in an advisory role to MCA-T. Within this framework, if TANESCO regional engineers observed a

design or implementation issue, they reported the matter to the TANESCO project coordinator, who reported it to MCA-T. MCA-T informed the consulting engineer, who then communicated it to the contractor. This was a long chain of communication for addressing issues arising on the ground. According to one respondent, "Everyone had 21 days to contribute feedback, as stated in the *Yellow Book*. If [they] do not receive feedback within 21 days, the contractor assumes that the submitted design plan is accepted." Respondents at MCA-T and TANESCO recognized that with a few staff at MCA-T overseeing the implementation of the energy project, and a few dedicated TANESCO staff members for the T&D activity that spreads across the regions, the complex communication chain and time limits on changes meant that the consulting engineer or contractor might not hear about TANESCO's concerns before it was too late to change a plan or construction.

**b. Local stakeholder involvement was limited, which resulted in local concerns about the placement of the new lines**

Although the TANESCO headquarter staff were involved during the planning of placement of the new lines, respondents from regional and district offices were not. At the community level, the eight community leaders we interviewed indicated that neither they nor other community members had been involved at any stage in the decisions about placement of the new lines. Respondents noted that the design of the lines did not account for the fact that many houses are unplanned and do not follow roads as they would in more developed countries. Because local stakeholders had no input, the project missed opportunities to include some sections of the community in electrification. Community leaders reported community members being angry that they were not included in the planning or design phase because they had lost the opportunity to connect to MCC lines. According to community leaders, some villages could have been included but were not. "There are people with the means to pay that are crying for electricity, and they are upset." Although there may have been sound technical and financial reasons for excluding these communities, the community leaders we interviewed did not feel that they were given an opportunity to provide input for the decision.

At the regional and district levels, TANESCO staff were not involved in designing the energy project, but were responsible for observing contractors and reporting their observations to MCA-T. Challenges arose from TANESCO's district-level engineers not having maps, so they could not effectively oversee all design and construction activities. Moreover, when TANESCO engineers observed problems in design or construction, they were only able to report to MCA-T, rather than to provide immediate feedback or corrections to the consulting engineer or contractors. In this way, TANESCO respondents reported they acted almost as a consultant to MCA-T, rather than as a key partner. In some cases, TANESCO engineers "held ropes as the consulting engineer drew boundaries, but were not privy to the drawings or sketches." We did not interview staff from HMM, ESBI, or the contractors, so we are not able to provide their perceptions of the process or the constraints to engaging local stakeholders in the design.

MCA-T respondents noted that in addition to location of the roads, in the future, taking into account population clusters and the location of public institutions may address some of the concerns about placement of the lines. Additionally, MCA-T suggested that software procured under the energy project for TANESCO would enable design engineers to balance improved

access and costs to help determine the optimal placement of the transformers and distribution lines in the future.

### c. The long gap between design and construction may have resulted in lines being built without regard to changes on the ground

According to MCA-T, the initial surveying and the design of the energy infrastructure occurred years before project implementation and construction of infrastructure. Feasibility studies were conducted in some locations in 2006, due diligence was completed in 2007, and the design plans were developed in 2008. Construction began in 2011 and was completed between October 2012 and December 2013. The four-year gap between design and completion of the new lines meant that by the time the lines were built, community expansions had rendered the plans outdated; consequently, some sections of villages ended up not benefitting from the new lines. TANESCO staff reported, "People with new houses couldn't be connected. The project did not cover all areas in the targeted area. People who were told that they would be connected, were not connected." This could be related to lack of local engagement during the design stage as well as insufficient communication about evolving plans for the location of the lines.

### d. The resettlement and compensation process lacked adequate coordination

Africare identified the corridor of impact and facilitated cash compensation for about 7,000 households in the regions of Morogoro, Tanga, Iringa, Mbeya, Dodoma and Mwanza (Africare 2014). MCA-T respondents indicated that Africare visited the districts and villages after ESBI's planning of line placement. However, Africare did not have accurate maps of the route of the proposed power lines. Subsequently, ESBI identified the coordinates and demarcated the route using differential global positioning system (GPS) units, and also placed beacons in some locations. Africare returned to the districts, but they used hand-held devices that provide accuracy within 15 meters (rather than the differential GPS coordinates, which provide accuracy to about 10 centimeters). Thus, in areas where beacons were not placed, Africare could only estimate where the poles would go rather than identify exact locations. TANESCO staff noted that the lack of good information about line placement resulted in overcompensation, under-compensation, and, in some communities, the wrongful compensation of households. Some respondents recommended that one organization—with adequate capacity—should be responsible for the design, valuation, and compensation of households affected by the infrastructure development. Most importantly, in the future, the valuation should not proceed without accurate details on the proposed route measured using differential GPS units.

### e. The implementation schedule was challenging and may have discouraged corrective actions during implementation

MCA-T and TANESCO respondents noted a number of challenges to meeting the construction schedule. A strike by service providers who ferried construction tools and materials by boat delayed materials and supplies; some materials, such as electricity poles procured from South Africa, were substandard and the contractors had to reorder and wait for the materials; one contractor's financial constraints delayed materials procurement, and its capacity constraints delayed construction; and there were unavoidable challenges arising from construction during the rainy season and in mountainous terrain that slowed construction.

Sometimes meeting the demanding schedule overrode oversight and corrective actions. For example, several informants noted that TANESCO was supposed to verify the quality of materials and supplies before purchase, but this did not happen consistently due to lack of sufficient staff and the tight schedule. Also, TANESCO respondents suggested that sometimes local engineers knew that decisions being made would have negative implications that would have to be addressed later. MCC recognized the issue in a recent report (MCC 2013b) as they noted:

> MCC and/or MCA-Tanzania often wanted to enforce or encourage action on the part of a contractor but found that the existing tools and options within MCC's standard bidding documents were limited. Ultimately, a supervising engineer could issue a stop-work order to a contractor to force contractual compliance, but given the fixed five-year time period for compact implementation and the general need for steady project progress, both engineers and MCC/MCA-Tanzania were sometimes hesitant to take this action. There is a need for a greater variety of more flexible tools to incentivize good industry practices without putting timely completion at risk.

### f. A shortage of materials affected installation of connections

After the line construction was completed, TANESCO installed connections to end users. Several respondents at TANESCO and MCA-T noted that TANESCO ran short of materials and supplies for these installations in some regions. For example, they ran short of poles, drop-out fuses, earth rods, and cables, as well as ancillary materials, including application forms and mounting brackets.[9] In addition, TANESCO did not have the resources to purchase all the materials needed. In some locations, MCA-T gave materials to TANESCO to help fill the gaps; however, these parts were often unsuitable, given the materials used by the international contractors. For example, new technology was used for MCC lines (such as ABC [Area Bundles Conductor]), which required different connectors than what TANESCO had used previously, and TANESCO struggled to obtain these parts. As new technology was introduced, there appears to have been inadequate pre-planning about the materials that would need to be available at TANESCO. Ultimately, a lack of service materials may have affected the number of connections that could be made; this may continue to be a challenge for TANESCO in the future.

## 3. Sustainability of electricity infrastructure

Respondents noted the need for maintenance to ensure that the new infrastructure reaches its lifespan. For instance, poles must be cleaned, trees must be trimmed or cut down, and lines must be maintained and repaired. TANESCO is responsible for ongoing maintenance. Respondents also described how infrastructure sustainability depends upon TANESCO's ability to upgrade the work done by project contractors. For example, one respondent described how TANESCO also needs to install "switches and isolators, because contractors did not install isolation flex switches, which should be installed every 10 to 20 km so that repairs can be made without

[9] When houses were low to the ground, a mounting bracket was needed to raise the height of the wire so it would not hang too low.

shutting off the entire length of the line. TANESCO will need to install jumpers, but this is costly." Another respondent explained that transformers needed to be installed:

> A transformer of a certain size and capacity was needed, but if it had not been ordered correctly, a different one was put in as an alternative so people could get electricity, but now changes are underway to replace them. We are still rectifying these problems. Sometimes we have to move poles if they were put in wrong.

Maintenance of the extended electricity distribution grid will be a challenge given that "the number of connections has increased, but the infrastructure to support them is [largely] the same." Nevertheless, to maintain the new lines, respondents observed that TANESCO needs a plan for its maintenance activities that specifies resource requirements, such as the number of main and satellite offices, adequate staffing with the requisite expertise, materials and supplies, tools and equipment, and vehicles. According to a MCA-T respondent, TANESCO plans to hire more technicians and electricians, and Tanzania has a vocational training center to train professionals for TANESCO positions. Also, as part of the MCC project, MCA-T provided TANESCO with technical assistance and 14 bucket trucks (insulated truck mounted mobile elevated work platform) to use for maintenance of the new distribution lines and substations. However, TANESCO staff reported that they need additional vehicles given the broad extension of the electricity infrastructure.

Respondents' reported varying challenges to maintenance by location because the network size varies across regions. For example, TANESCO respondents from Tanga were more likely to report that the lines are new and good as well as cheaper and easier to care for than old lines. TANESCO respondents from larger, mountainous areas were concerned about the distances that will have to be covered to maintain the lines. One TANESCO respondent at a district office explained that "if a pole falls 86 km away, we must travel 172 km in total to assess the damage and make the repair. There will be no payment, but we have to fix it." Another respondent explained: "This project will not benefit TANESCO financially. We provide a service. It costs more than 35,000 TZS to install service lines and meters. People mostly use electricity for lighting, so they will have low bills. There is no cost recovery."

Unauthorized connections in the T&D communities might damage infrastructure (for example, causing fires or system overload) as well as cause TANESCO to lose revenue. Neither the community leader nor the qualitative data collectors observed any illegal connections in the study communities. Most respondents in our interviews and focus group discussions said they had not witnessed or heard about illegal connections, although several respondents said that they had seen households with illegal connections to electricity. Respondents thought illegal connections were uncommon because people feared getting caught and paying a fine, and that illegal connections could lead to fires or electrocution. However, they noted that there were still few people who knew how to split the wires so that households or businesses could connect illegally, and as people learn how to do this, the frequency of these illegal connections may increase. As long as TANESCO is able to dismantle any unauthorized connections that emerge, it will help sustain the infrastructure built under the T&D activity.

## C. FS Initiative: implementation successes and challenges

Despite challenges to implementing the FS initiative in the selected communities, the low-cost connections it offered enabled households and businesses to connect to the electric grid.

### 1. Project implementation and successes

The FS initiative, which was developed in partnership with MCC, MCA-T, and TANESCO, tested an approach to reducing financial barriers to connecting to grid electricity. For the initiative, 29 communities were randomly selected from 178 communities that were receiving MCC-funded T&D lines. Camco was contracted to inform the selected communities about the low-cost connections available on a first-come, first-served basis. Camco staff reached out to each selected community four to five separate times to explain the process for taking advantage of the low-cost connection offer, announce the offer end date (community members had 60 to 90 days to apply), and visit households to stimulate interest. The application process for an FS-covered connection was the same as for a standard connection. It required a customer to make at least two trips to the district TANESCO office: once to submit the connection application form and then a second time, after TANESCO verified the suitability of the premises for a connection, to pay the connection fee.

During the FS initiative, 1,814 customer connections were made, many of which might not otherwise have occurred, representing about 31 percent of the available low-cost connections. Even though uptake of the program was lower than anticipated, there was broad interest in more-affordable connections to the electric grid. Respondents from communities and TANESCO expressed concerns that the coverage for the FS initiative was limited. Many respondents felt as though a program to reduce barriers to the poor should be available to more villages as they noted that members of nearby communities were interested in the low-cost connections.[10] Even though fewer connections were made than anticipated, additional residents, businesses, and public facilities in those villages expressed interest in connecting to the MCC lines. These households might have been able to connect had the low-cost connection offer been made available for a longer period of time. Nevertheless, respondents who connected to the grid reported satisfaction with their connection and appreciation for the opportunity to connect.

### 2. Implementation challenges

Respondents identified significant challenges to implementing the FS initiative, including TANESCO capacity constraints, insufficient communication of the application process to communities, and limited communication among contractors. Moreover, even with the subsidy, connection costs and wiring costs were still high and the application period was too short for many households to save enough money to get connected. These findings are consistent with Camco's reported lessons learned from implementing the communication campaign for the FS initiative.

[10] The design of the FS initiative included an option for offering low-cost connections to additional communities in a second round of the initiative in the event the first round did not exhaust all available connections. Although connections were indeed left over after the first round, the second-round option was not exercised, primarily due to lack of time available to implement a second round after the end of the Tanzania compact in September 2013.

### a. With limited capacity, it was challenging for TANESCO local offices to support FS implementation

Camco often visited communities on its own, even though TANESCO was needed to help explain the project. TANESCO did not have sufficient staffing to both respond to existing customers' needs as well as support the FS application and connection process. In addition, TANESCO's limited transport capacity meant that staff often did not accompany Camco on field activities. According to TANESCO, "Camco often went straight to the field without passing by TANESCO." TANESCO and other respondents reported that relationships with Camco were fine, but that Camco did not always communicate with TANESCO.

Finally, once customers were ready to connect through the FS initiative, the shortage of ancillary materials (such as application forms and mounting brackets) led to delays in connecting customers.

### b. Despite four to five visits to each community by Camco, the long process of getting a connection may have left some community members insufficiently informed

Leaders and members of the study communities explained that a lack of communication and community sensitization limited the number of low-cost connections. Despite the five visits to each community, many community members did not feel the campaign had informed them about the process and they did not understand the connection process clearly, which was indeed lengthy and involved several steps: internal wiring of the premises, obtaining an application form, submitting a completed application, waiting for TANESCO to survey the premises and determine suitability for a connection, paying the connection fee after TANESCO approval for a connection, and then waiting for installation of the service line and meter and for TANESCO staff to switch on the connection. Camco also noted in their implementation report that conducting additional public meetings could have sustained the initial enthusiasm among community members and provided more opportunities to answer community members' questions.

### c. The offer of reduced connection fee notwithstanding, other costs and timing of the FS offer still presented barriers to connecting to the grid

Internal wiring of houses or buildings to be connected to the grid required significant expenses, often equal to or greater than the standard connection fee (Chaplin et al. 2012).[11] Some community members did not trust the low-cost connection offer—that the lines would be built and that they could actually connect to electricity paying the lower connection fee—until they saw others actually getting connected. A community leader explained that people reported that they did not take the initial steps to connect because "they did not believe it would happen [low-cost electrification] so they delayed in wiring their houses. They did not save for wiring."

[11] Ready boards provide a low-cost alternative to wiring a house, but limit use of electricity to perhaps a few light bulbs. Ready boards are small electrical connection units wired with several socket outlets, and cost about 45,000 TZS. They are intended for single-phase 230-voltage service connections and are not suitable for use in homes or buildings with more than two rooms. Ready boards do not require wiring throughout the home and its associated costs, but do require service lines and meters. However, some community members did not want to bear the cost of getting a new electricity connection only to get limited use out of it, whereas others reported that they did not have enough information about ready boards to consider using them.

Residents of some communities commented that the FS enrollment period did not coincide with the harvest season. As a result, many households were cash constrained. Furthermore, community leaders noted that the two- to three-month window of time for applying for a low-cost connection was too short for some households to save enough to pay for both the wiring and the connection fee. Thus, many community members could not afford the connections even at the discounted rates, despite a strong desire to connect. They suggested that a longer application period would have increased applications for the low-cost connections.

#### d. Community leaders explained that the proximity of FS and non-FS communities posed a social problem

One leader explained that the FS initiative is "perceived as a political project and has caused divisions in society" because of perceived inequity and unfairness. For example, two neighboring communities can be very similar, but one benefited from the FS initiative while the other did not; this "created anger and jealousy" between communities, and some non-FS community members asserted that TANESCO was overcharging when in fact they were being charged the standard connection fee without the low-cost connection offer. Public communication of the way FS communities had been selected was needed in the non-FS communities to ensure that they understood that the selection process was fair.

### 3. Sustainability

The FS initiative was not designed to be sustainable. Rather, it was designed to help address the fact that many households might not be able to connect in the short run because of cash constraints.[12] Although the FS initiative was not designed to be sustainable, it could inform sustainability of a future subsidy program for connection costs. Such programs could be sustainable if international development partners, the Government of Tanzania, or TANESCO were interested in offering subsidies. However, there is growing agreement that energy subsidy programs may not be optimal, especially if these programs involve the use of fossil fuels (IMF 2013).

Even if offering subsidies for connection costs is not a policy option, the FS initiative could inform the sustainability of revenue-neutral approaches to covering overall costs of producing energy by reducing connection costs and increasing usage fees (some of which have likely been considered by the Government of Tanzania). Although the FS initiative does not test this type of policy directly, it does test the impacts of lowering connection costs without raising fees. Since such impacts are likely larger than revenue-neutral changes would be, the FS can be considered as providing an upper bound estimate of the potential impact on connection rates of a revenue-neutral policy that used the same reduction in connection fees. Given the generally positive reaction to the reduced connection costs through the FS initiative reflected in the qualitative data, key stakeholders, such as TANESCO and EWURA, may find it worthwhile to test a revenue-neutral change in connection costs and tariff.

[12] The lowering of connection costs was expected to increase the number of connected households in the study communities and thereby improve the prospect for the evaluation being able to assess the effects of electrification on various household outcomes, including those related to energy sources and expenditures, education, health, time use, and income-generating activities.

# IV. STAKEHOLDER PERCEPTIONS OF OUTCOMES AFFECTED BY ELECTRIFICATION

Stakeholder perceptions of outcomes related to improved access to electricity are a central evaluation issue. To measure these outcomes, we obtained information from direct observations, community leaders, and focus group discussions (FGDs) with households. We also interviewed business owners and staff at schools and health facilities.

Respondents noted potential effects of increased access across many domains. Many people said that connection costs were high, but they had less consistent views on usage fees. Some respondents suggested electricity was much cheaper than alternative forms of fuel and others noted large increases in their energy bills, especially if they tried to use high-consumption appliances like refrigerators, stoves, and even irons. Household and business respondents reported some economic benefits, For example, lights could be used to increase hours of operations and help poultry production, and refrigerators could be used to cool drinks and store food. Effects on business profits were less clear, perhaps because of competition with other firms. Household and school respondents mentioned benefits for education, in particular students being able to study at night. Health impacts seemed plausible given discussions by many types of respondents about the importance of light when serving patients and of refrigeration for storing medicines. Respondents also noted that access to electricity could increase safety. For example, lights at night could help reduce crime and offer protection from animals, and using electric lights instead of candles and kerosene lamps could reduce the likelihood of fires and respiratory problems. Household respondents mentioned many potential benefits of electricity at home, especially for entertainment (lights for reading, TV, and radio), communication (cell phones), family relationships, and chores (electric water heater, irons). Furthermore, more services (such as cell phone charging) became available locally; households with electricity no longer have to wait in line for cell phone charging or walk long distances to buy kerosene, so people have more time for other activities. In combination, all of these factors may encourage immigration to electrified communities, particularly for business owners. Finally, the reported benefits of electrification by gender were mixed, with some respondents suggesting one gender might benefit more than the other and others suggesting that everyone benefits from electricity.

## A. Community characteristics

To provide context for our findings, field staff collected background information from the community leader and by direct observation. Although knowledgeable, the community leaders could not always provide information on all community characteristics. In many cases, however, interviewers were able to observe important outcomes directly. Information obtained from both of these sources is presented in Table IV.1. We discuss the background information about the communities here, and then refer back to them in subsequent sections of this chapter.

## Table IV.1. Characteristics of communities in the qualitative study

| Characteristic | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Region | Dodoma | Dodoma | Iringa | Iringa | Mwanza | Mwanza | Tanga | Tanga |
| Urban/rural | Rural | Urban | Rural | Urban | Rural | Urban | Urban | Rural |
| FS community | No | Yes | Yes | No | No | Yes | No | Yes |
| Connected to non-MCC lines | Yes | No | No | No | No | No | Yes | Yes |
| Economic activities | Agriculture | Small kiosks, food vending | Agriculture | Agriculture | Agriculture | Fish selling | Fishing | Agriculture |
| Key geographic features | Hilly, covered by trees and forests | Surrounded by mountains | Near mountain and a river in rainy season | Surrounded by mountains | Unknown | By Lake Victoria. mountainous | Surrounded by small hills and river, near to city | Surrounded by small mountains |
| Common energy sources before grid electricity | Charcoal, firewood, kerosene, batteries, solar panels, | Charcoal kerosene, firewood, batteries | Car batteries, charcoal, kerosene, gas, electricity, few using firewood | Car batteries, charcoal, kerosene, gas, electricity, few using firewood | Generators, solar panel, firewood and to a lesser extent charcoal | Generators, solar panel, charcoal, firewood | Car batteries, kerosene, charcoal, few using firewood | Kerosene, charcoal, few using firewood |
| Number of households | 220 | 308 | 210 | 521 | 225 | 1,269 | 209 | 114 |
| Households connected | 30 | 68 | Unknown | Unknown | 17 | 196 | 102 | 9 |
| Households within 30 meters of new lines | 100 | 70 | 43 | 54 [a] | 70 [b] | 634 | 128 | 46 |
| Number of Businesses [c] | 15 | 10 | 26 | 17 | 30 | 300 | 17 | 14 |
| Businesses connected | 6 | 7 | Unknown | Unknown | 5 | 40 | Unknown | 3 |
| Types of businesses | No market, kiosks and home businesses | Small kiosks, milling, food vendors, tailoring, local brew bars | Small kiosks, cell phone charging, food vending, local brew bar | Small kiosks, men's salon, food vending, local brew bar | Cell charging kiosks, small groceries | 200 licensed, 100 unlicensed businesses | Kiosks, men's salon, food vendors, bars, video libraries, food vending | 8 shops, 4 food vendors, one maize mill and one male salon |
| Types of new businesses | Maize mills, ice cream selling, charging of phones | Men's salon, maize mills, ice cream, phone charging | Unknown | Unknown | Welding workshops, salons, charging of phones | Welding workshops, salons, charging of phones | Unknown | Unknown |

**TABLE IV.1** *(continued)*

| Characteristic | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Prevailing home structure | Most houses made of hard mud soil, few are connected | Most houses made of hard mud soil, few are connected | Aluminum and brick, looks like a modern town | Aluminum and brick (99%), looks like a modern town | Thatched and brick | Thatched and brick | Most houses thatched, a few brick and aluminum | Houses have aluminum roofs and brick walls |
| Has health facility | No, use neighboring dispensary | No, use neighboring health center | No, use neighboring dispensary | No, use neighboring dispensary | Dispensary within 30 M of a line but not electrified | Dispensary within 30 M of a line but not electrified | No, use neighboring health center | Private dispensary (connected), most use district hospital in town |
| Has school | Yes | Yes | Yes | No | Yes, line to school but not connected | Yes | No | Yes, lines near teachers' offices but not connected |
| School electrified | Yes, by REA | Teachers' houses | Yes | NA | No | Teachers' houses | NA | No |
| Water source | Public tap, new water source opening, uses MCC lines | Public tap, water collected from mountain, stored in tank | Community has piped water, 90% of households connected | Community has piped water, 90% of households connected | Water holes and from small rivers that flow from nearby hills | Water directly from the lake both for cooking and drinking | Community has piped water, 45% of households connected | Well water, school has a rainwater harvesting system |
| Other public buildings | Local government rents a building | None | Has government office, electrified | Leader uses his home as office, electrified | Local leaders use organization building | Local government office | Electrified community leader office | Local government chairman's office not electrified |
| Road | One main road, hard, rough dirt | Main road, very rough | Two main roads, one paved | Two main roads, one paved | Rough, dirt road | Rough busy dirt road, passable in dry season. | Two rough dirt roads | Three roads: one paved, others rough, dirt roads |
| Public lighting | No | No | No | No | No | No | No | No |
| Cell phone service | None | Some areas | Yes | Unknown | Unknown, but has cell charging shops | Unknown, but has cell charging shops | Unknown | Unknown |
| Broken lines | No | No | No | No | No | No | No | No |
| Illegal connections | No | No | No | No | No | No | No | No |

[a]Includes businesses.
[b]Response was "fewer than 70."
[c]Businesses exclude agriculture.

As discussed in Chapter II, the eight study locations were selected to include one urban and one rural community in each of four regions, and one FS and one non-FS community in each region. Most locations were not connected to grid electricity before the MCC project, although one location accessed electricity through a project funded by the Rural Energy Agency (REA) and two others were connected.[13]

Businesses can benefit in important ways from access to electricity. However, most of the study locations had 30 or fewer businesses, except again for the urban community in Mwanza where there were 300 businesses.[14] Types of businesses include maize mills or milling machines, hair salons, food vendors, cell phone charging shops, and bars. In four of the communities, community leaders described new businesses starting up after electrification, including welding shops, ice cream sellers, new phone charging stations, and additional milling machines and maize mills.

We talked to staff at health care facilities because of the substantial potential for improving health care quality offered by electrification. However, five of the eight communities had no health dispensary, health center, or hospital. Two communities had health dispensaries, which the MCC lines passed close to, but the facilities were not connected. The eighth community had a private, electrified dispensary. However, many people considered the private dispensary too expensive, so they tended to use the neighboring public hospital.[15]

Only two schools in these communities were electrified during the project; hence, discussions of effects by six of the eight respondents at the schools are mostly about potential effects. Two study communities did not have schools, whereas two communities had schools in which the teachers' houses but not the classrooms were electrified. Another two communities had lines passing close by or within 30 meters of the schools, but they were not electrified. One of the two connected schools was electrified through an REA project.[16]

Other infrastructure in the study locations was limited. The study communities had between one and three roads with no more than one paved road and most frequently hard-packed dirt roads. Some of the study communities had cell phone coverage; at least two had only minimal if

[13] REA is an autonomous body under the Ministry of Energy and Minerals. It is designed to improve access to modern energy services in rural parts of mainland Tanzania. It does not provide energy services directly, but helps to improve access in other ways, for example by funding the building of lines.

[14] The ratio of businesses to households is quite low (about 0.14). In contrast, in our baseline survey we found a ratio of 0.70 businesses per household. The difference is likely due in part to how small farms were treated. No small farms were listed by the qualitative data collection team in spite of the fact that the team estimated that over 75 percent of community members were involved in farming. The team did not put any restrictions on what would qualify as a small business, but relied on community leaders to identify the businesses. It appears that community leaders did not consider farms to be businesses, perhaps because many of the small farmers keep most of their produce for home consumption.

[15] Note that because five study communities did not have health facilities, we interviewed respondents from health facilities in replacement communities (that is, other communities with MCC lines sampled by Mathematica).

[16] In study communities that did not have a school, we interviewed the headmaster from a nearby community (that is, another community with MCC lines included in Mathematica's evaluation).

any coverage. None of the study communities had public lighting. Neither the community leader nor the interviewers observed downed or broken lines or illegal connections in any of the study communities.

## B. Connecting to the electric grid

The electrification project can only improve people's lives if they connect to the grid. Understanding why people do not connect—and conversely, why they do—may provide useful information for future projects. Our discussion focuses on the connection process (in particular, the entities that made the connections: TANESCO and the technicians installing household wiring), the cost of connecting, and the quality of the resulting electricity.

In the eight study communities, we estimate that only about 40 percent of the households within 30 meters of the new lines ended up connecting and that only about 18 percent of all households and 17 percent of all businesses in these communities connected.[17] Our data also suggest low connection rates for health facilities; among those in the study communities, only one out of three facilities was electrified. Four of the six schools in the study areas were connected to the grid (including those with connected teachers' houses). Government offices were also more likely to connect: three of the four were electrified.[18] The situation was somewhat better in the FS communities as three of four schools were connected (including teachers' houses) and one of the two health facilities. Low-cost connections were specifically set aside for 100 government institutions under the FS, most of which were for health facilities, schools, or water systems.[19]

### 1. Connection process

TANESCO's human and transportation resource limitations affected its capacity to survey areas, process applications, inspect wiring, install service lines and meters, and make the final connections. TANESCO could not reach all applicants for grid electricity and some customers may have faced long delays. Furthermore, TANESCO often ran out of materials, which made connections difficult or impossible or delayed them.

**Reasons for households not connecting.** In describing their reasons for not connecting to the grid, respondents mentioned lack of fairness, confusion around how to apply, and a lack of awareness in some communities of the project timeline that resulted in delayed applications. Also, if buildings were more than 30 meters from low-voltage lines, the consumers could not connect without purchasing poles to extend the lines to the building. This (approximately) 30-

[17] These numbers are based on data from the communities that provided sufficient information for these calculations.

[18] Three other communities had government offices but we did not find out if those were electrified.

[19] More precisely, 166 connections were set aside for 100 such government institutions. These included 49 health facilities, 28 schools (often the teachers' homes), 16 water facilities, 3 offices, 2 ginneries, one prison, and one hostel. Interestingly, the one school that was electrified in an FS community was private, so it may not have benefited from the FS, although there was nothing to stop it from applying on its own. Our data only show one community whose water system was going to be electrified, but we cannot identify which communities clearly lacked an electrified water source, since some of the other locales may have had water sources located too far from the community for the observers to easily make this determination.

meter rule presented a serious obstacle to connecting. Other obstacles included low-quality housing and building materials. For example, according to TANESCO, houses and buildings made of mud, sticks, and thatch (rather than timber with metal roofs) usually cannot support the hooks and brackets needed to connect wires. Buildings with low roofs require extra brackets that TANESCO often did not have in stock. TANESCO's material shortages, including conductors, earth rods, and poles, also presented obstacles to connecting. Further, electric lines are not supposed to hang directly above buildings, so houses built close together could not be connected if there was insufficient space between them to place electricity lines.

Some women reported that the process was not fair. For example, one said:

> I mean, most of the people in our area are [political party] members, and this is very clear. On the other side, the majority of the people are [other political party] members. Therefore, they can favor these members against those so that we can continue to live in darkness as if we are in a pit. We are being humiliated as if we are not Tanzanians. The government should consider us and make this matter clear.

Community leaders described situations in which jealous neighbors created obstacles to others connecting to the grid; for example, some household owners who could not afford electricity would not allow lines to pass by their homes and property to connect adjacent households.

**Reasons for health facilities not connecting.** Several health facility respondents hypothesized that their facility was not connected because transformers were not powerful enough to reach them or because TANESCO ran out of poles. Two respondents explained that they believed the facility was not connected because it was located too far from the new MCC lines: "I think the main reason is the fact that our health center is located far away from the main road which leads to our ward headquarters. Apart from this reason, I cannot lie. I do not know any other reasons."

**Satisfaction with the connection process.** Household FGD and IGA respondents who connected described their satisfaction or dissatisfaction, and reported on the fairness of the process. Customer satisfaction with the connection process was greater when the waits were short and when they did not have problems getting their homes and businesses wired. A woman from an FGD reported that the wait was not too long: "When the poles were installed, we made the payments, and we waited. It was not too long when they came and connected us; they installed meters, and we started using electricity."

Several male FGD participants, particularly in the FS communities, agreed that the process went well and that TANESCO provided helpful advice and instruction. Men in an FS community explained:

> We were given some information by a person on motorcycle, informing us that there is an issue of electricity. We received the message with joy, and the activities were started. They started erecting the electricity poles…it was also a period for registration. They started to identify who was ready to be

> connected. ... People were given the forms and were asked to complete them and to pay for the form. After making the payment, then they would come to connect us to electricity grid.
>
> TANESCO came and emphasized so much on the importance of using recognized technicians who are known and recognized by TANESCO for the purposes of wiring. There are some people who used some other unrecognized technicians. They were delayed in getting connected, while others were connected so quickly. In the end, we came to realize that what was insisted by TANESCO was quite true.

One IGA owner in a FS community believed the process was implemented fairly:

> I didn't see any problem because we had a public meeting with the leaders from TANESCO. They educated us and told us about the measurements to be used and the nature of wires which will be used in the meters. … We were educated; you just tell the electrician, and he will tell you the cost of the kind of wire to be used and the length. My electrician was honest about the measurements I had, and I did not experience any problem with that.

However, a number of respondents reported that the main challenge to connecting was the long wait to get connected. One business owner explained, "I had prepared myself as I finished wiring in February so I was waiting for them [TANESCO], and it took me two to three months to get connected; at that time two people had already been connected." Another respondent said, "….why does it take so long to get connected even if one has paid all the costs by selling cows and his other resources? To our surprise, you find an officer coming from […] to connect only one or two clients. What is happening to TANESCO?"

Respondents who were less satisfied frequently reported problems with the quality of work by local electricians who did the wiring. For example, one woman explained: "They [electricians] did the wiring erroneously, and thus I was forced to call another electrician to redo the work, and I had to incur extra expenses to pay him."

Despite these barriers to connecting, nearly all business owners felt that accessing grid electricity was important to their business: one respondent explained his unconnected business compared to connected businesses:

> Let me talk about myself as a case study of those traders who are not connected to the national electricity grid. I get many disadvantages since I incur more expenses when I use diesel than people who use electricity. The other disadvantage that I get is that during the night, the premises of the traders who are connected to the national grid electricity shine while my business area remains in total darkness and solitude. This makes me look hopeless during that time.

## 2. Costs of connecting

Technical and logistical challenges to connecting communities help explain why there were fewer connections than expected (supply side limitations); however, there were also fewer applications for connections than expected for demand side reasons, primarily the cost of connecting. Respondents who were not connected explained that they could not afford the application and connection fees, and the costs of wiring the home or building. In some FS locations, citizens wanted a subsidy for the wiring in addition to reduced connection costs.

**Household and business connections.** Connecting to the grid requires a large up-front investment. Although many households spend more on energy when using kerosene, diesel, and batteries compared to the usage cost of grid electricity, these expenses occur in frequent smaller purchases and do not require the up-front investment needed for an electric connection and wiring. Many poor households have seasonal employment and income from agriculture or fishing. Thus, some agrarian households have little income during the rainy season and can only pay for larger expenses during the harvest season. Likewise, fishermen often have less income in the first part of the year compared to the second part.

Limited and seasonal household incomes also impact schools and health facilities. In schools that did connect, headmasters reported that school connection fees were usually covered by family contributions. Similarly, contributions from communities have often been used to cover connection costs for health facilities. However, respondents perceived that citizens could not afford contributions to schools and health centers during the project implementation phase because of the season, a persisting drought that affected agricultural production, and their own connection costs.

In earlier discussions with staff at MCA-T, we were told that the costs of wiring are often over 300,000 TZS (Chaplin et al. 2012). However, one business owner reported that the high cost of wiring was a barrier after being asked to pay only 70,000 TZS:

> You may purchase the wire and later the technician may say that you need to add more wires. You might have used about 50,000 TZS and you might have finished all the money. Then you need to ask him to wait for few days so that you can get organized and have 20,000 TZS more. That is why you may find someone who has done the wiring only in one room because TANESCO used to say that once they have passed, they never come back once again. So people were afraid to miss it all, so they decided to do wiring in only one room and connect.

On a related note, a male FGD participant from a rural community reported a connection payment that appeared to include an extra charge that does not align with normal TANESCO fees: “I have a question. Why have the connection costs not been consistent? We used to pay 177,000 TZS, but now the price has risen to 200,000 regardless of the distance when counted within 30 meters….” This respondent’s concern appears valid because as of September 21, 2014, the TANESCO website still listed a connection cost of 177,000 TZS for a connection within 30 meters (that is, without an extra pole) in a rural area. Charges to connect with a pole or in an urban area were far more than the 200,000 TZS, so that the extra 23,000 TZS cannot be

explained by the cost of a pole. This suggests that this person may have been overcharged for the connection.

**Schools.** School respondents that were not connected to grid electricity explained that the costs of wiring, applying for electricity, and the monthly unit costs were a barrier. The headmasters we interviewed explained that their schools could not afford desks, books, and chalk, let alone electricity. Few schools had lighting and so only opened during the day.[20] Several unconnected schools explained that they were too far from the new power lines to connect. These schools and the remaining schools explained that financial constraints prevented them from accessing electricity. One headmaster at a school that had not yet connected explained that accessing electricity was a long-term goal.

The connected schools explained how they achieved it. One school explained that they just felt it was time to get electricity, so the staff pulled together to pay the connection costs when they did not get parental support. Some schools that connected to the grid phased in the connections rather than connecting all buildings at once: "Yes, but the problem was money, so we didn't connect all of our school buildings (classes)."

Although the connection costs, including wiring school buildings and purchasing poles, were prohibitive, the monthly usage costs were more easily affordable and could be passed on to families:

> Currently all services and related costs are provided for by parents. Water expenses—for drinking, cooking porridge, and also for toilets, as well as soap inside the toilets—are incurred by parents. Parents contribute every month, and also for the electricity. Since the initial process has started, through the school committee, we will involve them. We will manage.
>
> The school will afford by budgeting whatever little is collected as school fees. The use of electricity in school will not be higher like that of the industry. I don't think such costs can be unaffordable.

**Health facilities.** Few health facilities were connected to the grid, and the cost of connecting was once again the major barrier. Health facility respondents reported that they had been promised electricity by the government; however, they continued to wait for officials to take the steps necessary to connect the health centers. One respondent explained: "No, the electricity has just passed in our area, and there are electricity poles only. We are not connected due to our poor financial position."

Respondents reported that, once connected, the government would have to help with paying the usage costs. The health facilities could likely cover the usage costs by using patient fees or money from the National Community Health Foundation, which collects mandatory contributions. Respondents felt that grid electricity was affordable compared to the cost of kerosene and the cost of gas, which was used to run refrigerators. Once they connected to grid

[20] They used firewood and charcoal for cooking. Students were expected to bring firewood to one school and teachers contributed money to purchase charcoal for cooking porridge at another school.

electricity, they expected reduced expenditures on kerosene, gas, and watchmen. They also expected additional patients. The savings and increased fees would help to cover the monthly unit costs. One respondent explained:

> This health facility charges patients. The total amount of the collected money is taken to the district medical officer and then to the ministry for further ministerial uses and plans. The remaining amount of money is brought back here for the facility expenditures. So, we could use that amount of money to cover the electricity costs.

Respondents in the health facilities wanted to be connected to grid electricity and were disappointed that they were not yet connected.[21]

> Around the time the project came here, we had already been promised by the president when he was launching the electricity program that our institution together with the primary school will get electricity on that same week, but unfortunately the wiring was only in one ward. Then they completely disappeared since last year. Still now we are not connected to electricity**.**

> We don't have a big reason for not joining. We have applied for it at the municipal, but we are constantly being told that the budget is not enough, government issues as you know them, but we would like be connected, and we have applied for it, but there is no money.

> For sure I do not know why this health facility is not yet connected with electricity, though electricity poles pass by our neighbors' houses. Our neighbors, especially those who are well-off, have taken advantage of the electricity project like this. The nearby town has access to electricity, but the problem is that we are not yet connected, and we do not know why it is like that.

**Usage costs versus initial costs.** Many respondents, in both FS and non-FS communities, did not appear to understand what the usage costs of using electricity would be after the initial expense of connecting and wiring. For example, they had not understood how much electricity large appliances like refrigerators would use and the high associated costs. Thus, several respondents described their disappointment with the usage costs of electricity:

> The electricity project does not meet the planned objectives. The electricity is intended for people with low income, and we clapped our hands to rejoice for that, but instead this electricity is expensive as if it is for the bosses rather than the poor. I bought a refrigerator for development, but to be honest I failed to

[21] One health facility was identified as private. None of the other health facilities or schools was clearly labeled as public or private. However, even if they were private, they were still allowed to use the FS—they just did not have a specific low-cost connection set aside. Since very few communities ran out of connections, this suggests that even the private institutions could have benefited.

> use it because using electricity costs more than 17,000 TZS, and I use TV, radio, and bulbs for light.
>
> This electricity is intended to benefit us low-income people…but I am surprised…because we were told this electricity is cheap and for that we agreed to pay all the costs, and we got connected, but the service is expensive. When it comes to bills, for example, personally I bought 32,000 TZS electricity units in December last year. In mid-April I bought another 10,000 TZS worth of units, but I was told I had to pay more. I gave them 20,000 TZS. Again I was told to pay more. When I asked the reason, it was because there is a monthly service line charge of 7,000 TZS, so for those four months I have to pay 28,000 TZS, then buy new electricity units.
>
> What kind of electricity is this? Is it there to help us or torture us because this is not electricity for the poor? It has become electricity to be used by people of high class, not us poor people. I paid 28,000 TZS, then bought units for 12,000 TZS and stayed like a month. I went again to pay and was told 10,000 TZS for units was insufficient. I had to buy 15,000 TZS. I said to myself: "This kind of electricity is annoying to us low-income people. It does not help us at all." I have a fridge I no longer use as I have seen its costs are high. The electricity…honestly it is not helping us.

Nevertheless, most respondents found the usage costs of grid electricity *more* affordable than other energy sources. For example, one household FGD respondent said, "compared to battery, I could use up to 40,000 TZS at the end of month but for now am paying 17,000 TZS per month." Similarly, a school respondent said, "A good example is that we were using a generator that needed three liters from 8 p.m. to 11 p.m. A liter is sold at 2,500 TZS, so you needed 7,500 TZS a day. Now you just need 1,000 TZS for week. Don't you see a relief?" And another household FGD respondent said:

> There is a big difference, as the use of electricity has enabled us to save money, and it has simplified our lives. For instance, you may buy the electricity to use for a month just for 5,000 TZS and you may get your 41 electricity units that you might use for the whole month. In using kerosene, we could spend up to 20,000 TZS per month to purchase that source of energy.

### 3. Quality of and satisfaction with electricity

The majority of household focus group participants reported that they were satisfied with the overall quality of electricity from the MCC lines. Although there were outages, they were not frequent. One respondent explained: "The electricity has the good quality most of the time. It does not go off frequently. It does not change into low voltage. And if it goes off, it does not come back with high voltage that could cause some problems." Although respondents agreed that power surges and fluctuations did occur, few respondents reported this was a major problem or that equipment or appliances had been ruined by surges.

Regarding the frequency of outages, respondents agreed that outages were less frequent with MCC lines compared to other lines and that outages were more common in the rainy season: "Mostly during the raining seasons, the power cuts off more frequently because the poles will be falling, and TANESCO will be busy making repairs so we just wait for them to finish, but in dry season everything is okay." It was also noted that whereas outages used to last for three or four days, they were now only a few hours long. There was, however, a concern about being charged for electricity even during outages: "The thing that I do not understand for me is that every time the electricity cuts off, the units are deducted."

Finally, community observers did not report evidence of any broken lines (Table IV.1).

## C. Economic outcomes

Connecting to the grid can directly improve economic outcomes across communities. First, grid electricity can be much cheaper than many other forms of fuel. This is supported by research we have done in the T&D communities (Chaplin et al. 2012) and by the findings of this report (Section B, above). Second, grid electricity may increase income by improving options for creating and running businesses.

To assess the potential impacts on businesses of getting grid electricity, we interviewed 40 owners of businesses or income-generating activities. These tended to be household- or kiosk-based businesses, but also included local shops. The businesses were relatively small, with few or no employees. Of the 40 business owners we interviewed, 25 were male, and 15 were female; 21 were connected to electricity, and 19 were not (Table IV.2).

**Table IV.2. Owners of businesses and income-generating activities**

| IGA owners | Connected | Not connected | Total |
|---|---|---|---|
| Male | 14 | 11 | 25 |
| Female | 7 | 8 | 15 |
| Total | 21 | 19 | 40 |

Respondents' businesses included maize mills, bars, salons, mobile phone charging stations, restaurants, retail shops, pharmacies, clothing shops, food vendors, bars, tailoring, welding, video shows/cinema, and repair shops. Some respondents owned several businesses.

Business owners reported using electricity for lighting; running refrigerators, stoves, and milling machines; welding; charging phones; playing music; and raising poultry and increasing egg production in hens. For example, some IGAs that previously sold unrefrigerated beverages had begun to sell cold beverages such as beer, sodas, and water. Business owners who did not have access to grid electricity described similar uses to which they would put electricity if they had it.

Both household FGD and business respondents mentioned increases in their chicken-raising businesses resulting from use of electricity. For example, one business respondent said, "I used

to keep 10 local chickens, but now I keep 100 because you have the techniques and tools to preserve them. It means the business is expanding."

The most common outcomes reported by IGA respondents were that connecting to electricity meant that the businesses were able to stay open longer because lighting was available or cheaper with grid electricity compared to other energy sources. For example, "The other advantage of doing business here is that I can do business till 21:00 or 22:00 as opposed to those people who do not use electricity who are forced by the situation to close their shops at 18:00 every evening." Another said, "I used to make 50,000 [TZS] a day, but that has gone up to 80,000 [TZS] a day, to 90,000 [TZS], so you can see the increase. Back then, since I used to close at 9 p.m., I would make 40 to 50 thousand [TZS]. I now close down around 10 p.m., so there is an increase in revenue in my business."

Business respondents also noted improved communication with their customers and suppliers. Phones could be charged more reliably, so communication was easier. For example, "After being connected to this electricity, I have electricity all the time, my mobile is available all the time, so when my customers want to meet me, they always call me and tell me where we can meet easily. This is quite different to the time before having the electricity."

Many businesses reported increased profits since connecting to grid electricity although several others reported decreased profits. Increased profits came from being open longer hours and selling more items such as cold drinks and ice cream, which led to more sales and more customers. Businesses that offered cell phone charging and those operating milling machines said that they could operate their business at a lower cost and stay open for longer each day. In contrast, other business owners who reported reduced profits explained that they lost business when their customers connected to the grid. For example, business owners who charged cell phones reported that some business was lost because people were charging their own phones with electricity at their homes and that the demand for certain products like batteries had decreased.

Community leaders also told us that a number of types of new businesses had emerged, such as maize mills, ice cream sellers, men's salons, cell phone charging vendors, and welding shops. These may increase employment opportunities and income, and reduce the cost of goods and services (mainly by eliminating travel costs to other towns to obtain those goods and services).

## D. Educational outcomes

Having grid electricity may affect educational outcomes if students perform better in school because they are able to study more. In fact, respondents frequently discussed how electric light allows students to study at night either at school or at home. While we did not collect data on student outcomes, several parents asserted that their children were doing better in school because they were studying more. For example, one FGD respondent said,

> In reality, I find it a bit difficult to explain the relief we have, but all the same there is, because in most cases our children, especially those who are students, were facing difficulties in their studies as they were sometimes forced to use traditional methods of lighting. Now that electricity is available, you can find that they can read anytime as they wish. One may decide to read before

> sleeping or may decide to sleep first and wake up at any time and study. I think that is also one of the advantages.

Respondents also mentioned ways in which grid electricity might change schools. We asked eight school leaders about these changes. Only two of the schools were connected, so six school leaders' responses were about potential effects of electrification. School respondents explained that if they were connected, they would use electricity for lighting to study, lighting for security, TV, printers, photocopying, cooking, and cell phone charging. They also hoped to use computers and science and lab equipment. For example, one respondent said, "We will use electricity for teaching children in the extra evening classes, especially teaching those who have little ability in their studies (slow learners); therefore, we will be able to help them, especially standard seven and four who are waiting for their national exams." A household FGD respondent also discussed benefits while at school:

> At school, pupils can now do things which are quite different as compared to what they used to do before. I can see that if they are given electricity, they can have computers which will assist them. Also at home, children are now motivated to read at home because adequate light is there. This is opposed to how the situation was before, when they were told that now time is over we have to switch off the light and go to sleep. But now [they] can wake up even at 4 a.m. and switch on the light and start reading.

## E. Health outcomes

Respondents believe that getting access to grid electricity can affect health outcomes by improving health care facilities or by making it easier to stay healthy at home or school. We focus first on the health benefits likely to accrue from having electricity in homes and schools, and second on effects accruing from improvements in health facilities.

At home, when electricity replaces other types of fuels, air pollution may be reduced, which in turn can improve lung and eye health. Electricity may produce better lighting, which may also reduce eyestrain. Similar benefits can occur at school.

Here, one household FGD respondent refers to a number of the potential health benefits of grid electricity via household use:

> I think the relief I get when using electricity is that I get adequate light unlike the dim light that I used to get. The use of electricity as opposed to the former sources of energy enable[s] me to get an adequate light that I can use for reading purposes or in order to do any activity without causing any problems to my eyes. In addition to this, the use of kerosene energy did not generate adequate light and used to produce smoke which causes flu and disturbance to the users, but the use of electricity has not been causing such disturbances to me.

Another respondent focuses more directly on the pollution-related issues in homes:

> I may say in general that the health of the community has improved due to the presence of electricity. For those who are using electricity, problems like flu are minimized because the smoke from kerosene lamps has been eradicated. Locally made lamp sometimes cause flu, there is another problem of eyes. People suffering from eye diseases have been minimized because all these are caused by smokes.

Several women explained how important it was for them to use electricity for cooking because it reduced health problems, such as smoke inhalation, caused by using firewood or kerosene for cooking. However, as noted above, cooking with electricity can be quite expensive, so it is not clear how many households will end up benefiting through changes in cooking fuel.

When used in schools, electricity may have similar health benefits. For example, one school respondent said, "We will use electricity for preserving some chemicals which are open in our first aid kit; we can preserve them in the refrigerator which will also help to preserve various things for the students and the surrounding community."

Although few of these communities had local health facilities, respondents reported visiting neighboring health facilities when necessary. We start with a discussion of outcomes for health facilities that were not connected and then discuss those that were.

The facilities that were not connected to the grid reported significant operational challenges, some of which had effects on patient well-being.[22] Some statements by health facility staff are particularly striking. For example, one respondent describes using a cell phone to help a mother give birth:

> A pregnant woman can come for the service at midnight. To assist her in delivery, we use mobile phone torch. Okay, you have successfully managed to support her on delivery, where are you going to make her rest at 2 a.m.? We have one house that we use. There is neither solar nor electricity at that house, so she also needs to use a mobile phone torch. If she has not come with those Chinese dry cells, then they have to stay in darkness till morning.

Health facility respondents who were connected to grid electricity described how they used electricity to improve health outcomes. Respondents emphasized the importance of light when treating patients at night. They also described the importance of using appropriate and sanitized medical and diagnostic equipment, and the need to refrigerate vaccines and medicines.

Community leaders also reported expecting positive impacts on health outcomes. For example, one said, "Yes, because if you go to the health center when there is a light it is easy to know what the patient is complaining about, even the nurses and patients can see each other. So they can understand someone by seeing them." Another said, "There is a new business of

[22] In addition to the solar power, kerosene, gas, and batteries, the not-connected facilities used cell phones for lighting. Respondents reported energy shortages and that high-cost energy sources, such as kerosene, meant that they required patients to bring kerosene fuel and a lantern with them to the facility when they needed treatment. Solar power was not a reliable energy source because it depended upon sunlight and they had little storage capacity.

pharmacy, so we get quick treatment of our wounds whenever we get injured, as one may rush to a pharmacy where they will put a spirit and bandage, and one may start feeling well instantly."

One potential way in which grid electricity might improve health is by increasing access to clean water; however, no respondents mentioned this. Also, the data collectors noted only one community that was using MCC lines for their water system. Most communities had piped water for at least some households. One relied on lake water and another on wells and rainwater.

## F. Safety outcomes

Electricity from the grid has the potential to improve safety. First, light at night can reduce injuries from accidents and dangerous animals, as well as crime. Second, reduced use of candles, kerosene lamps, and open cooking fires can minimize the number of accidental fires that burn down homes and businesses.

One household FGD respondent mentioned snakes: "Additionally, we can freely walk around at nights because one can avoid dangerous animals like snakes."

Communities with electricity lines now had less crime at night, according to community leaders, because robbers and thieves were thwarted by lights. Both men and women reported that new lighting around their homes and local markets reduced worries about robbers and thieves. For example, one FGD respondent said:

> The other advantage of electricity is that it has enhanced security at our home. During the night on the roads or in our courtyards, there is satisfactory security, as nowadays thieves do not come at my home frequently, as I have a dog and an electric light during the night for security purposes. Thus, the electricity has chased away theft in our rural areas as we are free from theft these days.

School leaders and health facility respondents also mentioned the potential safety benefits of grid electricity. For example one school leader said, "We have been robbed in this year, because of those rains which we had in this year, the place was very dark, and so the watchman was robbed thrice. Some school items were stolen, and up to now doors are broken and that has been reported to the police. And the police also advised us to be connected to electricity." Similarly, one health facility respondent said, "Generally, the presence of electricity enhances the security for the dispensary all the time as it has the security lights."

A number of household FGD respondents mentioned how grid electricity reduces the likelihood of a fire. One said, "Sometimes we use candles to avoid the effects of smoke. We use candles, but these candles have a lot of effects because in the family are children. We need to blow off the candle so that they [children] sleep. If you do not put off the candle, it might set the net aflame and hurt the children." Another said:

> I am now scared of using a "koroboi" (a local small oil lamp) as well as a candle. They cause fire, and our children burn in houses. So I incur the cost of buying torches and batteries because I cannot use a candle or a koroboi.... My

> house burnt down, and I lost everything except that I only saved my children. That is why I am crying for electricity.

## G. Other household outcomes

Among respondents who had connected to grid electricity, the most commonly reported uses of electricity were for indoor and outdoor lighting, doing household chores like cooking and ironing, charging phones, refrigeration, watching TV, and listening to the radio, and starting income-generating activities. Respondents were mixed on whether they reported using electricity for cooking.

**Entertainment.** Grid electricity supports use of lights for reading at night, TV, and radio. Household FGD respondents expressed particular interest in entertainment via TV and radio. For example, one said, "Sometimes when you come back from work, because it is dark, we used to go to the bar to watch football. But when the service is at home, we have enjoyed it a lot. You cannot leave the house when you can watch football at home. That service is good."

**Communication and family relationships.** Respondents noted that grid electricity can improve communication and relationships in the family in several ways. First, as discussed earlier, grid electricity improves access to cell phones by making them easier to charge, thus enabling family members to more easily communicate with each other when outside of the home. Second, electricity can be used for lights, making it easier for household members to see each other's facial expressions, which helps spouses feel closer to each other. Also, by increasing the benefits of staying at home at night, grid electricity can increase the amount of time that household members spend together, which could also increase communication.

In discussing the benefits of lights, one household FGD respondent said:

> In the past, when you are resting with your wife after work, it was difficult to see my wife's face directly because of darkness in the house. It was difficult, but nowadays I can look her in the face easily. When you switch on the lights, you look into each other's face. You can tell your wife: "Please, look at me." In the past, when a person asked their spouse to look into their face while in darkness, the person had to guess how her spouse looked and vice versa. But nowadays, you just switch on the lights. So, both sides have benefited because of this electricity.

Both male and female FGD participants reported that having electricity meant the family could spend more time together at home. One male participant said, "Well, there are changes especially in relationships between men and women. As for us men, we have to go to the neighbors. For instance, I would go to […] to watch TV, and my wife would be wondering about my whereabouts at that hour, but if I had access to the service, I would be at home watching my own TV."A female FGD participant noted:

> The presence of electricity adjusts a bit the schedule of our husbands as they may be trying to come home early rather than staying for a long time outside their homes. This makes him come home early and stay with his family and talk to his children since there is an electric light. He may not be roaming

> around till 22:00 p.m. or 23:00 since there is electricity at his home. This will enable his children to converse with their father, and it will be useful even in adjusting the schedule for the love matters of the couple.

**Household chores.** Household FGD respondents noted the ways in which grid electricity can reduce the time spent on household chores like cooking and ironing, as well as time spent traveling to get services. Because electric stoves are quite expensive to operate, respondents reported that those households with more disposable income used electricity for cooking, refrigeration, and ironing, whereas lower-income households were only able to afford enough units for lighting and cell phone charging, although some used electric hot-pots that can boil water quickly and cheaply. Thus, one respondent said, "I can't use it for cooking because when you use electricity stove or iron, the cost is high, the meter runs fast, but I use it…for reading." Another said, "We did not have heaters for boiling water but now, one is obliged to boil water."

Many household FGD respondents mentioned the benefits of having a refrigerator at home. For example, one said, "There will be some changes for example in the evening, and you will be hearing people enjoying themselves drinking cold soda. These are changes because we never saw something like that before." Another said:

> …one can prepare food in a short period of time and then go to do other things. More importantly, one can go to […] to buy fruit—something which was very rare in the past days—because one may come to keep them in a freezer. One may keep them there and eat them day by day even for a week or more. Therefore, one may gradually build his health by eating fruit.

Among households that could afford irons, some respondents said that electric irons can be both faster and cleaner than the traditional coal irons. For example, one respondent said, "The truth, electricity has benefited us.... You can iron your man's clothes with good quality rather than charcoal iron which can put dirt on the clothes. Really, when you have electricity, life is great."

A number of respondents reported having more time and the ability to do chores at night as a result of having electricity. One said:

> [Chores] have changed a lot…. For example, my wife had to wake up early around 5 and light the fire. She had to light the local lamp and start preparing beans. But as for now, once she wakes up, she has little work to do because once she gets up she switches on the light and starts doing her chores. So compared to the time we did not have electricity, the time [needed for chores] has been reduced.

Lastly, living in a community with access to grid electricity reduced the amount of time community members spent traveling to get services. They reported that they were happy that there were more goods and services available to purchase in their local area since the MCC lines were constructed. One said, "Well, we are glad the milling machines that use electricity have been opened so the women don't have to go all the way to […] for the service."

## H. Migration outcomes

Getting access to the grid may increase in-migration and reduce out-migration by making a community more attractive. Thus, differential migration may be a symptom of the effects of grid electricity on the perceived value of a community. Many respondents mentioned the possibility of increased in-migration, and at least one mentioned the possibility of decreased out-migration.

FGD participants and interview respondents were asked whether households and businesses had relocated or would relocate in the future in order to access grid electricity. At least one respondent from each study location knew of households or businesses that had relocated to access electricity; however, such perceptions of migration were not common (which is not surprising, given that the lines were not completed until 2013). Respondents anticipated that their communities would become more popular with electricity and would be a preferred location to migrate to, compared to areas that were not yet electrified. Health workers and headmasters agreed that their staff preferred posts where there was electricity to other locations. Since such individuals tend to have higher incomes than other Tanzanians, especially in rural areas, they might be in a better position to migrate than others. One FGD respondent said,

> There are people who have migrated into our village. For instance, a certain man from [another village in that ward] bought a piece of land and opened a milling machine there and he started to provide the milling services there the day before yesterday. Apart from that man, there are so many other people who used to live in the mountainous area who have bought plots here and built their houses in our village. These people want to open businesses here.

Similarly, a community leader said, "The number of people residing there has increased and others have built."

At least one community leader believed that grid electricity would improve the community because the new immigrants would bring new ideas. That respondent said:

> People's lives are good because after connecting the community to electricity, the number of people who move into the community has increased. People with different ideas are living together with people who were here before. So, there is a high level of interaction among people with different backgrounds and ideas. If the old community did not know something people moving in might be aware of it. So, when they see it being done by the newly moved-in people, they may also start doing it. So, the old community does their activities by imitating the ones who started doing the activity in the community.

At least one household FGD respondent noted that getting access to the grid could reduce the chances that he or she would leave the community. For example, one said, "There are lot of advantages…. It's a big thing getting connected…because in my entire life I had never imagined that I will get connected to electricity here. But now I have changed. I no longer have those thoughts of shifting to town."

## I. Variation in outcomes by gender

Male and female FGD participants described how men, women, and children benefited from the new MCC lines. For the most part, respondents thought that whoever's workload was most reduced and whoever enjoyed using electrical appliances benefited the most. For example, respondents reported that women benefited by not having to walk so far to buy kerosene, children benefited if they no longer had to travel far to charge phones, and everyone who watched and enjoyed television benefited. Men frequently said that women benefit the most from electricity because they spend more time at home, so they can enjoy lighting and various small appliances. Most women agreed that they benefited the most from electricity in the home, which made their work easier and allowed them to complete it at different times of the early morning and evening. Still, several women thought men benefited more because they were no longer asked every day for money to buy kerosene or batteries. All those respondents who had electricity believed that everyone benefited from the service: "I think both men and women have benefited and experience changes through the use of electricity, because you cannot compare the previous time before we were connected to electricity and this time. Therefore, both men and women have benefited."

Respondents at schools were also asked whether boys or girls benefited more from electricity. The answers were mixed, but the majority thought all students would benefit, particularly those students who made an effort to study:

> I said performance may improve, provided purposive effort is made especially by those residing near the school as far as night study is concerned. Leaving alone these students near school premises, those staying in streets where there is electricity are likely to outperform those who still use oil lamps.
>
> Really, electricity is very important as it even improves kids' thinking ability. Kids think that when they will be adults; they will stop using little oil lamps, and they will be using electricity.

Still one respondent explained that he thought that male students would benefit the most:

> Most of the male students are so inquisitive. They like to know many things in general. You can see in the street, you are the witness; there is a certain center where children go to play computer games. In such areas, a greater percentage is the boys. I think it will motivate students to learn if there will be computers. We could have other things that use electricity. This makes them to become more proactive. On the loss side, for the boys, it may cause problems if they are not controlled. The absence of proper use of such items may bring detrimental effects…. Yes! In the case of girls, when the boys have high capacity of using such items, they [the girls] will also be motivated to know how their fellows do; therefore, it will motivate the female children to learn how to use computers, too.

Respondents at health facilities thought that women and children would benefit the most from electricity at health centers but that both women and men would benefit from improved patient care. Respondents from health facilities explained:

> This situation [without electricity] causes much trouble to the little children and the pregnant women since this is the category of people to whom we give priority as they are the ones who get infected with many diseases. A mother is a person who comes to deliver a baby at night, and most of these babies get cold, and hence they should be placed on that bed which has one side which gives out heat and the other side which gives out cold. All these things need energy.
>
> The patients who would benefit the most, for sure, are mothers. We mothers suffer a lot.
>
> It is not only women who would benefit; even men would. They will all benefit equally. For instance, a male can fall sick at night and, likewise, he can also benefit from electricity. Also, when someone's wife is pregnant, it implies that both the husband and the wife have to take responsibility. It is not only the pregnant mother who would be concerned but also the husband, especially when they come here and [I] tell them that I do not have a lamp to use to provide service to your patient, therefore, take her to […] hospital. In this scenario, the one who will take trouble is the husband. The wife will only experience pain, but the money to use will come from the husband. In fact, both would be involved in the problem.

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# V. SUMMARY AND CONCLUSIONS

As part of its energy project in Tanzania, MCC invested in building new lines (the T&D activity) and offered low-cost connections to randomly selected communities that received the T&D lines (the FS initiative). Using qualitative evidence, this report assesses the implementation of these two components of the energy project and discusses respondent reports on outcomes that might have been affected by access to electricity.

This chapter synthesizes the findings from the analysis presented in this report and describes the limitations of the qualitative evaluation. Implications of the findings for policy and practice are discussed. The chapter concludes by identifying implications of the findings for future data collection under the ongoing evaluation of the T&D activity and FS initiative.

## A. Summary of findings

1. *Lines built.* Under the T&D activity, more than 2,000 km of transmission and distribution lines have been built, providing increased access to electricity for hundreds of communities in seven regions in Tanzania. The activity also improved infrastructure for the local electric supply company.
2. *Management challenges.* Key informants described project management challenges resulting from capacity constraints, the length of the chain of command, less-than-optimal stakeholder engagement during the design phase that led to changes between the planning and building phases, and problems implementing resettlement and compensation due to weak coordination between key stakeholders.
3. *Suboptimal locations of lines.* Many respondents were concerned that the lines were not optimally placed within communities. The final design did not reflect new housing in the communities. Moreover, concern was expressed that lines followed existing roads too rigidly and thus did not extend to reach many households located far from roads. Respondents were also concerned about the criteria used to determine which communities were chosen. Respondents expressed the need for more explicit criteria to help determine where infrastructure is placed.
4. *Barriers to connecting.* The barriers to connecting to the electric grid were on both the supply and demand side. On the supply side, pole and line placement outside of populated areas, the 30-meter rule about the proximity of lines to buildings, transformer size, TANESCO capacity to serve customers, and material and supply limitations presented barriers to households, businesses, and public facilities connecting to the grid. On the demand side, costs (application, connection, and internal wiring), the application process, extended wait times, housing materials not being suitable for electric connections, and the season when connections were offered all presented barriers to connecting.
5. *Usage costs.* Respondents had less consistent views on usage costs. Some respondents suggested that electricity was cheaper than other sources of energy, such as kerosene or diesel. Other respondents who relied on more basic energy sources, such as candles and batteries before electrification struggled to afford their energy bills after electrification, especially if they tried to use certain types of high-consumption appliances like

refrigerators, stoves, and even irons. Some respondents expressed distrust of TANESCO because they had not realized that they would have to pay a monthly fee for electricity in addition to the units of electricity they consume. The lack of trust of TANESCO could be misplaced as this could happen with TANESCO's offer of a low-cost tariff plan without a monthly service charge, but that was only for customers willing to consume no more than 75 kilowatt hours per month.

6. *Uses of electricity.* Among respondents who had connected to the grid, the most common reported uses of electricity were indoor and outdoor lighting, appliances for household chores, charging mobile phones, refrigeration, watching TV and listening to the radio, and starting income-generating activities. A few respondents also reported using electricity for cooking, but others suggested that other energy sources (such as charcoal and firewood) were more affordable than hot plates.
7. *Reported benefits of electricity.* There was consensus on the importance of electricity and the wide range of benefits that accrue to households, businesses, and other community institutions from accessing grid electricity. Respondents reported a range of benefits from using electric lighting, including increased hours of business operations, help with things like poultry production, increased hours for study in the evening, increased family communication, enhanced ability of health workers to serve patients at night, reduced crime, improved safety by protecting people from snakes, and reduced likelihood of fires by replacing candles and kerosene lamps. Other important domestic uses of electricity were for lighting, entertainment, communication, and household chores. Refrigeration was mentioned as important for storing vaccines and medicines and for business and social uses like cooling drinks and storing food.
8. *Gender differences.* Respondent reactions to benefits of electrification by gender were mixed. Most female respondents agreed that women benefited the most from electricity in the home, which made household chores easier (for example, using electric water heaters or not having to wait in line or walk far to purchase kerosene) and allowed them to complete chores at different times of the day. Men also mentioned benefiting from the ability to watch a TV show or games at home, whereas all would benefit from greater awareness about domestic and world affairs by watching or listening to the news. Both boys and girls enrolled in school were expected to benefit from electricity equally. Health facilities also expected to benefit all who need care, but particularly pregnant women and children.

## B. Limitations of the qualitative analysis

Although we collected data from a large number of stakeholders, we did not talk to all types of stakeholders involved in implementing the energy project. We collected information from community leaders, household heads, business owners and managers, staff from schools and health facilities, TANESCO staff, and MCA-T staff. We also observed the target communities, and incorporated our own understanding based on years of having worked with many of the key stakeholders. However, we were not able to interview ESBI, Pike, Symbion, Africare, or EWURA staff. Such interviews would have helped provide a more complete picture of the implementation successes and challenges, and allowed us to derive additional relevant lessons learned for future investment in the energy sector.

Another important limitation of the analysis is that this is a qualitative study. Given the small number of stakeholders from whom we collected data, findings from the analysis may not be generalizable beyond the study sample as the informants' shared their individual perspectives which may not be widely held views. The study provides insights into the types of customer outcomes that had been influenced by access to electricity, but it does not provide estimates of the size of those impacts or suggest how widespread the impacts were. Moreover, some of the data collected were about impacts that might happen in the future. Thus, this study describes themes and compares similar and disparate reports in order to understand the full scope of experiences.

Although the sample from which we collected qualitative data was designed to elicit a range of opinions and perspectives, it was not exhaustive. Households and businesses in other regions or neighboring communities may have had different experiences. However, the locations from which we collected qualitative data for the study were purposively selected in order to provide a range of perspectives from different regions. In addition, within these communities, we randomly selected the participants for focus group discussions to gain information that would be representative of the households in the study communities.

## C. Implications for policy and practice

These findings have implications for building new electricity lines and related infrastructure, encouraging new connections, and for maintaining the existing network in Tanzania.

1. *Benefits of electrification are well recognized.* As discussed above, respondents overwhelmingly expressed positive views towards having electricity. This suggests that there is room for policymakers to help provide more Tanzanians with access to electricity and potentially improve a broad set of outcomes. Although determining how to increase access to electricity in a cost-effective way might still be a challenging issue for policymakers, they may not need to worry about a lack of understanding of the potential benefits as they craft policies designed to increase use of grid electricity. Policymakers in Tanzania could encourage more connections by reducing connection costs, improving the communication and education around the connection process, making the connection process shorter, and strengthening capacity within TANESCO.
2. *Increase TANESCO capacity.* Although TANESCO is in the process of building internal capacity, findings from the qualitative analysis suggest the need to bolster its capacity to maintain the new MCC-funded lines as well as to implement any future expansion of the T&D system. TANESCO could be more effective at installing new service lines and providing maintenance and repair if it built capacity in a number of areas, particularly by increasing the number of electricians in local offices and providing its engineers and technicians with adequate supplies and transport. Capacity building may need to be balanced against the company's financial health, but an assessment of how improved capacity would contribute to the company's financial condition in the future would be useful.
3. *Improve procurement process.* During the procurement process, the implementing entity needs to ensure that the scope of work for implementation contractors is reasonable and that contractors have sufficient capacity and commitment to design and construct new

electricity distribution lines well and on schedule. Further, it is important for stakeholders to anticipate competing demands for consultants or contractors operating in distant locations and managing multiple projects.

4. *Improve contracts.* MCA-T should consider various changes to their contracts. In particular they should consider developing a Conditions of Particular Application (COPA) that simplifies processes so that decisions on the ground can be made more quickly and efficiently. They should also investigate methods of reducing the lengthy chain of communication among the implementation partners in ways that balance the need to reduce delays while ensuring project quality. In addition to developing more flexible agreements, MCA-T may want to consider including positive and negative incentives that motivate consultants and contractors to stay on time and implement a high quality project.
5. *Optimize locations of transformers and lines.* The locations of the transformers and low-voltage lines need to be optimized both within and between communities. Considerations should be given to the benefits and costs of serving a new community in planning the locations of new lines.
6. *Optimize involvement of local stakeholders.* Local stakeholders can be optimally engaged at the design stage to ensure that the project benefits from the knowledge of local conditions, local stakeholders such as TANESCO district-level staff, community leaders, and community members can be consulted at the design stage. Such efforts would likely result in a project design that is sensitive to local conditions and reduces the need for large modifications to the plan during implementation.
7. *Improve partner coordination.* Implementation would benefit from improved coordination among partners. Coordination could include sharing of project maps and documents at multiple points in the design stage, consistent use of differential GPS units, and more-complete preparation to ensure availability of materials (for example, mounting brackets) needed for installing new connections. Such preparation would ensure smoother implementation and, ultimately, faster installation of connections for the end users.
8. *Keep community members informed about line locations.* Community members need to be informed where lines will be built. Respondents noted that many individuals built new homes where they were told that the lines would be built, only to find out later that the lines would be built elsewhere. It might make sense to inform community members that the final decision about where lines will be built cannot be made until the lines are actually energized, since even after poles are put up they are sometimes moved. This type of clear communication would reduce the likelihood of potential customers moving to the wrong locations in an attempt to access the new lines, and thus could increase the demand for new connections.
9. *Improve outreach efforts regarding connection process.* Effective sensitization and outreach is needed to inform community members about the connection process and monthly costs. Such efforts will ensure that potential customers are well informed about the process and all costs. Early communication would give individual and institutional customers adequate time to acquire funds needed to cover the costs of connecting. Moreover, new customers may lack clear understanding of the usage costs and may not

anticipate all costs. It might be helpful to design a brochure that provides illustrative examples of how much a potential customer should expect to pay for electricity units based on consumption and perhaps even depending on which appliances are used. Community members would also benefit from clear communication about the difference in application fees between rural and urban areas.

10. *Clarify community selection process.* Greater outreach to share information with communities that do not directly benefit from an intervention may reduce social tension. If interventions are undertaken in selected communities (such as the FS initiative), the selection process should be public and transparent and the reasons for it well communicated to all communities in the area, including those that do not benefit directly from the intervention. This could reduce chances of confusion and social tension in these communities.
11. *Facilitate sharing of lessons learned.* Facilitate sharing of connection lessons across schools and health facilities. Although respondents clearly agree how important electricity is to schools and health facilities, only some of these public institutions were able to connect to the grid. It might be helpful to share with the Ministries of Education and Health lessons on how connected facilities managed to raise funds, in order to inform other local institutions that may want to connect in the future.

## D. Implications for future data collection for the evaluation

1. *Add questions in the follow-up survey.* Findings from the qualitative analysis provide us with a clearer understanding of the outcomes for households and businesses that gain access to electricity. Although these outcomes are broadly in line with what we anticipated based on existing research, having the supportive evidence from Tanzania is reassuring. In addition, some findings are new and will inform development of the instrument for the follow-up community and household surveys. For example, we may decide to add questions regarding the use of lights for poultry farming, the use of electric irons, the presence of electric lights for safety from crime and wild animals, and how electric energy might facilitate interactions between family members.
2. *Consider doing follow-up survey in the fall of 2015.* It is also reassuring that households and businesses that connected to the electric grid are already recognizing changes in their socioeconomic outcomes. This suggests that if MCC decides to conduct a follow-up household survey in fall 2015, households that connected are likely to have had a long enough time with electricity to experience changes in some of the intermediate outcomes on which the impact evaluation would focus. These include sources of energy, expenditure on energy, time use among adults and children, and hours of business operations.

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# APPENDIX A

# DOMAINS AND MEASURES FOR THE QUALITATIVE EVALUATION

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## Table A.1. Domains and measures for the qualitative evaluation

| Domains | Measures |
|---|---|
| **Implementation** | |
| Short- term implementation outcomes | • Infrastructure installed including medium and low voltage lines, poles, and transformers<br>• Overall connection rate<br>• General satisfaction levels of those connected<br>• TANESCO satisfaction with materials |
| Processes and inputs | • TANESCO capacity<br>• Communication chain<br>• Local stakeholder involvement<br>• Timeline<br>• Resettlement process<br>• Availability of materials |
| Sustainability | • Responses to customer complaints<br>• Maintenance of new lines<br>• Illegal connections<br>• Financial sustainability |
| **Outcomes** | |
| Connecting to the electric grid | • Connection process<br>• Costs of connecting<br>• Usage costs relative to other energy sources<br>• Quality of and satisfaction with electricity |
| Economic outcomes | • Uses of electricity in businesses<br>• Types of businesses<br>• Goods/services available in the community |
| Education, health, and safety outcomes | • Education/health/safety behaviors and outcomes related to electricity<br>• Education/health/safety services in community due to electricity |
| Other household usage and outcomes | • Changes in the use of time<br>• Household chores,<br>• Communications and access to information<br>• Entertainment |
| Migration | • Immigration<br>• Outmigration |
| Gender outcomes: who benefits more from electricity usage | • Education/health/safety<br>• Time spent in chores and child care |

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# APPENDIX B

# IMPLEMENTATION AND EVALUATION TIME LINE

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## Table B.1. Timeline for the T&D activity and the FS initiative: implementation and evaluation

| | 2007 | 2008 | 2009 | 2010 | 2011 | | | | 2012 | | | | 2013 | | | | 2014 | | | | 2015 | | | | 2016 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 |
| **Project design** | | | | | | | | | | | | | | | | END OF COMPACT | | | | | | | | END OF CONTRACT | | | |
| Hatch Mott MacDonald: due diligence | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ESBI: surveying and design | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Africare: valuation for resettlement | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Project implementation** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pike and Symbion: begin T&D work | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Camco: FS communication campaign | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| T&D line extension completed | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FS initiative completed | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Project evaluation** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Baseline community survey | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Baseline household survey | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Connection data from TANESCO | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Qualitative data | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Follow-up community survey | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Follow-up household survey | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reporting | | | | | | | | | | | | BR | | | | IR | | | IR | IQR | IM | | | | FR | | |

Notes: The figure only shows completion of the T&D activity and FS initiative; implementation of each component started earlier.

Q1 = January–March, Q2 = April–June, Q3 = July–September, and Q4 = October–December.

BR = Baseline report, IR = Interim impact report, IQR = Interim qualitative report, IM = Interim impact memo, FR = Final impact report.

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# APPENDIX C

# STAKEHOLDERS COMMENTS AND EVALUATOR RESPONSES

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## C.1. Stakeholder comments and evaluator responses

| Page Number | Comment | MPR responses |
|---|---|---|
| xi, 2-3, 24 | How the financing scheme fits in to the overall T&D project design should be made clearer in the evaluation reports. While it does test an important policy question, it was not part of the original program design or logic, and its inclusion was partially motivated by the need to evaluate the project. | Revised- See pages xi, 1, and 2. |
| xii | Points 4-5 seem to be describing the same things. | Revised. |
| xiii | How, specifically, could policy makers in Tanzania encourage more connections? Does the evaluation take any position on this, or does it just describe the effects of the particular method employed in the FS initiative? | We have not weighed in on different ways to reduce connect costs. We acknowledge that reducing costs for customers requires an investment on the part of TANESCO, the Government of Tanzania, or other development partners. In the qualitative report, we described respondents' experiences related to the reduced connection costs under the FS initiative. From the data, it appears that some citizens will only be able to access electricity with connection subsidies. We mention reducing connection costs as one of many ways of encouraging connections, including educating potential customers about connection process, shortening the connection process, and strengthening capacity within TANESCO. |
| xiv (Point 4), 50 | It should be noted that the works contracts are between MCA-T (not MCC) and the contractor, so some of the recommendations should be directed to MCA-T. | Revised. |
| 2, 17 | Why use both the MCC and HMM estimates? In 2013, Mott McDonald said they expect 37,132 connections within five years. It is impossible to get this estimate exactly right, but I would say that 35,000 is closer to the mark. | Revised to keep only the reference to 35,000 estimate based on MCC (2007). |
| 10 | Since the community leaders helped arrange the focus groups and identify respondents, the focus groups do not represent a random sample of the community, correct? | For the household focus groups, the community leaders helped the research assistants understand the parameters of the community, locate households, and list households if existing lists were no longer accurate. However, the study team randomly selected and recruited the household focus group respondents independently. The business owners were not selected randomly but were selected to include a range of possible types of businesses. |
| 13 | Wasn't Mott McDonald also MCC's independent engineer for the project? That seems more relevant than the fact that they conducted a due diligence study back in 2007. | We now mention HMM as MCC's "independent engineer" (p. 13 and Figure III.1). |

| Page Number | Comment | MPR responses |
|---|---|---|
| 18 | It would be interesting to do a little quick fact checking on issue of the long chain of communication this. What prevented more integrated communication? Was it contract terms and legal constraints, or simply poor standard operating procedures laid down by MCA-T or MCC? | This was an important topic in the MCA-T Energy interview. There were legal constraints that prevented more efficient and integrated communication. MCA-T had to follow the "Yellow Book" or the Guide to the Use of the FIDIC Conditions of Contract for Electrical and Mechanical Works (1988). A COPA or Condition of Particular Agreement is needed to override the strict guidelines in the Yellow Book. We did not make any changes in the report to address this comment. |
| 18 | Was there a technical reason that not all villages were included, or was there just not enough money to connect them all? Were the reasons that these villages not included explained to them? While it is understandable that some people may be disappointed, maybe there was a sound reason for excluding them from the project. | We have added the following sentence to clarify the point: "Although there may have been sound technical and financial reasons for excluding these communities, the community leaders we interviewed did not feel that they were given an opportunity to provide input for the decision." |
| 19 | If community expansions were unforeseen by the design, who told people in these expansion areas they would be connected? Perhaps it is as much of communication issue as a design issue. | We have added the following sentence to clarify the point: "This could be related to lack of local engagement during the design stage as well as insufficient communication about evolving plans for the location of the lines." |
| 20 | Why did TANESCO run short of materials and supplies for connections? Did demand exceed their expectations? Did they not prepare properly? Did they have cash flow or procurement issues that prevented them from obtaining the necessary materials? | TANESCO did not have the resources to purchase all the materials needed. In some locations, MCA-T gave materials to TANESCO to help fill the gaps; however, these parts were often unsuitable, given the materials used by the international contractors. As new technology was introduced, there appears to have been inadequate pre-planning about the materials that would need to be available at TANESCO. |
| 20 | People seem to recognize the importance of proper maintenance, but they also realize that TANESCO may not have the financial resources to do so. Did the enumerators ask customers if they would be willing to pay higher tariffs to ensure proper maintenance? | No, we did not ask this question. Only TANESCO discussed the topic during the interviews. |
| 21 | When asking community leaders about illegal connections, did the enumerators refer to them as "illegal connections"? It seems like it could be difficult to get truthful feedback if such loaded terms are used. If so, what were their responses? How much would they be willing to pay? | We discussed this during enumerator training and also during the piloting to determine the appropriate way of asking about these connections. Our local team asked the question in a culturally appropriate way. We heard few reports of these connections and rarely observed these connections in communities. It may happen in the future as people become more comfortable with the lines and learn how to split them. In addition, if illegal connections are not promptly detected and dismantled by TANESCO, high connection costs may provide adequate incentive to potential customers to make unauthorized connections through their neighbors. |

| Page Number | Comment | MPR responses |
|---|---|---|
| 26 | Did anyone mention lower consumer prices since electrification? If competition led newly electrified firms to use their energy cost savings to lower prices, this would have a positive effect on consumers, even if it is less positive for firms. | We did not hear much about lower prices for any particular commodity. This may take longer to happen as the markets grow. In several study areas, the markets were small with few businesses. |
| 29 | Were the eight study locations randomly selected across regions, urban and rural, FS and non-FS, or were they purposefully chosen? | The selection of communities were random within the strata. We updated the language to clarify this point. |
| 35 | The story about people not realizing how much energy they consume sounds like a good illustration of the Jevons effect - more efficient technology or energy sources tend to lead people to increase their rate of consumption. | Agreed. |
| 12 | Key Findings – Points 4 and 5 seem to be the same. Also, the 'Key Findings' and 'Implications for Policy and Practice' seem to be intertwined (i.e. findings are reported in implications). It might be useful to convert these summaries into a matrix, with implications directly linked to their findings, in order to create that clear link but also avoid repetition and confusion. | We have deleted point 5 (and made some additional edits in point 4), and also revised the "key findings" and "implications for policy and practice" sections to avoid presenting findings in the implications section. |
| Implication #8 | Did the placement of the lines differ by the 'design' of Pike vs. Symbion? There were conversations at MCC with regards to how different designs should respond differently to population growth – one can accommodate it more than another. If there is a design element here it would be useful to note/clarify. | Unfortunately we do not have the level of detail needed to determine whether this was related to the Pike or the Symbion design. It may be that the Symbion was in a better position to respond to population growth, however from the transcripts, we did not find evidence that either contractors made design changes due to population growth. |
| 33 | It would be useful to include a general statement on the total number of expected connections as a result of the T&D investment to date, particularly to compare to the figure provided in the paragraph above on the expected total number of connections. | Given the still unresolved concerns about the administrative data on number of connections, we have removed references to the connections data and the interim impact report. |
| 22 | There are references to reports like Camco 2013, 2014 – are these public? If not, how can they be used as sources in the paper? If the reports aren't public, should they become annexes, or reviewed for public posting? | We have deleted references to the Camco reports (2013, 2014), to Schurrer (2014), and to the Hatch Mott and Macdonald report (2007). We believe that all of the other reports cited are publicly available. |
| 24 | The statement regarding the FS initiative as a way to address a weakness in the T&D evaluation is incorrect. The FS was intended to address the gap in the program logic of the T&D investment – the killer assumption that households wouldn't face any financial barriers to connecting to the grid once available. | We have revised the language appropriately. |
| 31 | When presenting the results of the FGDs, particularly looking at satisfaction/dissatisfaction, it would be useful to know if this varied for FS vs non-FS communities – for example, the description of good communication on pg. 31 – is this a result of the investments made for communication in the FS communities, or was this just business as usual communication? | In this case, this was communication in an FS community, which seems to have been better than in non-FS communities. Overall, people felt there was not enough communication everywhere, but the situation was worse in non-FS communities. TANESCO staff confirmed this and suggested that they did not have enough communication from Pike and Symbion as well. We revised the text to clarify that the communication campaign under the FS initiative was helpful. |

| Page Number | Comment | MPR responses |
|---|---|---|
| xi | There should be more detail in reference to the submarine connecting Zanzibar's Unguja Island to Mainland including the substation construction and cities that were connected. | We have added a footnote in the introductory chapter (p. 1) to provide more details about the Zanzibar activity, including mention of those substations. |
| 3 | The conceptual framework should include the substation component. The substations activity was a large part of the energy sector activities involving construction rehabilitation and extension of 24 Interconnector and Distribution Substations. | We added a footnote on p. 2 (footnote 4) to describe that the T&D activity included substations. |
| 14 | Figure III.1. Stakeholders involved in the implementation of the T&D activity and the FS initiative; • In the TANESCO box: consider "Implementation entity, national electric utility firm, and final beneficiary" • In the ESBI box: Consider "Consulting Engineer, Construction Supervisor, Capacity Development and Technical Assistance & oversight", • In the PIKE box: Consider "Design and build distribution network rehabilitation and extension -Dodoma" , • In the SYMBION Power box: Consider "Design and build distribution network rehabilitation and extension-Tanga Morogoro, Iringa, Mbeya, Mwanza & Kigoma | Revised as suggested. |
| 15 | Consider the following edits to the paragraph: a. TANESCO. As the implementing "entity" for the compact, TANESCO "jointly reviewed" the electricity infrastructure design "submissions", verified purchases of building materials in accordance "with specifications", and observed construction "activities on behalf of MCA-T". Given the terms of the "FIDIC" Yellow Book "for design and construction of plant for electrical and mechanical plants and for buildings and engineering works designed by Contractor" and the fact that "FIDIC recognizes three parties to this contract (Client, Engineer and Contractor)", TANESCO did not have direct oversight over the consulting engineer or the contractors.... TANESCO managed the process of installing "service line" connections, including receiving applications for connections, assessing suitability of the premises for electrification, "constructing the service lines" and "installing the prepaid" meters connecting the end user to the low-voltage lines. b. Consulting engineer: ESBI. Consider the following edits in quotes to the paragraph<br>"ESBI was contracted by MCA-T from "2008 as the Consulting Engineer/Construction Supervisor (CE) for MCA-T and TANESCO, and to assist in a technical consulting and project management role for the successful development and implementation of all three energy projects which included preliminary design and design review of contractors final designs of the" infrastructure that would extend the electricity distribution network in the seven regions of Tanzania for the T&D activity….", c. Contractors: Pike Electric and Symbion Power LLC. | We revised the text based on the new words (in quotes) in this comment. |

| Page Number | Comment | MPR responses |
|---|---|---|
| 20 | On Page 20: Considering adding information regarding the technical assistance program, through which MCA-T provided TANESCO with bucket trucks and Insulated Truck mounted Mobile Elevated Work Platform (MEWP) to enable ease of live line maintenance of the constructed distribution lines and substations.B30 | We revised the text appropriately. |
| 20 | The proposed changes have been incorporated as indicated see highlighted response in the comments sheet. However I have noted on page 20, under section f: A shortage of materials affected installation of connections: there is a statement that reads, “According to TANESCO and MCAT-Energy, the materials estimate developed by the contractors and the consulting engineer were not adequate” this statement is not correct if the author is referring to House connections. The works contractors and the Consulting Engineer (ESBI) were not responsible for Materials cost estimates for house connections, this was the responsibility of TANESCO. The mentioned ancillary materials, including application forms and mounting brackets are fully estimated and supplied by TANESCO Not our works contractors or the Consulting Engineer ESBI. | In light of the input from MCA-T about the responsibility of the contractors and the consulting engineer, we have deleted the sentence “According to TANESCO and MCAT-Energy, the materials estimate developed by the contractors and the consulting engineer were not adequate”. The key finding we intended to capture in this paragraph is that the introduction of the new technology, lack of planning and resources led to a situation where installation of end-user connections may have been affected. To clarify that point further, we added a sentence to the paragraph. |
| | Generally the report is very informative, it has pointed out benefits of electrifications as perceived by the users. | Thank you. |
| 15 | Consider revising the following sentence: MCA-T Energy consisted of two MCA-T employees as well as a TANESCO expert designated to the MCC electricity project, to read MCA-T Energy consisted of three MCA-T employees as well as a TANESCO expert designated to the MCC electricity project | Revised. |
| 27 | Why is the Iringa rural region categorized differently than the other regions? This should be consistent. | Changed all to "agriculture" to be consistent. |
| | The report is well presented and has covered important issues especially concerning community involvement from the beginning of the project and being updated frequently | Thank you. |

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# APPENDIX D

# FOCUS GROUP AND KEY INFORMANT INTERVIEW PROTOCOLS

(UNDER SEPARATE COVER)

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