Evaluation of the Millennium Challenge Corporation's Electricity-Transmission and Distribution Line-Extension Activity in Tanzania: Baseline Report

November 20, 2012

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Policy Research

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ACRONYMS

DID	Difference-in-differences
FS	Financing scheme (the customer-connection financing scheme initiative)
GDP	Gross domestic product
GPS	Global positioning unit
g	Gram
IGA	Income-generating activity
kg	Kilogram
km	Kilometer
kW	Kilowatt
kWh	Kilowatt hour
LPG	Liquefied petroleum gas
MCA-T	Millennium Challenge Account—Tanzania
MCC	Millennium Challenge Corporation
MDI	Minimum detectable impacts
MoF	Ministry of Finance
NBS	National Bureau of Statistics
NGO	Nongovernment organization
NRECA	NRECA International
PSU	Primary sampling unit
T&D	Transmission and distribution systems rehabilitation and extension
TANESCO	Tanzania Electric Supply Company
TZS	Tanzanian shilling [1 USD = 1,577 TZS]
USD	U.S. Dollar

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EXECUTIVE SUMMARY

Promoting access to electricity in developing countries is a policy area of growing interest (Barnes 1988; World Bank 2008; Moss 2012). In Tanzania, only about 12 percent of all households in the mainland had access to the national electricity grid in 2007, and the rate was just 2.5 percent in rural areas (NBS 2009). To help improve access to electricity, promote economic growth, and reduce poverty, the Millennium Challenge Corporation (MCC) is funding a $207 million energy sector project in Tanzania, which is being implemented by the Millennium Challenge Account–Tanzania (MCA-T).

MCC has contracted with Mathematica Policy Research to carry out rigorous evaluations of the energy sector project, including two major components of the project—rehabilitation and extension of the transmission and distribution (T&D) network, and a customer-connection financing scheme (FS) initiative to facilitate lower-cost electricity connections in selected areas. The T&D activity is designed to provide new electricity lines to over 300 communities spread throughout seven regions of Tanzania; the FS initiative will provide low-cost connections to about 5,800 households in 29 of these communities. The evaluation of these components is designed to address a number of research questions. Broadly speaking, these research questions can be divided into two categories:

- **Impact evaluation questions.** What are the impacts of the project components on outcomes? Are there unintended consequences? Would a less rigorous evaluation produce similar results? How do impacts vary by subgroup? How do the benefits compare to the costs? What lessons can be learned from the impact findings?
- **Performance evaluation questions.** How well were these components of the program implemented? What challenges were encountered? What lessons can be learned from the implementation of the program?

In order to estimate impacts of the T&D activity and the FS initiative, we developed rigorous evaluation designs. We are using a quasi-experimental **difference-in-differences (DID)** design **with a matched comparison group** to estimate the impacts of T&D line extensions. For estimating the impacts of the FS initiative, we are using a **random assignment evaluation design**, which is considered to be the gold standard for impact evaluations.

In this report, we present findings from analyses of baseline data that have been collected as the first step of the evaluation of the T&D activity and FS initiative. Baseline surveys were conducted in spring and fall 2011, prior to the implementation of the T&D activity. These surveys collected data for the evaluation from 362 communities, over 10,000 households, and 59 enterprises. The same survey data are used for both components because the FS initiative is being carried out in a subset of the communities where the T&D lines are being built. Together, these data enable us to describe communities, households, and businesses in terms of energy use, health, education, community assets, income, poverty, and gender differences.

We have conducted thorough analyses of the baseline data. Following are the key findings.

- **Feasibility of rigorous evaluations.** These data enabled us to demonstrate baseline equivalence—that is, after matching at the household level, we find no evidence of systematic baseline differences between the intervention and matched comparison groups used to evaluate the T&D initiative, or between the treatment and control groups used to evaluate the FS initiative. Thus, we have the platforms for estimating unbiased impacts using follow-up survey data for these two components of the energy sector project.

- **Generalizing findings from the evaluation.** We selected intervention communities that are expected to have a high percentage of households with access to the new electric lines. Consequently, our results will not generalize to communities with less access to the new lines. However, the results will be of strong policy relevance since, in the long run, it is expected that most communities in Tanzania will have a high level of access to electricity.

- **Findings from the baseline community survey data.** Communities targeted for the T&D line extension lack many key facilities. About 14 percent of these communities have an electrified primary school. Similarly, about 18 percent have an electrified dispensary, 14 percent have an electrified repair shop, and only 15 percent have a police station, post office, or bank. Almost none have an electrified market.

- **Findings from the baseline household survey data.** The households in these communities are low income, use traditional forms of energy such as wood and charcoal, and show expected gender differences. About 72 percent of the households earn less than US$1 per day per capita and about 45 percent of household consumption consists of food. On average, these households consume over 150 kg of wood and charcoal per month. Adult household members spend relatively little time in wage employment and spend much of their working hours in nonwage farming and other income-generating activities. Men spend far less time than women cooking, collecting fuel, collecting water, or doing other household chores. At the same time, men earn more than women, have more income generating activities, have more employees, and use far more electricity in their businesses.

- **Findings from the enterprise survey data.** The 59 enterprises covered in our baseline enterprise survey are small, with no more than six employees each. A large fraction (63 percent) are small grocery shops (*duka*), only 29 percent have female owners, 58 percent are registered with the local or national government, and 89 percent use mobile telephones for business purposes. More than half of these enterprises already use electricity from the grid, with two-thirds of the electrified businesses reporting lighting as the primary use of electricity. A majority of the electrified businesses report experiencing power outages and voltage fluctuations either daily or a few times a week, indicating the need for improving the quality and reliability of electricity.

- **Baseline data on willingness to pay for electricity.** We estimate that the households that will have access to the new electric lines are currently getting energy at a lower cost per unit of energy content from traditional energy sources than what the Tanzania Electric Supply Company (TANESCO) charges for grid electricity—in large part because they get a large amount of wood (about 75 kg per month) for free. This suggests that many households will not switch from solid fuel to grid electricity. At the same time, we estimate that many of these households would benefit from grid electricity because of savings that could be realized via electric lights, TV, and mobile phone charging. They might be able to achieve additional savings via cooking and heating depending on how efficient electricity is for these purposes compared to their current fuel sources; however, our estimates as well as prior research suggest that for cooking and heating such shifts from traditional fuel source to electricity are unlikely in the short term. While the benefits of using grid electricity are potentially large, it could still take households from a few months to a few years to realize cost savings large enough to pay for the fixed costs of getting access to electricity. Hence, the financing scheme initiative, which provides low-cost connections, may provide valuable insights on the benefits of grid electricity in the absence of this potential barrier to connections.

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I. INTRODUCTION

Access to reliable, high quality electricity can be a key driver of economic growth and household well-being (Barnes 1988; World Bank 2008). In Tanzania, only about 12 percent of all households in the mainland had access to the national electricity grid in 2007, and the rate was just 2.5 percent in rural areas (NBS 2009). In addition to the low level of electrification in the country, the power that is available is subject to frequent surges and interruptions in service. With a gross domestic product (GDP) per person of only US$529 per person in 2011 (World Bank 2012), Tanzania is one of the poorest countries in the world. Nearly 33 percent of the population in mainland Tanzania and 49 percent of the Zanzibar population live below the poverty line, as determined by Tanzania's Ministry of Finance (MoF 2009; Zanzibar MoF 2009).

In an effort to promote economic growth and reduce poverty in Tanzania, the Millennium Challenge Corporation (MCC) is funding an energy sector project that is being implemented by the Millennium Challenge Account–Tanzania (MCA-T). The project has a number of key components, including rehabilitation and extension of the transmission and distribution (T&D) network, a customer-connection financing scheme initiative to facilitate lower-cost electricity connections in selected areas (hereinafter, financing scheme initiative or FS initiative), 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 mainland Tanzania. This last activity includes solar systems for schools, health facilities, markets, and fishing boats as well as development of a market for solar systems for households. Together, these activities are intended to increase the availability of reliable and high quality electricity to people in mainland Tanzania and Zanzibar.

MCC has contracted with Mathematica Policy Research to carry out rigorous evaluations of the T&D activity and FS initiative.[1] These evaluations are designed to enable MCC to understand more fully how the T&D activity and FS initiative affect the well-being of the target populations. In this report, we present findings from analyses of baseline survey data. The same survey data are used for both components of the energy sector project because the FS initiative is being carried out in a subset of the communities where the T&D lines are being built. We describe characteristics of communities, households, and businesses prior to the implementation of the T&D activity, and present evidence on baseline equivalence for each evaluation. We also discuss the potential usefulness of these types of data for re-estimating the economic rates of return for the project. These results should provide valuable information and context for the impact evaluations that will be carried out after the activities are fully implemented.

We begin this report in this chapter with an overview of the Tanzania energy sector project, a brief review of the literature on impacts of electrification, and a discussion of the conceptual framework that guides the Tanzania energy sector evaluation. In Chapter II, we present the evaluation design for the T&D activity and the financing scheme initiative, the baseline survey data collection and sampling for these surveys, and statistical power for the impact analysis. In Chapter III, we describe the characteristics of the communities in the intervention group based on data from the baseline community survey. We discuss the characteristics of households in the intervention group in Chapter IV, followed by a discussion in Chapter V of the baseline characteristics of businesses surveyed in the Tanga region. In Chapter VI, we provide evidence on baseline equivalence of households in the intervention and comparison groups for the T&D evaluation, as well as the treatment and control groups for the financing scheme evaluation. In Chapter VII, we

[1] Mathematica is also conducting an evaluation of the Zanzibar cable activity, as discussed by Chaplin et al. (2011a).

present results relevant to households' willingness to pay for electricity. We conclude in Chapter VII with a summary of the findings and a discussion of future analyses that we will carry out to estimate impacts of the T&D activity and the financing scheme initiative. In Appendix A, we present technical discussion on sampling and matching weights, and in Appendix B we discuss challenges with the household survey data and how we deal with them. In Appendix C, we present results from supplementary analysis. Finally, we provide the English version of the Tanzania energy sector baseline community, household and enterprise survey instruments in Appendices D, E, and F, respectively.

A. Overview of the Energy Sector Project

Tanzania is one of a handful of nations awarded a compact from MCC. At about $698 million, the Tanzania compact is the largest to date. In order to effectively manage the work of this compact, the Tanzanian government created MCA-T, which is now implementing the project activities with oversight from MCC. To address infrastructure constraints to economic growth and poverty reduction in the country, MCA-T is using the MCC compact to fund projects in three sectors: roads, water, and energy. In particular, MCC is investing $207.2 million in four components of the energy sector project:[2]

- **Transmission and distribution systems rehabilitation and extension activity (T&D activity).** This activity involves rehabilitation of existing electricity transmission and distribution networks as well as construction of new lines in Dodoma, Iringa, Kigoma, Mbeya, Morogoro, Mwanza, and Tanga—regions identified as being high priority for investment in electricity. The $126.2 million being invested in the T&D activity represents more than three-fifths of MCC's total investment in the energy sector project.

- **The financing scheme initiative (FS initiative).** MCC and MCA-T are concerned that many households will not be able to afford to connect to the new lines created by the T&D activity. Consequently, they are funding a separate but closely related financing scheme initiative to facilitate 5,800 lower-cost connections for households in 29 selected communities that are receiving the new T&D lines. A communications campaign will be carried out as part of the initiative, to inform households about the low-cost connection offer that will be available for a limited time and on a first-come, first-served basis.

- **Zanzibar interconnector activity (cable activity).** This activity is designed to improve the quality and reliability of the electricity to Unguja Island in Zanzibar by installing a new submarine cable from the mainland, upgrading substations at either end of the cable, and installing new overhead cables on both the mainland and Unguja Island. With about $68 million being invested in it, the cable activity represents about one-third of MCC's total investment in the energy sector project.

- **Kigoma photovoltaic activity (solar activity).** This activity involves installing solar modules and other solar electric systems in 45 schools, 130 health facilities, 45 markets, and 90 fishing boats, as well as development of a market for solar systems for households, all in the Kigoma region of Tanzania. Almost all direct beneficiaries of the activity are slated to receive photovoltaic power.

[2] For more details on the energy sector project activities, see Annex I in the Tanzania Millennium Challenge Compact (MCC 2008), available at http://www.mcc.gov/documents/agreements/compact-tanzania.pdf.

Through these investments in the energy sector, MCC aims to help Tanzania take fuller advantage of its economic growth potential and ultimately improve the well-being of its people. Mathematica's evaluation of the energy sector project will help assess how successful these activities have been in achieving those goals. Although the overall energy sector evaluation is expected to address each component activity, the current report is focused on the evaluation of the T&D activity and the financing scheme initiative under that activity. In the remainder of this chapter, however, we provide a conceptual framework for the overall energy sector project, along with a brief review of the empirical evidence that helps underscore the conceptual framework.

B. Evidence on Impact of Electrification

There is limited rigorous evidence regarding the impacts of electrification, and much of the existing evidence is centered on impacts of rural electrification on poverty, education, health, and the environment. There is a dearth of rigorous research on impact of electrification on peri-urban areas (that is, locations on the periphery of urban areas); such research would have been relevant for Tanzania energy sector project, as many of the MCC-funded T&D lines are being built in urban/peri-urban areas, though many are also in rural areas. These areas may benefit more than rural areas since they are likely to have better infrastructural support for industrial and commercial development that can create higher-wage jobs than currently exist in these areas.

The primary challenge in improving household well-being through electrification is the continued low rate of connection to the electricity grid among households even in communities that are covered by the electricity distribution network. This is particularly prevalent among poorer rural households across many countries in Africa (see, for example, ESMAP 2007b for Senegal; Jacobson 2007 for Kenya; Ketlogetswe et al. 2007 for Botswana; Heltberg 2003 for South Africa and Ghana; and World Bank 2008). The low connection rates are a result of relatively high connection costs and/or high tariffs that many households are unable to afford. The financing scheme initiative under the Tanzania energy sector project is expected to address this challenge in selected areas where new T&D lines are being extended, and would provide an opportunity to assess the effects of electrification when a larger percentage of households are connected to the electric grid.

Evidence suggests that when households are connected to the electric grid, benefits accrue to them primarily through consumption of electricity for lighting, entertainment, and increased home and farm production. There are only a handful of rigorous evaluations in this regard. Their findings indicate that rural electricity reduces expenditures on lighting (Bernard and Torero 2009 in Ethiopia), increases time for household work, facilitates entry of women into the labor market (Dinkelman 2011 in South Africa), and increases farm income through irrigation (Khandker et al. 2009 in Vietnam). While there is some evidence of benefits through increased economic activity and improved health and educational services at the community level, the benefits are smaller or less clear relative to the benefits that directly accrue to the household (Bernard and Torero 2009, Dinkelman 2011, World Bank 2008).

Considering the limited rigorous evidence on the impacts of electrification on household well-being and economic activities in developing country settings, the Tanzania T&D evaluation is expected to fill in some of the gaps in the literature. More specifically, the evaluation will provide estimates of short-term effects of electrification in rural, urban, and peri-urban areas in Tanzania. In the process, the evaluation is expected to generate critical information for policymakers in international development agencies as well as in Tanzania, and to provide input for future energy policy in the country.

C. Project Logic and Conceptual Framework for the Evaluation

MCC and MCA-T have developed a set of logic models for each activity under the energy sector project (MCA-T 2012). Mathematica consolidated the logic models in a conceptual framework, presented in Figure I.1, which guides our approach to the evaluation of the project activities. The boxes on the far left of the figure show the four energy sector activities. The box on the far right shows the ultimate objectives of the activities—increased economic growth, improved standard of living, and poverty reduction. The project activities are designed to achieve these objectives through their effects on access to electricity, which will be realized in the short term, and through subsequent effects on households, businesses, and communities, which will be realized in the intermediate and longer terms.

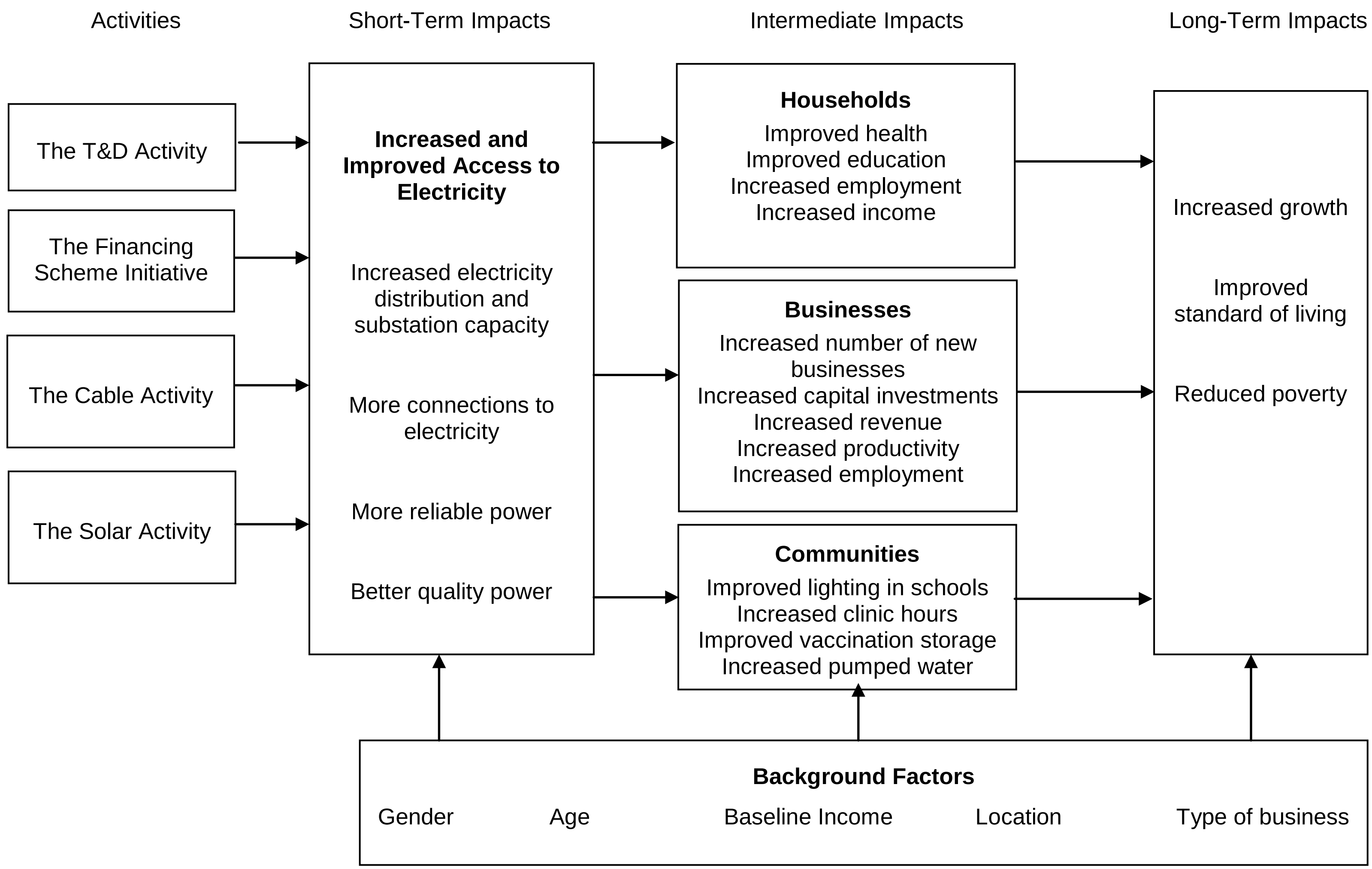
The energy project activities can affect access to electricity in several ways, as shown in the box in the second column of the conceptual framework. First, the successful implementation of the project is expected to increase the reach of the distribution networks and improve the substation capacity. Second, by expanding the distribution network and facilitating lower-cost connections, the T&D activity and the financing scheme initiative can increase the number of households, businesses, and community organizations (such as schools, health facilities, and water utilities) connected to the national grid. Third, by installing a new submarine interconnector cable, the cable activity is designed to reduce the extent of service interruptions or outages, referred to as the "reliability" of electricity supply. Fourth, the installation and rehabilitation of electricity infrastructure may reduce variations in voltage magnitude or harmonic distortions, referred to as the "quality" of electricity supply, which is expected to reduce equipment damage at the electric utilities and in homes and businesses.

These improvements in access to electricity can have important intermediate impacts on households, businesses, and communities, as presented in the third column of the conceptual framework. 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. It can also help households obtain valuable information on the market prices of goods and services, adverse weather conditions, and opportunities available to them, via radio and television programming and mobile phone communications. Electricity can improve health outcomes if it enables households to reduce use of certain types of fuel that are particularly likely to cause health problems, such as charcoal and wood. Finally, it can improve education outcomes by enabling students to spend more time reading after dark.

Electricity can also have important impacts for businesses. In particular, it can enable businesses to use many types of machinery that cannot be operated cost-effectively without electricity. 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 for longer hours, use electricity for refrigeration, and use certain types of 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 T&D lines funded by MCC can be far less expensive than electricity produced by the small generators commonly used by many businesses, schools, and health facilities that are operating away from the existing electric grid.

The box at the bottom of the framework shows background factors that may affect the short-term, intermediate, and long-term outcomes we are studying. It will be important to control for differences in these background factors when conducting our impact analyses. In addition, 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, since they spend more time there. Low-income households may benefit least if they cannot afford the connection fee or electric appliances. Benefits to businesses may depend on their use of electrical equipment. Communities may differ in the benefits they gain from electricity, depending on the number and type of public facilities they operate. Our evaluation will pay particular attention to differences by gender, as that is a strategic priority for MCC and MCA-T.

Figure I.1. Conceptual Framework for the Energy Sector Project



II. EVALUATION DESIGN, METHODS, AND DATA

In this chapter, we present a brief discussion of the design, methods, and data sources for the evaluation of the T&D activity. A more detailed discussion of these topics is available in the evaluation design report (Chaplin et al. 2011a). The aim of the T&D evaluation is to assess the implementation successes and challenges as well as to estimate the impacts of the T&D line extensions and the FS initiative. This report is focused on findings from the analysis of baseline survey data; however, in order to lay out the methodological underpinnings of the evaluation, in this chapter we discuss the central research questions the evaluation will address; key aspects of the impact estimation methods, sampling, and baseline surveys; and statistical power for identifying impacts of the T&D activity.

A. Evaluation Questions

The T&D evaluation is designed to address a number of research questions that were selected in collaboration with MCC and MCA-T. It will answer the following impact and performance evaluation questions regarding the T&D activity.

1. Impact Evaluation Questions

- **Impacts on outcomes.** Does access to electricity lead to (1) increased household income and better health and education outcomes; (2) increased business activity, including creation of new firms, capital investments, and greater levels of employment; and (3) improved community outcomes related to schools, hospitals, or water supply? If impacts are detected, what are the magnitudes of those impacts?
- **Unintended consequences.** Are there unintended impacts of the program (positive or negative)?
- **Benefits of a rigorous evaluation.** Does a rigorous evaluation design yield the same impact estimates as a simple pre-post design?
- **Subgroup analyses.** Do the impacts vary by gender, age, and income?
- **Benefit-cost analyses.** Was the project a good investment?
- **Lessons learned.** What are the implications of the evaluation findings for future electricity projects and long-term policymaking?

2. Performance Evaluation Questions

- **Implementation successes.** Were the interventions under the T&D activity implemented successfully? How well was the T&D activity implemented relative to its goals? How was the activity perceived by potential and actual beneficiaries? Was the activity sustained over time?
- **Challenges encountered.** What challenges were encountered in implementing the activity? How were the challenges addressed?
- **Lessons learned.** What are the lessons learned from the implementation of the activity?

We plan to present the findings from the impact and performance evaluations in two reports—an interim report to be completed before the end of the compact and a final report in June 2015. The interim report will present short-term findings based on administrative data on electricity use, reliability, and quality. The final report will present longer-term impacts on a rich set of additional outcomes based on follow-up survey data on poverty, economic development, and well-being. The follow-up surveys are planned for fall 2014. Since implementation of the T&D activity is expected to be completed by September 2013, the follow-up survey will allow at least one year for the communities, households and businesses to take advantage of the newly built lines. Thus, analysis of data from the follow-up surveys will enable us to assess the impacts one year after these communities will have been electrified. In addition, as part of the performance evaluation, we are planning to collect qualitative data in January 2014—after the energy sector project is fully implemented—and present findings from the analysis of these data in the final report.

B. Impact Evaluation Design for the T&D Activity

In Table II.1 we summarize the technical approach for impact evaluation of the T&D line extensions and the FS initiative under the T&D activity.

Table II.1. Technical Approach to Impact Evaluation: T&D Line Extension and Financing Scheme

Intervention	Evaluation Methodology	Intervention/ Treatment Group	Comparison/ Control Group	Key Outcomes
T&D line extension	Difference-in-differences (DID) method, which compares changes in outcomes over time between T&D intervention and matched comparison areas	Households, businesses, and communities in areas that received line extensions	Households, businesses, and communities in matched areas that did not receive new line extensions	Access to, reliability, and quality of electricity Household income and expenditures Business energy expenditures and revenue Employment Health outcomes
Financing scheme (FS) initiative	Random assignment of areas either to a treatment or a control group; compare outcomes between these two groups at follow-up	Households in areas that received the T&D lines and the FS offers	Households in areas that received the T&D lines but did not receive the FS offers	Child schooling attainment/ intensity of study Distribution of time and resources within the household by gender

1. Matched Comparison Group Evaluation Design for T&D Line Extensions

We are using a difference-in-differences (DID) method with matched comparison group design to estimate the impacts of extending electricity lines to the new areas covered by the T&D activity. We will compare changes over time in outcomes for intervention communities (that is, communities that will receive the line extensions) in six regions of the country with changes in outcomes for comparison communities.[3,4] The households in the comparison communities were chosen using propensity score matching so that they are similar to the households in the intervention communities based on various household characteristics, such as income, assets, consumption, energy use, gender of the household head, mobility, use of tools and appliances, housing materials, and household size. The changes in outcomes will be captured by using baseline and follow-up surveys of households, businesses, and communities conducted, respectively, before and after the line extensions are completed.

Propensity score matching, a statistical method of matching based on multiple factors (Rosenbaum and Rubin 1983), was implemented in three stages. In the first stage, we applied a nearest-neighbor matching with replacement method and used existing census and global positioning system (GPS) data from the National Bureau of Statistics (NBS) as well as data from the Tanzania Electric Supply Company (TANESCO) to identify three potential comparison communities for each intervention community (for more details, see Schurrer et al. 2011a). NRECA International (NRECA), the firm contracted to carry out various surveys for this evaluation, then implemented a community survey in the 182 selected intervention communities and 546 potential comparison communities. In the second stage of propensity score matching, we used data collected in the community survey and applied a matching without replacement method to identify one matched comparison community for each intervention community (for more details, see Schurrer et al. 2011b). NRECA then conducted a household survey in the 182 intervention communities and 182 comparison communities. Since the completion of the household surveys, we learnt from MCA-T and TANESCO that four of the 182 surveyed intervention communities will no longer receive new lines under the T&D activity. Consequently, we decided to exclude these four communities from the evaluation, which brings the total number of intervention communities to 178. We used the results of the household survey for a third and final stage of matching of households in the intervention and comparison groups. A detailed technical discussion on this final stage of matching is provided in Appendix A of this report.[5]

2. Random Assignment Evaluation Design for the Financing Scheme Initiative

The FS initiative is being implemented only in the communities covered by the T&D line extensions. It will cover all six regions in the T&D evaluation. Therefore, the evaluation of the initiative is closely related to the evaluation of the T&D activity, as illustrated in Figure II.1. Both the treatment and control groups for the FS initiative evaluation are selected from among the

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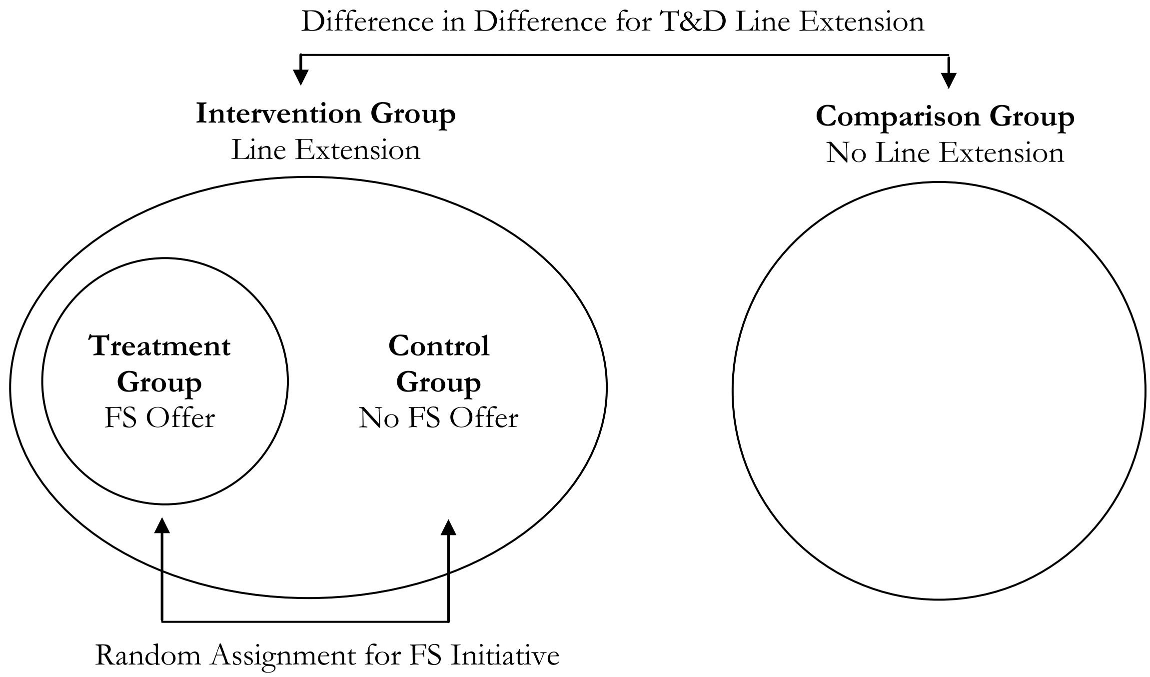
[3] For the evaluation of the T&D activity, we refer to the areas receiving the line extensions as the "intervention group." A subset of that group will receive low-cost connections through the FS initiative. We refer to that subset as the "treatment group."

[4] The T&D activity is also being implemented in a seventh region—Kigoma. However, because Kigoma was not initially part of the T&D activity, no baseline surveys were conducted there; consequently the evaluation will not cover that region.

[5] In Appendix Table C.2 we present differences between the intervention and comparison groups means for over 200 variables. We find that the percentages of the differences that are statistically significant at various significance levels are consistent with what one would expect by chance alone. To help ensure that these remaining differences do not lead to biased estimates of impacts, we will use regression adjustment for other covariates. Key control variables will include the baseline measures of the outcome. This regression adjustment should also increase precision of the DID estimates by eliminating extraneous variation due to those covariates (see, for instance Rubin 2007; Imai and Van Dyk 2004; Robins and Rotnitzky 2001; Rubin 1973). Since we will be estimating impacts on a large number of outcomes, even after regression adjustment, some of our estimated impacts might be statistically significant due to chance. We will use appropriate strategies to account for this possibility (Schochet, 2009).

Figure II.1. T&D Evaluation: Overlap of Line Extensions and Financing Scheme Initiative



intervention communities for the T&D evaluation. In a public event on July 16, 2012, we randomly assigned 29 communities to the treatment group that will receive the FS initiative.[6] The remaining 151 intervention communities constitute a control group that will not be offered low-cost connections. We have since started working with a communication firm to inform these communities about the offer of low-cost connections.

The design for the evaluation of the FS initiative has two implications for the evaluation of the T&D activity. First, when we estimate overall impacts of the T&D activity, we will also be capturing impacts of the low-cost connections as well as of the outreach work occurring through the communications campaign to reach the portion of our T&D intervention group that receives the FS initiative. Second, by excluding the FS treatment communities, we will be able to estimate impacts of the line extensions without the low-cost connections initiative when estimating the impacts of the T&D activity, although the resulting estimates will be somewhat less precise than our main results because of the smaller sample sizes.[7]

[6] A total of 30 communities were randomly assigned to receive the FS initiative; however, two of the communities are in the Kigoma region, which is currently not covered by the T&D baseline surveys, but are likely to be covered by the follow-up surveys. In addition, one community that was randomly assigned to receive the FS initiative during the public event will not be receiving new lines under the T&D activity (this is one of the four communities mentioned earlier that are no longer receiving the MCC funded lines). The decision to not provide new lines to this community, as well as to three other intervention communities, was made prior to random assignment. Consequently, these four communities are being dropped from the T&D evaluation. Any communities that change status later will be included in the study with appropriate adjustments (Bloom 1984).

[7] In Chapter VI we show baseline equivalence between the intervention and comparison households at baseline after matching at the household level. Since the control group households are a random subset of the intervention group, we would also expect to see baseline equivalence between households in the control group and those in the comparison group.

C. Sampling

To provide data for the T&D evaluation, three baseline surveys were implemented prior to the implementation of the T&D activity: the Tanzania energy sector baseline community survey (or more succinctly, baseline community survey), the Tanzania energy sector baseline household survey (baseline household survey), and the Tanzania energy sector baseline enterprise survey (baseline enterprise survey). In this section we describe the sampling strategies applied for these surveys.

1. Sampling for the Baseline Community Survey

The baseline community survey was conducted in 182 intervention communities and 546 potential comparison communities in six regions. The primary sampling unit (PSU) for the community survey was a village (*kijiji*) in rural areas and a *mtaa* in urban areas.[8] The rural and urban communities covered by the community survey were selected in three steps. First, the evaluation team worked with MCA-T and TANESCO to finalize a list of communities (villages or *mitaa*) that are likely to receive new lines; we identified a total of 337 communities (Table II.2).[9] Second, we randomly selected 182 of those villages and *mitaa* to represent the intervention communities in the evaluation. This number was chosen to achieve the desired level of precision, as explained in our design report (Chaplin et al. 2011a). Third, as mentioned in Section B, we identified 546 potential comparison villages using propensity score matching and existing data. The potential comparison communities were chosen from among all of the non-intervention communities in the same region. Table II.2 presents the distribution of the intervention and potential comparison communities across the six regions in mainland Tanzania where the T&D activity is being implemented. The numbers of intervention and potential comparison communities sampled were chosen to have the same distribution across regions as the total population of intervention communities, as shown in Table II.2.

2. Sampling for the Baseline Household Survey

The baseline household survey was conducted in 182 intervention communities and 182 matched comparison communities.[10] The 182 comparison communities were chosen from among the 546 potential comparison communities using propensity score matching based on the community survey data, as explained in Appendix A. For the household survey, in urban areas we continued to use a *mtaa* as the PSU. In rural areas, when a village had multiple subvillages, we used a subvillage (*kitongoji*) as the PSU; otherwise, we used the village as the PSU. In the intervention group,

[8] The Swahili word *kijiji* (plural *vijiji*) means village and refers to a rural administrative unit; *mtaa* (plural *mitaa*) translates to "street" and refers to the smallest urban administrative unit. Villages can be further subdivided into subvillages (*vitongoji*, singular *kitongoji*), which is the smallest rural administrative unit. Because the English word "street" could be confusing for a geographic area, throughout this report we use the Swahili words *mtaa* or *mitaa* to refer to the urban communities in the evaluation. For the rural communities, we use villages and subvillages to refer to *vijiji* and *vitongoji*, respectively.

[9] The 337 villages and *mitaa* on our list were divided into 182 subprojects. Subprojects are units used by MCA-T and the implementing entities building the lines.

[10] During the household survey, we had to replace seven comparison communities because all households in those communities were within 30 meters of existing lines or were already connected, and thus not eligible for the survey.

Table II.2. Number of Intervention and Potential Comparison Communities for the Community Survey by Region

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Intervention Villages/ *Mitaa*				**Non-Intervention Villages/ *Mitaa***		
Region	Total Number of Villages/ *Mitaa*	Total Number	Percent of Total	Number Sampled	Percent of Total Sampled	Total Number	Number Sampled for Community Survey	Percent of Total Sampled
Dodoma	658	73	22	39	21	585	117	21
Iringa	1,017	37	11	20	11	980	60	11
Mbeya	1,330	21	6	11	6	1,309	33	6
Morogoro	1,009	74	22	40	22	935	120	22
Mwanza	1,186	55	16	30	16	1,131	90	16
Tanga	1,269	77	23	42	23	1,192	126	23
Total	**6,469**	**337**	**100**	**182**	**100**	**6,132**	**546**	**100**

Note: The number of potential comparison communities in column 8 equals three times the number of intervention communities in column 5.

for a village with multiple subvillages, we selected the subvillage with the largest percentage of households expected to have access to the new T&D lines (as reported by the community leaders in the baseline community survey).[11] In each comparison village with multiple subvillages, we selected a subvillage that was matched to the population rank of the corresponding intervention subvillage. The purposive selection of the subvillage as the PSU in rural areas allowed us to achieve a much higher proportion of households in the sampling frame expected to have access to the new lines than we would have achieved had we used the village as the PSU. Without this purposive selection of subvillages, the evaluation would have needed a much larger sample of households to have reasonable confidence in detecting impacts. We did not need to identify a smaller PSU in urban areas because we expected that in urban areas receiving new lines, almost all households will have access.

Because we selected intervention communities that are expected to have a high percentage of households with access to the new lines, results from the evaluation will not generalize to households in communities where a small fraction of households have access to electricity. However, focusing on communities with better access to new lines is better suited to inform future policy decisions about electrification because future projects would build on the T&D activity and move closer to providing access to electricity for most or all households in the long term. Consequently, estimating impacts for communities where a greater percentage of households have access to electricity would be more policy relevant than estimating impacts for subvillages where only a small fraction of households have access.[12]

[11] Here access to the electricity lines implies that the household is within a certain distance from the new low-voltage lines. Households or businesses within this distance are eligible for connection at a basic rate. Entities farther away must pay for additional poles. Currently, the distance is 30 meters.

[12] In estimating impacts of the T&D activity, we will use weights to adjust for sampling, non-response and matching so that the estimated impacts represent impacts on household outcomes in communities where large fractions of households are receiving the new T&D lines (Angrist and Pischke 2009, p. 91-92; Pfefferman 1993).

For the baseline household survey, in addition to identifying the communities, we had to sample households. For each intervention and comparison community (village, subvillage, and *mtaa*) selected for the baseline household survey, a list of all households residing in the community was created; this list also identified whether a household was already connected to the grid or near an existing line.[13] We do not expect that households that are already connected to the grid or close to an existing line will connect to the new lines. Consequently, they were excluded from the household survey sampling frame. The remaining households on the list constituted the sampling frame for each community. In both the intervention and comparison communities, we sampled the same fraction of households from each PSU, which meant that we interviewed more households in the larger communities.[14] Within the intervention group communities, we oversampled households with a small house (these were being considered for a targeted subsidy pilot activity that was not implemented), as discussed in Appendix A.

3. Sampling for the Baseline Enterprise Survey

The baseline enterprise survey was conducted only in the Tanga region.[15] The target sample size for the survey was 32 enterprises in seven intervention communities, and another 32 enterprises in seven comparison communities. The original goal had been to sample enterprises from eight intervention and eight comparison communities. However, one intervention community was dropped because it will no longer receive new lines under the T&D activity, and one comparison community was dropped because no eligible enterprises were identified there. The communities where the enterprise survey was administered were selected randomly from all intervention and comparison communities in the Tanga region. We originally planned to survey only stand-alone businesses that do not already have access to the national grid and that have five or more employees. However, when all stand-alone businesses in the selected intervention communities were listed, we found that there are relatively few of them in these communities—and almost all of them already have access to the national grid. Subsequently, the evaluation team, in consultation with MCC, MCA-T, and NRECA, decided to sample businesses that are currently connected to the national grid as well as those that are not connected, and also to not impose any restriction regarding the number of employees in the business.[16]

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[13] According to data we received from TANESCO, about one-third of the intervention communities where the new lines are being built already had existing lines. TANESCO provided us with these data to help us develop a sampling frame for communities in the intervention group.

[14] In theory, we could have achieved more precise results had we randomly sampled communities proportional to their size and then sampled an equal number of households in each community (Lohr 1999). However, we lacked data on subvillage size when we drew our sample of villages and *mitaa* for the community survey. We could have sampled villages instead of subvillages, but the data on village size was dated, from the 2002 Census. In addition, based on the community survey data, we now estimate that only about 33 percent of the households in the target villages will have access to the new lines compared to about 69 percent of the households in the subvillages we selected for the household survey. Thus, selecting subvillages with high access more than doubled the estimated fraction of households with access to the new lines in our intervention group village sample. For more details on the sampling of households, see Chaplin et al. (2011b).

[15] The enterprise survey was implemented in the Tanga region because the region was expected to have larger businesses. However, the communities in the Tanga region where the enterprise survey was administered were selected based on the household survey sampling, and there were no large businesses in those communities. During the follow-up survey we could increase the sample size for the enterprise survey and cover more regions, using the enterprises identified in the household survey as a sampling frame.

[16] For more details on sampling of enterprises, see Mamun et al. (2011).

D. Baseline Data Collection

Using the sampling strategy described in the preceding section, three baseline surveys were conducted at the community, household, and enterprise level to support the evaluation of the T&D activity. MCA-T contracted with NRECA to administer all three surveys. NRECA developed the survey instruments, with input from MCC, MCA-T, and Mathematica. Table II.3 presents summary information on the respondents to each survey and the time period when each survey was in the field. The community survey was conducted first, over a seven-week period from April 18 to May 28, 2011. Data collection for the household and enterprise surveys started on August 15, 2011. The enterprise survey, a much smaller data collection effort, was completed within three weeks, on September 3, 2011. The household survey required a total of 14 weeks of field work and was completed on November 20, 2011.

Table II.3. Purpose, Respondents, and Timing of Baseline Surveys for the Tanzania Energy Sector Evaluation

Survey	Purpose	Regions	Target Sample Size	Respondent	Start and End Date
Baseline Community Survey	Collect community-level data at baseline; also used to identify matched comparison communities for the T&D evaluation	Dodoma, Iringa, Morogoro, Mbeya, Mwanza, Tanga	182 intervention, 546 comparison communities	Community leaders	April 18–May 28, 2011
Baseline Household Survey[a]	Collect baseline data on households for the T&D and subsidy pilot evaluations	Dodoma, Iringa, Mbeya, Morogoro, Mwanza, Tanga	11,648 households in 182 intervention and 182 comparison communities	Key female and male members of household	Aug 15–Nov 20, 2011
Baseline Enterprise Survey	Collect baseline data on small, medium, and large enterprises for the T&D evaluation	Tanga	64 enterprises in the intervention and comparison areas	Owner/operator of the business	Aug 15–Sep 3, 2011

[a] All households in the sampled intervention communities were listed, and information on eligibility for a planned subsidy-pilot activity was completed, when the baseline community survey was administered in April–May 2011. This list was used to produce the household survey sampling frame for the intervention group.

There was a potentially important difference in how the intervention and comparison group household surveys were conducted. The data collection team prepared lists of all households in the sampled intervention and comparison communities; these lists were used to produce the sampling frame for the household survey. In the intervention communities, the list of households was prepared when the community survey was being fielded; for the comparison communities, it was prepared the day before the household survey was administered in a particular community.[17] This

[17] The difference in the timing of the household listing in the intervention and comparison communities occurred for a number of reasons. The community and household surveys were conducted in the same intervention group communities. Consequently, for the intervention group, NRECA was able to carry out the household listing and the community survey at the same time. Moreover, we needed to identify households with small (no more than two rooms) versus large houses for the planned subsidy-pilot activity in the intervention communities, so that we could oversample subsidy-eligible households. As a result, the listing of households in the intervention communities had to be carried out long before the fielding of the household survey. In contrast, for the comparison group, the community survey was

(continued)

could have generated differences in results if large fractions of households moved during the months between the community and household surveys in the intervention group. However, as discussed in Chapter IV, our analysis suggests that a fairly small percentage of households moved during this time in the intervention group. In addition, results discussed in Chapter VI suggest that dropping these households does not affect the comparability of the intervention and comparison group households. A detailed discussion of the implementation of the surveys is provided by NRECA (2012).

The baseline community survey was administered as planned and data were collected from all target communities. The distribution of the community sample who responded to the survey was the same as those shown in Table II.2. For the baseline enterprise survey, a total of 59 businesses responded to the survey (32 in the intervention group and 27 in the comparison group) compared to the target of 64 businesses.

In Table II.4, we present the distribution of the baseline household survey sample based on the NRECA report (NRECA, 2012) and in our final analysis sample by intervention status. NRECA's data collection team provided data on 10,298 households with complete survey data (4,767 in the intervention group and 5,531 in the comparison group). They reported an overall response rate for the household survey of 91 percent (86 percent for the intervention group, and 99 percent for the comparison group). The regional distribution of the intervention and matched comparison communities where the baseline household survey was conducted is shown in a map in Figure II.2.

Table II.4. Baseline Household Survey: Matched Intervention and Comparison Sample versus Data from NRECA

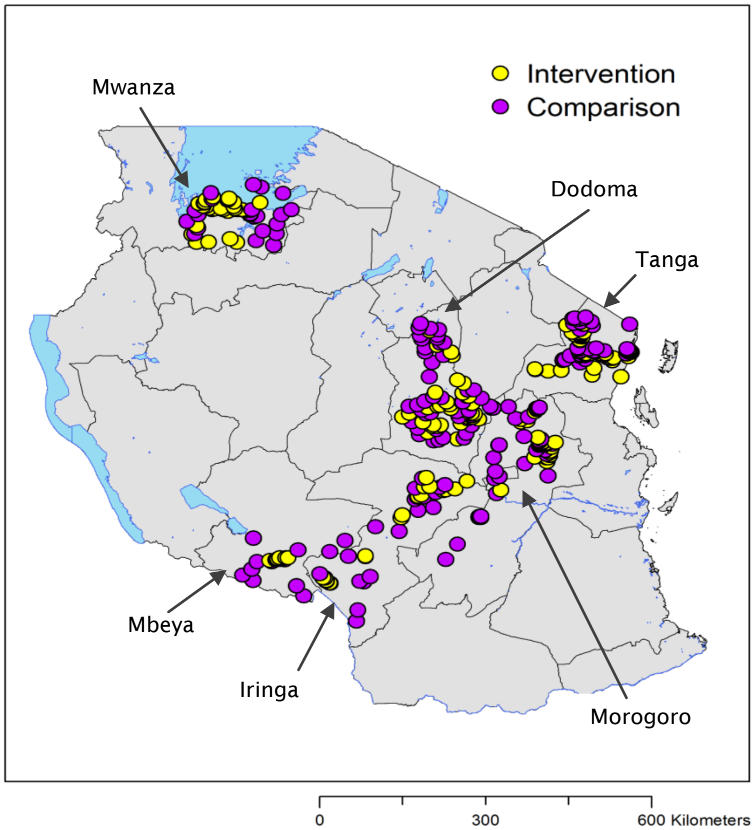
	Intervention Group		Comparison Group	
Region	Total Number of Villages/*Mitaa*	Number of Households Interviewed	Total Number of Villages/*Mitaa*	Number of Households Interviewed
Data from NRECA	182	4,767	182	5,531
Not receiving new lines under the T&D activity	4	38	0	0
Could not be merged to household listing	0	41	0	0
Duplicate records	0	6	0	0
Not matched in propensity score analysis	0	3	0	0
Matched Sample for T&D Evaluation	**178**	**4,679**	**182**	**5,531**

Source: NRECA (2012) and Tanzania Energy Sector Baseline Household Survey

(continued)

conducted in three times as many communities as the household survey, and data from the community survey were used to select the communities where the household survey was administered. Consequently, it was not possible to do the household listing at the same time as the community survey there.

Figure II.2. Regional Locations of the Intervention and Matched Comparison Communities In Tanzania



Sources: Tanzania Energy Sector Baseline Household Survey and Global Administrative Areas Database.

Notes: This figure is for descriptive purposes only as it was not always possible to determine the accuracy of the GPS data. We have mapped 176 of the 182 intervention communities, and 181 of the 182 matched comparison communities in this figure. We plan to collect the GPS data again during the follow-up survey in a format that can be used for analytic purposes.

The final analysis file drops 4 of the intervention group communities where NRECA collected data and 88 of the intervention group households with completed surveys shown in Table II.4. As noted earlier, four communities were dropped from the intervention group because they will not be receiving new lines. These communities had 38 households. Another 41 households in the intervention group were dropped because they could not be matched to the household listing.[18] Six other households were dropped because they were duplicates. Thus, our final pre-matching sample size is 10,213 households from 178 intervention and 182 comparison communities.

Descriptive statistics for intervention and comparison group households in our pre-match sample are presented in Appendix Table C.1. We dropped three more intervention group observations after conducting propensity score matching at the household level because we could not find suitable matches in the comparison group (see Appendix A for details). Thus, our final

[18] We needed to merge the household survey data with the household listing in order to calculate their selection probabilities, which depended on eligibility for the subsidy pilot intervention as estimated during the household listing.

sample size post-matching is 10,210 households. Descriptive statistics for intervention and comparison group households in the post-match sample are presented in Appendix Table C.2.

E. Statistical Power

Even elegant study designs may be undermined by inadequate sample sizes. Large sample sizes protect against a "false negative" finding—that is, the failure to detect true program impacts simply because the study lacks statistical power. The sample sizes for the household survey are large and should provide sufficient power to detect household-level impacts of policy-relevant magnitude. The sample size for the community survey is relatively small, so results based on that survey will be more illustrative. The sample size for the enterprise survey is also small; we will use the results based on that survey as illustrative case studies to address some of the research questions considered for this evaluation. In discussing the statistical power for estimating impacts, we focus on the household survey here.

In Table II.5, we present the minimum detectable impact (MDI) for the evaluation of the T&D line extension and FS initiative for a number of key outcomes. The MDI is the smallest true impact that can be detected with a given level of power. Thus, the smaller the MDI, the better it is for an evaluation. We used data from the baseline household survey to calculate the MDIs, accounting for clustering at the community level.[19] The MDIs are based on the assumption that the control variables to be included in the impact estimation model would explain half of the variation in the outcomes (that is, an R-squared of 0.5).[20] In addition, we calculated the MDIs with and without the weights that account for survey sampling, nonresponse and matching at the household level. As shown in Table II.5, MDIs without the weights can be as much as 16 percent smaller, but most are less than 5 percent smaller. However, because applying the weights makes the sample representative of the underlying population, in discussing the MDIs below, we focus on weighted calculations.

Our ability to detect impacts varies across variables. For the outcomes presented in the table, the average MDI is 9 percent of the standard deviation of the outcome for the T&D line extension results and 18 percent for the FS initiative results.[21] We expect to be able to detect impacts as small as 15.4 kilograms on solid fuel use, as small as 0.07 hours on children's hours of study after sunset, as small as 4.8 percentage points on the $1-a-day poverty rate, and as small as 404,000 TZS on annual household consumption. For consumption, this is about 14.6 percent of the intervention group mean observed at baseline. For the other outcomes, these MDIs represent smaller fractions of the means.

It is important to recognize that the impact of the T&D line extensions probably hinges critically on the percentage of households in the intervention communities that have access to the new lines, as well as on the percentage of households with access that actually connect to the lines. If either of these percentages is low, expected impacts of being in a community with access to the lines

[19] Clustering occurs because residents of the same community are likely to face similar, unobserved (by the researcher) random shocks that affect the outcomes. This results in greater correlation of outcomes among households in the same community than can be explained by observed variables that will be included in the impact estimation model.

[20] If the R-squared statistic drops by half, to 0.25, then the estimated MDIs increase by about 22 percent (compared to those in Table III.1). If R-squared goes to zero, then the estimated MDIs increase by about 41 percent.

[21] These MDIs in standard deviation unit are very close to the clustering-adjusted MDIs presented in the evaluation design report (Chaplin et al. 2011a).

are also likely to be low. For example, suppose that using electricity increases consumption by 15 percent, or by about 415,000 TZS. If only 70 percent of the intervention group households have access to electricity, and only half of the households with access install a connection, then on average we would expect to see only a 145,000 TZS increase in consumption in the communities that get access, compared to those that do not. This is much less than the MDI for consumption reported in Table II.5.

The MDIs are somewhat larger for the evaluation of the FS initiative because the household sample size is reduced by half. For example, for solid fuel use, we will be able to detect an impact of at least 40.1 kilograms; for children's study hours after sunset we will be able to detect an impact of

Table II.5. Minimum Detectable Impacts (MDI) for T&D Evaluation: Line Extension and FS Initiative

			Minimum Detectable Impacts			
	Intervention Group		T&D Line Extension		FS Initiative	
Variable	Mean	Std Dev	Weighted	Unweighted	Weighted	Unweighted
Household Level Outcomes						
Monthly amount of solid fuel used (kg)	151	209	15.42	15.17	40.11	36.77
Average hours/day spent studying after sunset, members ages 5–24 (hours)	0.66	0.87	0.073	0.070	0.114	0.115
Adult has had health problems in past 7 days (percent)	45.2	49.8	5.22	5.07	11.56	11.58
Child died if any born alive in last two years	8.6	27.9	2.71	2.61	5.66	5.72
Number of tools and appliances	7.0	4.7	0.46	0.39	0.65	0.63
Household has no IGA (percent)	29.5	45.6	4.35	4.22	10.00	9.52
Average number of female-operated income-generating activities (IGAs) if household has IGAs	0.47	0.58	0.045	0.041	0.080	0.076
Average number of male-operated IGAs if household has IGAs	0.63	0.71	0.061	0.058	0.099	0.096
Makes less than $1 US income per capita per day (percent)	71.7	45.0	4.83	4.51	9.78	9.22
Annual household consumption (TZS)	2,769,502	3,882,798	403,656	352,637	710,964	664,299
Annual household consumption (USD)	1,756	2,462	256	224	451	421

Source: Authors' calculation based on Tanzania energy sector baseline household survey data.

Note: The analysis accounts for clustering by community. To calculate the MDIs, we assumed a confidence level of 95 percent, two-tailed tests, 80 percent power, and R-squared=0.50. The sample sizes for each outcome shown in the table are available by intervention and treatment status in Appendix Tables C.2 and C.3, respectively. The MDIs for T&D line extension are calculated using the matching weight (W_i^M) described in Appendix A, Section 2. The MDIs for FS initiative are calculated using the pre-match weight (W_i), described in Appendix A, Section 1.

at least 0.11 hours, and for the $1-a-day poverty rate, we should be able to detect an impact of at least 9.8 percentage points. These MDIs reflect the current assignment of 27 communities to the treatment group for the FS initiative and 149 to the control group.

For the FS initiative, the expected impacts of being connected to the electricity grid depend in part on the fraction of the control group that gets connected to the grid. We expect that a similar fraction of households in the treatment and control groups will have access to the new lines. However, only the treatment group will be offered the low-cost connections. We estimate that there are about 6,340 households in the treatment group that are potentially eligible to receive the low-cost connection (that is, not connected to an existing line).[22] MCC plans to make about 5,800 low-cost connections available to these communities. If the overall rate of take up of the low-cost connections is relatively low, and a substantial fraction of these offered connections are not used in these communities then we will do a second round of random assignment.

The evaluation's ability to detect impacts on outcomes based on the community and enterprise surveys will be much weaker because of smaller sample sizes. Data from the community and enterprise surveys will be used for case studies and are expected to provide illustrative findings that will inform other components of the evaluation. As such, this lack of statistical power for estimating impacts using data from these surveys should not be critical.

[22] The estimated total number of households includes 140 households in the two communities in the Kigoma region that are not part of the T&D evaluation.

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III. COMMUNITY CHARACTERISTICS

In this chapter we describe the characteristics of the 178 intervention communities scheduled to receive the new T&D lines. We examine basic community characteristics, access to energy, economic activities, public institutions and facilities, and other economic factors. As mentioned in Chapter II, 178 intervention communities were sampled for the community survey; they included both rural and urban communities (villages and *mitaa*). The statistics presented in this chapter depict the conditions of these villages and *mitaa* prior to the implementation of the T&D activity based on reports from the community leaders who responded to the baseline community survey.

A. Basic Community Characteristics

We present the basic characteristics of the intervention communities in Table III.1. On average, 1,004 households resided in each of these communities. About 72 percent of the communities are villages and the remaining 28 percent are classified as *mitaa*. The average distance from the community to the nearest district or regional capital is about 30 kilometers (km). There is substantial variation in the distance to the nearest capital, however. Fifty-two communities (about 30 percent) are less 10 km away from the nearest capital and three communities are over 100 km away. At the time of the survey, the average price of an acre of residential land was 4.62 million TZS; however this varied substantially between rural and urban communities. The average land value in the rural communities was 1.04 million TZS per acre—substantially lower than the average land value of about 14 million TZS per acre in the urban communities.

Table III.1. Basic Community Characteristics

Community Characteristic	Intervention Group Mean
Number of households in the community	1,004
Percentage classified as villages	71.9
Distance to nearest district or regional capital (km)	30.0
Price of residential land per acre (TZS)	4,624,746
Price of residential land per acre in villages (TZS)	1,036,172
Price of residential land per acre in *mitaa* (TZS)	13,998,980

Source: Tanzania Energy Sector Baseline Community Survey

Note: The analysis sample includes 178 intervention group communities. Survey item nonresponse may have resulted in smaller sample sizes for specific measures. See Appendix Table C.4 for sample sizes for all measures.

B. Access to Energy

The T&D line extension is designed to have an immediate effect on access to electricity and sources of energy used in the intervention communities. In this section we summarize access to electricity, sources of electricity, and other energy sources used in the intervention villages and *mitaa* prior to the extension of the new T&D lines.

1. Access to Electricity from the Grid

Table III.2 presents access to electricity at baseline as reported by the community leaders who responded to the baseline community survey. About 42 percent of the 178 intervention communities currently have access to the exiting electrical grid. This is not surprising since data from TANESCO for all 337 communities served by the T&D activity indicated that about a third of them already had access to the electric grid (data not presented in the table). In an average intervention community, about 11 percent of households were connected to the grid. This suggests that although a sizeable fraction of the intervention communities had access to the grid, a relatively small fraction of the households within the communities were actually connected to it. The community leaders also reported that a relatively small fraction (12 percent) of the intervention communities had a power line project in the past two years.

Table III.2. Electricity and Other Energy Sources in the Community

Community Characteristic	Intervention Group Mean
Access to Grid Electricity	
Percentage with access to the existing electrical grid (community leader report)	41.6
Average percentage of households in the community connected to the grid	11.4
Percentage that had a power line project in the past two years	12.4
Access to Other Sources of Electricity	
Percentage of communities in which any household uses:	
Isolated grid power system	24.7
Community, privately owned, or small individual generator	84.3
Solar lanterns, windmills, or other electrical sources	23.6
Access to Other Energy Sources	
Percentage of communities where the following are available for purchase:	
Kerosene	96.1
Diesel or petrol	50.1
Firewood, charcoal, or dung	90.0

Source: Tanzania Energy Sector Baseline Community Survey

Note: The analysis sample includes 178 intervention group communities. Survey item nonresponse may have resulted in smaller sample sizes for specific measures. See Appendix Table C.4 for sample sizes for all measures.

2. Access to Other Sources of Electricity

About one quarter (25 percent) of the intervention communities had households that obtained electricity via an isolated grid system, whereas a majority of the communities had at least one household that used generators to produce electricity (Table III.2). Approximately a quarter (24 percent) of the communities had at least one household that got electricity from other sources, including solar lanterns and windmills.

3. Access to Other Energy Sources

Kerosene, firewood, charcoal, and dung were commonly available in the intervention communities (Table III.2). About 96 percent communities were reported to have kerosene available for purchase. Diesel or petrol was available for purchase in roughly half of the communities, and 90 percent of the intervention communities had firewood, charcoal or dung available for purchase.

C. Economic Activities

Table III.3 presents the main source of income and business activities in the intervention communities. For about 87 percent of the communities, farming, livestock, fishing, or hunting was the main source of income for the inhabitants of these communities. About one-quarter of the communities have a weekly market, but few communities (less than 1 percent) had an electrified weekly market. Repair shops were present in about 62 percent of the communities and 14 percent of the communities had electrified repair shops. Tea stalls, coffee shops, guest house and hotels were common; 94 percent of communities had these facilities, and 33 percent communities had such facilities that were electrified.[23] In terms of electrification of different types of business, on average about 36 percent or about 6 of the 17 different business types, used electricity.

Table III.3. Sources of Income and Business Activities in the Community

Community Characteristic	Intervention Group Mean
Main source of income is farming, livestock, fishing, or hunting (percent)	86.5
Percentage of communities that have:	
Weekly market	25.3
Repair shop	61.8
Tea or coffee shops/guest house/hotel	93.8
Percentage of communities that have:	
Electrified weekly market	0.6
Electrified repair shop	14.0
Electrified tea or coffee shops/guest house/hotel	33.1
Number of different types of businesses	7.0
Percentage of the different types of business that use electricity	35.7

Source: Tanzania Energy Sector Baseline Community Survey

Note: The analysis sample includes 178 intervention group communities. Survey item nonresponse may have resulted in smaller sample sizes for specific measures. See Appendix Table C.4 for sample sizes for all measures.

D. Public Institutions and Facilities

In addition to effects of the T&D line extension on households, public institutions such as schools or health facilities may benefit from new or improved electric lines. In this section, we describe the schools, health facilities, and sources of water in the intervention communities prior to the implementation of the new lines (Table III.4).

[23] The community survey asked separately about the presence of restaurants/tea or coffee shops, and hotels/guest houses in the community. However, judging from the pattern of responses we concluded that the respondents may not have distinguished between hotels and tea stalls/coffee shops. Hence, we combined these different types of businesses into a single measure.

Table III.4. Public Institutions and Facilities in the Community

Community Characteristic	Intervention Group Mean
Schools	
Percentage with a pre-primary or primary school	89.3
Percentage with an electrified pre-primary or primary school	13.5
Distance to nearest pre-primary or primary school (km)	0.98
Percentage with a secondary school	42.1
Percentage with an electrified secondary school	15.2
Distance to nearest secondary school (km)	2.78
Health Facilities	
Percentage with a dispensary	36.7
Percentage with an electrified dispensary	17.5
Distance to nearest dispensary (km)	2.73
Percentage with a health center, laboratory, or hospital	12.9
Percentage with an electrified health center, laboratory, or hospital	11.8
Distance to nearest a health center, laboratory, or hospital (km)	11.04
Percentage for which nearest health center, laboratory, hospital is electrified	98.9
Distance to obtain a vaccination (km)	0.73
Distance to obtain an X-ray (km)	25.19
Distance to obtain a malaria test (km)	7.02
Distance to obtain an HIV test (km)	4.50
Civic Institutions (police station, post office, or banks)	
Percentage with a police station/post office/banks	15.2
Main Source of Water	
Percentage with piped water as the main source	36.5
Percentage with well or borehole as the main source	40.4
Percentage with spring, river/lake, and rain water as the main source	22.5
Percentage with vendor or other sources	0.6

Source: Tanzania Energy Sector Baseline Community Survey

Note: The analysis sample includes 178 intervention group communities. Survey item nonresponse may have resulted in smaller sample sizes for specific measures. See Appendix Table C.4 for sample sizes for all measures.

1. Schools

On average, 89 percent of the intervention communities had a pre-primary or primary school. However, only a small fraction of the communities (14 percent) had an electrified pre-primary or primary school. Overall, the average distance to the nearest pre-primary or primary school was less than 1 km.

On average, about two in five communities (42 percent) had a secondary school, but only one in seven communities (15 percent) had an electrified secondary school. Because fewer communities had a secondary school, the average distance to the nearest one (2.8 km) was greater than the distance to the nearest primary school.

2. Health Facilities

Communities had varying degrees of access to health facilities and services. In Table III.4 we present statistics on access to health facilities such as dispensaries, health centers, laboratories, and hospitals, and to services such as vaccinations and X-rays. On average, 37 percent of the communities had a dispensary and only 17.5 percent of communities had an electrified dispensary. The average distance to the nearest dispensary was 2.7 km. Not surprisingly, fewer communities (13 percent) had a health center, laboratory, or hospital. The share of communities with an electrified health center, laboratory or hospital (12 percent) was nearly equal to the share that had any of these facilities. In other words, most of the health centers, laboratories, or hospitals in these communities were electrified. The average distance to the nearest health center, laboratory, or hospital was about 11 km, reflecting the fact that few communities had one of these facilities.

The distance to obtain certain health services varied substantially. The distance from the community to the nearest health facility for vaccination was only 0.7 km, whereas the closest X-ray facility was over 25 km away. This distance to obtain an X-ray is not unexpected, given the equipment required. Compared to an X-ray facility, community members had to travel a shorter distance to obtain a malaria test (7 km) or an HIV test (4.5 km). The distances to obtain an X-ray, malaria, and HIV test are all shorter for electrified communities (not shown in the table).

3. Other Civic Institutions

Civic institutions such as a police station, post office, or bank, can provide valuable services to community members. About one in seven (15 percent) of the intervention communities sampled for the study had a police station, a post office, or a bank in the community (Table III.4). Only 1.6 percent of the communities had all three of these institutions present in the community (not shown in the table).

4. Main Source of Water

A well or borehole was reported to be the main source of water in 40 percent of the communities (Table III.4). For another 36.5 percent, piped water was the main source of water. Spring, river/lake, and rain water was the main source for 22.5 percent of the communities. Vendors and other sources were the main suppliers of water for only one community. Access to water in the intervention communities may improve due to electrification if it is possible to install electric pumps at water source locations, such as wells or boreholes, provided that these sources are not currently electrified.

E. Community Infrastructure and Development Projects

In this section, we describe the infrastructure and development activities in the sampled intervention communities as reported by the community leader. More specifically, we discuss availability of telephone service and road accessibility, as well as past and planned development projects in these communities.

According to the community leaders, all but three of the 178 sampled intervention communities had working mobile telephone service. Moreover, in about half (49 percent) of the intervention communities, most people had a mobile phone (Table III.5). Far fewer, about one in five of the 178 communities were connected to land line telephones. About 62 percent of the communities were accessible by paved roads and 77 percent had bus services to other towns.

At the time when the community survey was conducted, across all types of development projects, the percentage of communities that had a project planned in the subsequent two years was greater than the percentage that had projects completed in the preceding two years (Table III.7).

About 73 percent of communities had a primary or secondary school project planned in the next two years whereas 58 percent had such a school project implemented in the past two years. The percentage of communities with planned road projects was also slightly higher than the percentage with such projects already implemented—62 percent versus 61 percent, respectively. Only 11 percent of communities had a market project in the preceding two years, whereas 62 percent had one planned in the next two years. Water and health center projects were implemented, respectively, in 36 and 34 percent of the communities during the past two years. In the next two years, 57 percent of the communities have a water project planned and 62 percent have a health center project planned. Altogether, the community leaders reported that their communities are expected to experience greater infrastructure development at about the same time that the new T&D lines are expected to be built in these communities.

Table III.5. Community Infrastructure and Development Projects

Community Characteristic	Intervention Group Mean
Percentage with working mobile phone service	98.3
Percentage in which most people have a mobile phone	48.9
Percentage connected to a land line phone	20.8
Percentage accessible by paved roads	61.7
Percentage with bus access to other towns	77.0
Percentage that had the following development projects in the past two years	
Primary or secondary school	57.9
Road	61.2
Market	10.7
Water	36.0
Health center	34.3
Percentage that have the following projects planned in the next two years	
Primary or secondary school	72.5
Road	62.4
Market	35.4
Water	57.3
Health center	61.8

Source: Tanzania Energy Sector Baseline Community Survey

Note: The analysis sample includes 178 intervention group communities. Survey item nonresponse may have resulted in smaller sample sizes for specific measures. See Appendix Table C.4 for sample sizes for all measures.

F. Variation by Urban-Rural Status

As noted in Section A of this chapter, 72 percent of the intervention communities are rural, and the remaining communities are urban (*mitaa*). In Table III.6 we present the means for several key characteristics separately for the urban and rural communities.

Rural intervention communities were larger on average compared to the *mitaa*, but as expected a smaller percentage of the rural communities had access to the existing electrical grid and a much smaller proportion of households were connected to the grid. The average number of household per community was 1,071 in the rural areas whereas it was 834 in the urban areas. Among the rural communities, only 25 percent had access to the grid and roughly 3 percent of the households in these communities were connected. By contrast, 84 percent of the *mitaa* had access to the grid and about one-third of the households in these communities were connected.

Table III.6. Variation in Community Characteristics by Urban-Rural Status

Community Characteristic	Urban Intervention Group Mean	Rural Intervention Group Mean
Number of households in the community	834	1,071
Percentage of communities with access to the existing electrical grid (community leader report)	84.0	25.0
Average percentage of households in the community connected to the grid	33.0	2.9
Price of residential land per acre (TZS)	13,998,980	1,036,172
Percentage with piped water as the main source of water	80.0	19.5
Main source of income is farming, livestock, fishing, or hunting (percent)	58.0	97.7
Percentage with working mobile phone service	100.0	97.7
Distance to nearest district or regional capital (km)	9.56	38.02
Distance to nearest pre-primary or primary school (km)	0.76	1.07
Distance to nearest secondary school (km)	1.56	3.26
Distance to nearest a health center, laboratory, or hospital (km)	4.2	13.71
Sample Size	50	128

Source: Tanzania Energy Sector Baseline Community Survey

Note: The analysis sample includes 178 intervention group communities. Survey item nonresponse may have resulted in smaller sample sizes for specific measures.

in 58 percent of the *mitaa*. All of the *mitaa* and almost all of the communities in the rural areas (98 percent) had working mobile phone service.

There were also differences between rural communities and *mitaa* in terms of the price of land, the main source of income, and presence of piped water. The average price of residential land per acre in the *mitaa* was about 14 million TZS compares to just over 1 million TZS in the rural communities. Piped water was the main source of water for 80 percent of the *mitaa*, but only one-fifth of the rural communities. As expected, farming, livestock, fishing, or hunting was the main source of income in all but three of the rural communities. These were the main sources of income

Not surprisingly, mitaa were closer to the district or regional capital and to schools and health facilities. On average, mitaa were about 10 km away from the nearest district or regional capital compared to 38 km for the rural communities. In Mitaa, the nearest pre-primary or primary school was less than a kilometer away (0.8 km) on average; the nearest secondary school was an average of 1.6 km away. The nearest pre-primary or primary school was about 1 km away on average for rural communities and the nearest secondary school was 3.3 km away. Residents of the rural communities had to travel much farther on average to visit the nearest health center, laboratory, or hospital—31.7 km—compared to the 4.2 km that people who lived in mitaa had to travel.

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IV. CHARACTERISTICS OF HOUSEHOLDS IN THE INTERVENTION GROUP

In this chapter, we describe the characteristics of households in the intervention communities—those scheduled to receive the new T&D lines.[24] We look at household composition and mobility, energy use, human capital, current economic activities, poverty and economic well-being, and variation by gender. Our sample includes about 4,700 households in 178 intervention communities.[25]

A. Household Composition and Mobility

Table IV.1 shows the household composition and mobility for our sample. Our sample has approximately 4.9 people per household, about 2.5 of whom are under the age of 18. In comparison, the average household size for Tanzania is 5.0 persons and almost half (47 percent) are under the age of 15 (NBS and ICF Macro 2011). The head of the household in our sample of intervention group households had an average age of 45. Only about 3 percent of the household heads were in the 18 to 24 range and about 73 percent were married. The average time in the home was around 10 years. About 3 percent of the sample had moved in the last 7.5 months.[26]

Table IV.1. Household Composition and Mobility

Variable	Intervention Group Mean
Household Size	
Number of household members	4.9
Number of household members under 18	2.48
Age	
Head of household age (years)	44.8
Household head is 18–24 years of age (percent)	3.1
Marital Status	
Head of household married (percent)	72.8
Mobility	
Years in home	10.3
Moved in last 7.5 months (percent)	2.7

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Survey item nonresponse may have resulted in smaller sample sizes for specific measures. See Appendix Table C.2 for sample size for each measure shown in this table.

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[24] In Chapter VI we compare the intervention and comparison groups based on the characteristics presented here. We find no evidence of jointly significant differences, once the comparison group has been weighted appropriately.

[25] Our original sample contained 182 intervention communities where new lines were planned at that time. Since the completion of the household survey, we learnt from MCA-T and TANESCO that four of the 182 surveyed intervention communities will no longer receive new lines under the T&D activity. Consequently, these four communities are left out of our analysis in this report, as explained in Chapter II. For the sample discussed in this chapter, we also drop three households that could not be matched to the comparison group households, as explained in Appendix A. Means with and without these three households are very similar. The means with these households are shown in Appendix Table C.1.

[26] This may be an underestimate of actual mobility because the household listing and survey for the intervention group were often conducted a few months apart. In the comparison group, where the listing and survey were completed within a few days of each other, about 4.8 percent had moved in the last 7.5 months. This differential is discussed in Chapter VI, Section A.

B. Energy Use

The most direct impacts of getting access to grid electricity are likely to be seen in energy use. The household survey collected detailed information on energy consumed by the household from many different sources.[27] In order to summarize this information in a parsimonious way, we translated the energy content available from these sources into kilowatt hours (kWh) using information on the approximate amounts of energy content from a unit of each type of fuel (see Appendix Table C.6). Energy content refers to the total energy that could be obtained under ideal conditions from a given unit of fuel. As discussed below, the actual output produced from a given unit of energy varies depending on how efficiently the energy content of the fuel is used. For example, burning wood at higher temperatures is generally more efficient than burning at low temperatures and boiling water with an electric tea kettle may be more efficient than on a stove. To portray a fuller picture, we also collected similar data on energy consumed by various devices and appliances covered in our survey (see Appendix Table C.6). These estimates are all approximate, but are helpful for summarizing the information we have across different fuel types.

In this chapter, when we compare the price of grid electricity with that of other sources of energy, we focus on the monthly tariff households pay for grid electricity, and not the fixed costs of getting connected and wired. Our choice is motivated by the idea that the fixed costs can be amortized over time and may be viewed as an investment in durable goods, as discussed in Chapter VII. However, many households may be cash constrained; hence, we do present an analysis of the potential importance of the fixed costs of electricity in Chapter VII.

We also focus on the price consumers pay for grid electricity rather than the actual costs of producing electricity. The prices consumers face may differ from the actual costs if the government is subsidizing generation and distribution of electricity, if the electricity company is reaping substantial profits over and above their costs, or if there are externalities, like the costs of pollution, associated with producing different types of energy.[28] While these issues will be important for conducting a complete cost-benefit analysis, they are less important for determining whether or not households will take advantage of grid electricity at current prices, once it becomes available.

1. Total Use

The households in our sample report spending about 30,900 TZS per month (about 13 percent of their total monthly income) on fuel and we estimate that they obtained around 867 kWh per month in energy content from that fuel (Table IV.2). This implies an average cost of 36 TZS/kWh. Purchasing the same amount of grid electricity would cost around 200,000 TZS/month using 2012 prices, at the regular tariff of 221 TZS/kWh. This suggests that Tanzanians in these communities may not replace all of their current energy use with electricity. However, the cost of energy varies greatly across households, and electric appliances may be far more efficient than non-electric appliances for many purposes (for example, for light), so many households may choose to replace substantial portions of their current energy use with grid electricity from the new lines.

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[27] These include fuel wood, crops, straw/leaves, dung, charcoal, candles, kerosene, diesel/gas, liquefied petroleum gas, three types of small batteries, car batteries, grid electricity, solar power, hydropower, and electricity generated from diesel or gas-powered generators.

[28] We discuss pollution levels as a health issue, but do not try to monetize those levels in this report.

2. Electricity

Currently, the households in our sample use only around 12.3 kWh/month of electricity, 11.4 kWh generated at home and another 0.82 kWh from the grid (Table IV.2).[29] In comparison, the monthly consumption of electricity for similar sized households is 51.7 kWh in sub-Saharan Africa, excluding South Africa, and 4,249.2 kWh in high-income countries (Eberhard et al. 2008).[30] These averages include households that use no electricity. Households that use electricity obtain it from three major sources—batteries, generators, and the grid.

a. Batteries

The households in our sample report spending around 3,382 TZS/month on small household batteries (sizes D, AAA, and AA). We estimate that they get around 0.024 kWh/month of electricity from this source, at an average cost of around 141,000 TZS/kWh. This suggests that it might be cost-effective to replace batteries with grid electricity. However, some of these small batteries may be used to power devices like flashlights that are used outside of the home and cannot easily be replaced by grid electricity.

The households in our sample also report spending about another 4,433 TZS/month on car batteries used for household tools and appliances. We estimate that they get around 0.096 kWh of power from these car batteries for a cost of around 48,000 TZS/kWh. This rate is also much higher than the tariff TANESCO charges, suggesting that it might be cost-effective to replace most, if not all, of their car battery use with grid electricity.

b. Generators

Only around 6.2 percent of the households in our sample reported using generators.[31] We estimate that these generators produce around 11.4 kWh/month of electricity, which is almost all of the energy content consumed by these households from electricity.[32] We did not directly ask how much households spent to obtain this electricity.[33] However, other research suggests that grid electricity is far cheaper than electricity produced by household generators (Woofenden 2012). In addition, the data we collected in Appendix C suggest that a small generator that produces 2 kW of electricity per hour uses around 0.7 liters of fuel. If that fuel costs 2,700 TZS per liter, then the

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[29] We estimated grid electricity consumption using the amount the household reported paying for electricity and the TANESCO rates as of June 2012 and that households chose the payment plan that would give them the most kWh given what they were spending. The payment plans are discussed below in the section on grid electricity.

[30] We obtain these estimates by multiplying the annual per-capita estimates from Eberhard et al. (2008) by 5 people per household and then dividing by 12 months.

[31] In Section D of the baseline household survey, 171 intervention group households reported using regular generators, 117 reported using solar generators, and 1 reported using a pico-hydro system.

[32] Another 16 households reported getting electricity from a local grid and 3 reported getting electricity from their neighbors. We omit these sources of electricity in our calculations of total kWh.

[33] In section D of the household survey we asked about hours of use of "generator sets," "solar PV systems," and "pico-hydro systems." We use those data to estimate kWh produced. In section L we asked about spending on a different set of categories that also included "generator set" and "solar PV system." However, most households that reported using generator sets or solar PV systems did so in one section or the other, but not in both. Hence, it is not clear that the cost data can be directly compared to the kWh data for these questions.

electricity generated costs around 945 TZS/kWh—again, well above the general use tariff charged by Tanesco (221 TZS/kWh).

Table IV.2. Total Energy Use per Month and Electric Energy Sources

Variable	Intervention Group Mean
Total Energy Use (per Month)	
Total expenses for energy (TZS)	30,912
Non-electric energy expenses (TZS)	25,879
Total energy content (kWh)	867
Energy content from non-electric fuels (solid and liquid) (kWh)	855
Electric Energy Sources (per Month)	
Batteries	
Electricity generated including batteries (kWh)	11.5
Expenses for house batteries	3,382
Household battery output (kWh)	0.02
Hours of car battery use	12.1
Expenses for car batteries	4,433
Electricity generated by car batteries (kWh)	0.096
Generators	
Household uses generators (percent)	6.2
Hours of energy generation including car batteries	26.5
Electricity from generators (kWh)	11.4
Grid	
Household uses grid electricity (percent)	1.1
Amount of grid electricity (kWh)	0.82
Expenses for grid electricity (TZS)	141

Sources: Tanzania Energy Sector Baseline Household Survey.

Notes: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Survey item nonresponse may have resulted in smaller sample sizes for specific measures. See Appendix Table C.2 for sample size for each measure shown in this table.

We assumed that households used the lifeline rate to pay for grid-electricity if that would get them more electricity than the regular rate given what they spent. The regular rate includes a fixed monthly charge. The lifeline rate increases to 273 TZS/kWh for households that consume more than 50 kWh/month. We also adjust for taxes. The monthly spending on grid electricity comes from section L of the household survey.

c. Grid electricity

Households connected to the grid were not included in our survey. However, about 42 of the households in our intervention group sample (about 1 percent) did report having grid electricity.[34] The households in our survey report currently were spending an average of around 141 TZS per month on grid electricity (including the non-users). We estimate that they obtained around 0.82 kWh

[34] One potential explanation for this would be if they had an IGA not located at the home. However, of these 42, only 4 reported having an IGA with grid electricity not at the home. Another potential explanation is that these households may have obtained grid electricity between the time when the listing was done and when the household survey was conducted, which was sometimes as much as six months later. This is less likely in the comparison group, where the survey was usually done within days after the listing. Consistent with that, we find only 7 such households in the comparison group.

for this amount, for an average tariff of around 150 TZS/kWh.[35] This is less than the 221TZS/kWh general use tariff discussed above (that they would have to pay to cover all of their energy needs) because Tanzanians who use fewer than 50 kWh/month for grid electricity can pay TANESCO only a "lifeline" tariff of around 60 TZS/kWh, compared to a standard tariff of 221 TZS/kWh for a regular household user.[36]

3. Non-Electric Fuel Use

We estimate that the intervention group households in our sample obtained almost all of their energy content (around 855 kWh/month) from non-electric sources (Table IV.2). We estimate that they spent about 26,000 TZS/month for this type of energy. This includes the fuel used for generators. This implies an average cost of about 30 TZS/kWh—lower than the grid electricity tariff, even at the lifeline rate of 60 TZS/kWh. However, as discussed below, electricity may be a far more efficient source of energy content in at least some situations.

a. Solid fuel use

Households reported using around 151 kg/month of solid fuel and spending around 14,458 TZS/month to obtain this fuel (Table IV.3).[37] Almost all of the solid fuel was wood and charcoal.[38] We estimate that they obtained approximately 788 kWh/month of energy content from these sources, implying an average cost of 18.3 TZS/kWh. This low cost occurs in part because they got about half of their solid fuel (wood in particular) for free. Although this appears to be a cheaper source of energy content than electricity, some of this energy may be used very inefficiently. For example, electricity might be a more efficient source of heat for cooking than wood in some situations and this may be particularly true of certain devices, such as electric kettles (Paster, 2009). However, this may be offset to some extent by the costs of purchasing electric tools and appliances (Hosier and Kiponda, 1993). In addition, some of the heat lost when cooking with wood may help to warm houses in colder parts of Tanzania. Finally, our calculations suggest that on a per-hour basis, it costs around 663 TZS per hour to run an electric stove using grid electricity compared to

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[35] We estimate grid electricity in kWh based on the assumption that the household uses the payment plan (either the lifeline or regular one) that provides the most kWh given the amount that they pay. The regular plan has a fixed cost per month. The lifeline plan has a rate that increases to 273 TZS/kWh after the first 50 kWh. These rates are pre-tax; when doing our calculations of kWh of electricity, we adjust the estimates based on the assumption that households reported expenditures including taxes.

[36] The regular tariffs are referred to as "general usage, T1" rates and also include a monthly fee of 3,841 TZS. The lifeline rate is also referred to as a "domesstic low usage, D1" rate and has no monthly fee. However, if a household consumes more than 50 kWh, the rate for the domestic low usage customers goes up to 273 TZS/kWh.

[37] When we estimate total solid fuel consumed by the stoves reported in section D of the household survey we get a lower estimate—of around 107 kg/month. The difference may be due to the fact that we assumed they were using charcoal stoves rather than wood fires, which might consume a far greater quantity of fuel in kg.

[38] For example, 112kg is from wood. In comparison, a study of non-electrified rural villages in South Africa showed a mean rate of around 60kg per month per person (19.9 kg purchased and 40.5 collected) prior to getting grid electricity (Madubansi and Shackleton 2006, Table 2 for 1991). This implies an average of around 300 kg/month for a household of five people.

only about 143 TZS per hour using solid fuels.[39] Table IV.3 shows how the solid fuels used break down by type.

Table IV.3. Solid Fuel Use per Month

Variable	Intervention Group Mean
Solid fuel used (kg)	151
Spending on solid fuel (TZS)	14,458
Energy content of solid fuel (kWh)	788
Wood used (kg)	112
Free wood (kg)	75
Charcoal used (kg)	36
Free charcoal (kg)	2.3
Crop residues used (kg)	2.8
Free crop residues (kg)	2.2
Straw used (kg)	0.0
Free straw (kg)	0.0
Dung used (kg)	0.0
Free dung (kg)	0.0
Candles used (kg)	0.6
Free candles (kg)	0.0

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Survey item nonresponse may have resulted in smaller sample sizes for specific measures. See Appendix Table C.2 for sample size for each measure shown in this table.

b. Liquid fuel use

Households reported that they obtained around 7.0 liters of liquid fuel per month at a cost of about 11,564 TZS/month. We estimate that they obtained approximately 66.4 kWh of energy content from this liquid fuel, implying an average cost of 174 TZS/kWh (Table IV.4).[40] This price is far more than the 60 TZS/kWh tariff for lifeline electricity, but it is less than the general usage tariff for electricity (221 TZS/kWh). Given the variation in the efficiency of producing output from liquid fuel and the variation in price across the different types, this suggests that households may replace some but not all of their liquid fuel use with electricity.

[39] The estimated cost for cooking using electricity is based on the 221 TZS/kWh tariff that TANESCO charges times an estimate of 3 kW per hour to run an electric stove. We use the regular rate of 221 TZS/kWh instead of the lower 60 TZS/hour lifeline rate TANESCO charges because the lifeline rate is only available for up to 50 kW per month which would imply cooking for only 17 hours—less than 1 hour per day. The estimated cost for cooking with solid fuel is 96 TZS/kg price based on our data (total spent on solid fuel divided by average kg consumed) times 1.5 kg/hour for cooking with a stove. The later is based on a weighted average of the wood and charcoal cooking constants from Appendix Table C.6 where the weights are 75% for wood and 25% for charcoal.

[40] When we estimate total liquid fuel consumed by the devices and appliances reported in section D of the household survey (regular kerosene lanterns, pressurized kerosene lanterns, kerosene stoves, gas cookers, diesel water pumps, and diesel/gasoline motors) we get a lower estimate—less than 3.2 liters/month. The difference between the 7.0 liters reported in Section K and our estimate from section D may be due to our estimates for the fuel consumption of these devices, which are necessarily very approximate.

Table IV.4. Liquid Fuel Use per Month

Variable	Intervention Group Mean
Liquid fuel used (L)	7.0
Spending on liquid fuel (TZS)	11,564
Energy content of liquid fuel (kWh)	66.4
Kerosene used (L)	5.0
Free kerosene (L)	0.4
Gas used (L)	1.9
Free gas (L)	0.00
LPG (L)	0.14
Free LPG (L)	0.00

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. The monthly spending on liquid fuel, reported in this table, and the monthly spending on solid fuel, reported in Table IV.3, do not add up exactly to the reported spending on both because of missing values.

Although the story may be somewhat mixed for liquid fuel in general, it is far clearer for liquid fuels used to produce light. This is because electricity may be far more efficient for producing light than kerosene lamps are. We estimate that the households we observed got around 67 lumens of light per TZS using grid electricity and regular incandescent bulbs if they paid the higher tariff for electricity (221 TZS/kWh).[41] They got even more (almost 250 lumens/TZS) if they paid only the lifeline rate (60 TZS/kWh). In contrast, we estimate that a regular kerosene lantern will produce only 2.5 lumens per TZS.[42] This suggests that households may switch a large percentage of their light use to grid electricity once they have access.

Although light use may switch over to electricity, it is less clear what will happen to some of the other possible uses of liquid fuels. For example, households that use liquid fuels for cooking may continue to do so because electricity is still expensive and its supply is unreliable (Energy and Environment Partnership 2012). Indeed, we estimate a cost of 378 TZS/hour for cooking with kerosene compared to the 663 TZS cost for electricity.[43] A breakdown of the types of liquid fuels used by households is presented in Table IV.4.

4. Tools and Appliances

The households in our sample have an average of 7.0 tools and appliances per household. About 2.9 of these are lights. Table IV.5 shows the use of different types of tools and appliances.

[41] See Appendix Table C.7 for the source of our data on energy consumption and lumens of light from incandescent lights.

[42] This is based on the constants in Appendix Table C.7 and an assumed cost of 2,700 TZS/liter of kerosene.

[43] Our estimate for cooking with kerosene is based on an estimated cost of 2,700 TZS per liter (from our household survey data) times 0.14 liters per hour to run a kerosene stove (from Appendix Table C.6). The 2,700 TZS price is the average paid per household in our data. The average per liter is much lower, perhaps because households that consume larger volumes get fuel in bulk at a much lower price. The lower income households may pay premium prices to purchase small quantities.

For most appliances, we do not have good output measures other than total hours of use. However, for a few we do. For example, based on the types of lights used and the numbers of hours per light, we estimate that these households consumed around 72,000 lumen-hours of light per month. In comparison the average per capita light consumption in Great Britain is around 3.8 million lumen-hours per month.[44] Since electric lights produce far more lumens than non-electric lights, the amount of light produced may increase greatly with the introduction of grid electricity.

Table IV.5. Tools and Appliances

Variable	Intervention Group Mean
Number of appliances	7.0
Number of lights	2.9
Light-hours/month	326
Light lumen-hours/month	71,911
Water pump hours/month	1.1
Water liters/month from pumps	36,587
Radio and CD hours/month	58
TV hours/month	8.7
Cooking hours/month	196.0
Water heating hours/month	0.0
Refrigeration hours/month	11.9
AC Fan hours/month	0.8
Someone in home has mobile phone (percent)	69.8
Home has landline phone (percent)	0.2
Total phone minutes/month if have a phone	828
Mobile phone recharges/month if have a mobile phone	16
Mobile phone recharge costs/month if have a mobile phone (TZS)	3,809

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Valid skips and survey item nonresponse may have resulted in smaller sample sizes for specific measures. Minutes of mobile phone use, recharges and recharge costs are only calculated for households with phones. See Appendix Table C.2 for sample size for each measure shown in this table.

We can also estimate liters of water produced by pumps. This could change if households switch from getting water manually to obtaining it with electric pumps that can operate for more hours and free up the time of household members for other types of productive activities. In addition, some households may use pumps for irrigation (Khandker et al. 2009). Currently, households average only about 1.1 hours per month of pump use, but this is because only 22 households currently use water pumps. During that one hour they produce an average of over 36,000 liters of water—which is possible because 12 of the pumps are diesel-operated and we used an estimate of 60,000 liters/hour for diesel water pumps.[45] At the same time, however, diesel water pumps may be more expensive to run than electric pumps. Indeed, some evidence suggests that

[44] We obtained this estimate from an article in *The Economist* (2010) using the following formula: 3.8 million lumens per month=46 megalumen-hours per year times one million lumens per mega-lumen divided by 12 months per year.

[45] Five of the reported water pumps are electric and six are manual. One household reported using two water pumps.

electric water pumps may be more than three times as efficient as diesel water pumps per unit of energy content of the fuel (Martin et al, 2011). Thus, some households who would not use diesel pumps may choose to use electric pumps. On the other hand, many of the communities that receive new lines may also see improvements in their water supplies, so it is not clear if there will be an increase or decrease in pumped water when grid electricity arrives in a community.

We also obtained information on phones, because one potential benefit of grid electricity will be that it will enable households to charge their mobile phones more easily. This may create economic benefits to the extent that mobile phones are used to improve economic outcomes (Collings 2011). Currently, about 70 percent of the intervention group households have mobile phones compared to 46 percent of Tanzanians overall (NBS and ICF Macro 2011).[46] Almost none of these households have landlines. The households with phones use their phones for about 828 minutes per month on average and recharge their mobile phones about 16 times per month at a cost of around 3,809 TZS per month. It will probably cost households far less to charge their phones using grid electricity; however, this expenditure represents less than 2 percent of household income on average. That said, the extra convenience of being able to charge phones at home may enable far more households to keep their phones charged and may encourage some additional households to get mobile phones.

5. Housing Materials and Grid Electricity Connection Requirements

In order to obtain grid electricity, one needs to have housing materials that satisfy TANESCO standards, which are designed to avoid safety risks. According to MCA-T and TANESCO staff, houses with grass thatch and mud walls are less likely to qualify. We asked households about the materials used for their walls and roofs and used this information to estimate the percentage of houses that were electrifiable. We found that a large fraction (about 79 percent) have the requisite materials (Table IV.6). In comparison, about 73 percent of Tanzanian households have electrifiable walls, and a little over 62 percent of them have electrifiable roofs (NBS and ICF Macro 2011), suggesting that the households in the communities we are studying are better off than the average household in Tanzanian in terms of housing materials.

Table IV.6. Housing Materials (percentages)

Variable	Intervention Group Mean
Wall electrifiable	89.0
Roof electrifiable	84.8
House electrifiable	79.3

Sources: Tanzania Energy Sector Baseline Household Survey.

Notes: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Survey item nonresponse may have resulted in smaller sample sizes for specific measures. See Appendix Table C.2 for sample size for each measure shown in this table.

We treated walls made of grass or poles and mud as not electrifiable. We treated roofs made of earth, sand, dung, or thatch as not electrifiable. For a house to be electrifiable it needed to have both its walls and roof electrifiable.

[46] The percentage of households with cell phones in Tanzania may be much higher than the number of individuals with phones, since not all household members need to have a phone for the house to be counted as having one.

C. Human Capital

1. Schooling

If lighting use does change substantially when grid electricity is introduced, one potential benefit would be to increase the education levels of household members. This could happen both because grid electricity may reduce the need for non-education tasks (such as collecting fuel) and because it will be easier to study at night (by providing better light). Child enrollment may be most sensitive to increased access to electricity, but we will also look for impacts on adult levels of education as some of them may also be pursuing additional education, and perhaps rely even more heavily on attending school and studying at night than their children. Table IV.7 reports on education levels and on the percentage of children and youth ages 5–24 attending a school that is electrified, among households with any child attending school.[47] That level is over 7 percent, perhaps reflecting the fact that about a third of these communities already have electricity even though it is not available to the households in our survey sample.

2. Student Time Use

Even if we do not see a change in school attendance or completed levels of education, we might still see improvements in time use related to educational activities associated with receiving grid electricity. This could happen for at least two reasons. First, if grid electricity improves access to light in the evenings, it may be easier for children to study. Currently, the students in our data spend less than an hour per day studying at home at night. Second, electricity may reduce the need for students to participate in other activities, such as collecting fuel and water. Currently they spend about one hour per day on these two activities combined. On the other hand, grid electricity may also increase access to television, which could reduce total time spent studying effectively. Currently, the students in our sample spend an average of only 0.2 hours per day watching television. Table IV.8 reports on student time use at baseline.[48]

3. Health-Related Outcomes

Health is another area where we might see impacts of getting electricity. We asked households to report on adult and child health, the degree to which they obtain information about health issues on the radio, and sanitation (water and toilets). We also used their data on energy sources to estimate pollution levels due to their energy use (see Appendix Tables C.6 and C.7 for the conversion factors). Table IV.9 shows how these variables are distributed in the households in our sample.

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[47] For all variables describing children, we calculate the average for each household and then take the average across households. Thus, the results are representative of households but not of children. We obtained education data on all youth ages 5–24. In Table IV.7, we report on enrollment for ages 5–14. Enrollment rates are lower for the higher age groups. We use the full age range (5–24) for the variable on school electrification.

[48] We also looked at student's time use by gender (results not shown in the table). We found no differences larger than 0.40 hours per day on any activity. Girls spent more time than boys in other household chores (0.38 hours more per day) and more time collecting water (0.11 hours more per day). Boys spent more time on other leisure activities (0.31 hours more per day) and listening to the radio or CD player (0.12 hours more per day). Gender differences for the remaining activities covered in Table IV.8 were all less than 0.10.

Table IV.7. Education

Variable	Intervention Group Mean
Adult Education	
Highest grade completed – household head	5.8
Completed any education – household head (percent)	81.6
Completed primary education or more – household head (percent)	11.2
Completed secondary education or more – household head (percent)	8.4
Completed tertiary education – household head (percent)	2.1
Child Attendance	
In school of those ages 5–14 (percent)	75.1
In an electrified school of those ages 5–24 in school (percent)	7.1

Sources: Tanzania Energy Sector Baseline Household Survey.

Notes: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Valid skips and survey item nonresponse and may have resulted in smaller sample sizes for specific measures shown in this table. The variable "in school of those ages 5–14" is only available for households with people age 5-14. The variable "in an electrified school of those ages 5–24 in school," is only available for households with people age 5-24 in school. See Appendix Table C.2 for sample size for each measure shown in this table.

For all variables describing children, we calculate the average for each household and then take the average across households. Thus, the results are representative of households but not of children.

Table IV.8. Student Time Use (Hours per Day)

Variable	Intervention Group Mean
Average Hours Studying at Home, Ages 5–24	
After sunset	0.66
During the day	0.57
Educational Time Use, Ages 5-14	
At school	6.01
Reading and studying	0.98
Energy-Related Time Use, Ages 5-14	
Collecting fuel	0.33
Collecting water	0.68
Entertainment, Ages 5-14	
Listening to radio	0.58
Watching TV	0.22
Other leisure activities	3.46
Other Time Use, Ages 5-14	
Doing other household chores	0.99
Taking meals	0.78
Personal hygiene	0.51
Resting during the day	0.79
Sleeping at night	9.08

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The means are weighted to adjust for sampling and nonresponse. Only households with students in the stated age groups answered these questions. The two questions on members ages 5–24 are averages across the responses to section B for all students in that age range in the household. The other variables are available only for the student ages 5–14 for whom time-use data were provided in section H. See Appendix Table C.2 for sample size for each measure shown in this table.

Table IV.9. Health, Sanitation, and Pollution (percentages, unless otherwise noted)

Variable	Intervention Group Mean
Adult Health	
Adult had health problems in last 7 days	45.2
Adult (15 years or older) was unable to work due to illness in last 30 days	17.4
Child Health	
Child under 6 had health problems in last week, if any child under 6	44.3
Child died if any born alive in last two years	8.6
Health Information	
Receive HIV/AIDS or other health information via radio or TV	64.2
Water Sources	
Inside dwelling	4.4
Outside dwelling	37.8
Well and borehole	34.2
Vendor, kiosk, truck/tanker service	5.5
River/lake/spring/pond/rain	33.9
Other	4.3
Toilet Types	
Flush	4.7
Pit	87.1
Latrine	5.6
Other	0.8
Pollution per Month	
Soot (g)	150
CO_2 (kg)	275

Sources: Tanzania Energy Sector Baseline Household Survey.

Notes: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Valid skips and survey item nonresponse may have resulted in smaller sample sizes for specific measures. The first and second child child health variables are only available for households with children under 6 and for those with a child born alive in the last two years respectively. See Appendix Table C.2 for sample size for each measure shown in this table.

We grouped the water sources from the Tanzania NBS report (NBS and ICF Macro 2011) as follows: (1) shared tap and public tap for piped water outside dwelling, (2) tube well or borehole and protected dug well for well or borehole (with or without pump), and (3) unprotected dug well, rainwater, surface water, and protected spring for river/lake/spring/pond. We asked separate questions about water use during the rainy season and dry seasons. We combine the responses here by reporting on the percentages that use the source in either season. Consequently, the totals for water use add up to more than 100 percent.

We grouped the toilet types from the Tanzania NBS report (NBS and ICF Macro 2011) as follows: (1) flush to piped sewer system, flush to septic tank, flush to pit latrine, and flush not to sewer/septic tank/pit latrine for flush toilet and (2) VIP, pit latrine with slab, pit latrine without slab/open pit for pit toilet.

Adult and child health measures include respiratory and vision problems as well as headaches. Respiratory problems may be affected in the short term because of a change in indoor air quality (through reduction in soot within the home, as discussed below). Vision problems and headaches may be impacted by light. Thus, we may see short-term impacts on both of these types of outcomes. Households reported that about 45 percent of adults and 44 percent of children had had these types of problems in the past week.

Providing grid electricity to a community could also reduce child mortality by improving access to health clinics with electricity. About 9 percent of the respondents to our household survey who had at least one birth in the last two years said that at least one of those children had died. In comparison, infant mortality in Tanzania was around 5 percent and the under-5 mortality rate was around 8 percent in 2010 (NBS and ICF Macro 2011). Our survey child mortality rates may be higher than the infant mortality rates reported for Tanzania in part because our rates are calculated at the household level and some households in our sample may have had more than one birth in the last two years. In contrast, the Tanzanian infant mortality rates are all per child.

Water sources also affect health and could be affected by grid electricity if that source of energy is used to improve water supplies (perhaps by powering a community pump). Fewer than 5 percent of the households in the intervention group reported having access to piped water inside their house during either the rainy season or the dry season (or both).[49] On the other hand, 38 percent of the households get piped water outside. Other major water sources are well/borehole (34 percent) and natural sites (34 percent) such as rivers and ponds. In comparison, 8 percent of Tanzanian households have piped water inside the house, 25 percent have piped water outside the house, and almost half (49 percent) get water from natural sites. Only 15 percent of Tanzanian households use wells or boreholes for water (NBS and ICF Macro 2011). To summarize, our sample appears to be less likely to rely on natural water sources and more likely to rely on piped water outside the home and wells or boreholes than the average in Tanzania.

Electricity may also have an impact on health through the types of toilets that Tanzanian households use. For example, improved lighting could make household members more likely to build and use pit toilets farther from their home, thereby minimizing contamination risks. Similarly, electricity in a community might improve access to water, and thereby improve the households' ability to clean their toilets and/or perhaps even get flush toilets. Almost 87 percent of the households in the intervention group have pit toilets and only 5 percent use flush toilets. Similarly, most Tanzanian households have their own pit toilets (76.6 percent) and just 6 percent use flush toilets (NBS and ICF Macro 2011).[50]

One way in which energy use can affect health is through pollution. We use the household survey data to estimate two types of pollution produced in the homes—soot (or black carbon) and carbon dioxide (CO_2).[51] We obtain these estimates by combining the household survey data on energy use with estimates of the amount of pollution produced per unit of fuel used. Details on the pollution per unit of fuel estimates we used are provided in Appendix Table C.6.

One direct impact of grid electricity on the health of household members could occur through its impact on the production of soot within the home. Wood and charcoal, generally used for cooking, are particularly large sources of soot. Hence, if households were to replace cooking and heating fuels with grid electricity, their health outcomes might greatly improve. However, as discussed earlier, it is not clear that households will reduce their use of these fuels when electricity is

[49] We asked separate questions about water use during the rainy and dry seasons. As explained in the table notes, we combine the responses here by reporting on the percentages that use the source in either season.

[50] Another 5.4 percent of Tanzanian households share toilets with other households. Some of these shared toilets may also be pit latrines.

[51] There are, of course, many other pollutants created from energy use—for example, nitrogen oxides and sulfur oxides, both of which contribute to acid rain. We chose soot and CO_2 as those are somewhat better known than many of the other forms of pollution.

introduced, since the wood used for cooking and heating can often be obtained for free and since electric appliances can be quite costly.

Kerosene is another source of soot, and the use of kerosene for light may also diminish if more people use grid electricity. However, kerosene is a much smaller source of pollution than wood and charcoal, because households use far less liquid fuel than solid fuel (in terms of either volume or mass).[52]

Soot creates direct problems for breathing in a relatively small area around the home. Carbon-based fuels also produce substantial amounts of CO_2 which, together with soot, can affect global warming and thus impact far more people (Engelke 2012). We estimate that these households are producing about 150 grams of soot per month and another 275 kg of CO_2.[53] In comparison, Tanzanians produce around 0.152 metric tons of CO_2 per year per person, which implies around 62 kg per month per household.[54] The relatively high rates of CO_2 emission in our sample appear to be driven by the high levels of use of solid fuels—in particular wood and charcoal.[55] Although they are high compared to the Tanzanian average, they are much lower than the rates reported in five rural South African communities that obtained electricity between 1991 and 2002. For wood alone, the households in those five South African communities averaged around 60 kg per person per month, or over 300 kg per household (Madubansi and Shackleton 2005), compared to only 150 kg/month of solid fuel per household in our sample.

The discussion above has focused on relatively direct potential impacts of grid electricity on health outcomes. We may see some indirect benefits as well, in terms of access to better medical facilities. Also some households may use electricity to obtain cleaner sources of water, larger volumes of water needed for flush toilets, and perhaps improved access to information about health via TV, radio, and mobile phones.

D. Current Economic Activities

1. Household Activities and Adult Time Use by Gender

Obtaining access to grid electricity may impact household behaviors in many ways. In Table IV.10, below, we present hours per day by activity for the key female and male members of the household, if present. Both the key male and female are either the head of the household or the spouse of the head. Since some households have single heads, not all have a key male or female.

We start with work-related activities. If access to grid electricity can improve the productivity of households, this could be one of the major benefits. We also measure studiousness by adults. This could also change if access to light at night improves their ability to read. We measure numerous chores in which adults participate, including food preparation, fuel collection, and water collection.

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[52] The sources we identified suggest that kerosene, wood, and charcoal produce about the same amount of soot per kilogram of fuel burned. See Appendix Table C.2 for details.

[53] It might seem surprising that the mass of CO_2 produced could exceed the mass of fuel used. This is possible because these fuels are primarily made of carbon and during combustion this carbon combines with oxygen in the air.

[54] Based on data from [http://data.worldbank.org/country/tanzania]. Accessed on September 25, 2012.

[55] Grid electricity might also be produced using coal. However, the systems to clean the emissions in a power plant used for the grid may be better than in a typical home.

We find that males spend more time on non-wage farming and IGA activities than females, whereas females spend more time doing various household chores, including collecting water and fuel. Time spent collecting water and fuel may not change substantially unless households change their sources of water and their use of solid fuel for energy.

We allowed household members to report hours of time use that summed to more than 24 hours. This is plausible if they are doing multiple activities at the same time—for example, preparing food and listening to the radio. We calculated the total number of hours of activities reported and subtracted 24 to calculate a "multitasking" category. That is also reported as the last item in Table IV.10. The impact of multitasking on total household productivity depends on the degree to which multitasking reduces the productivity of each activity compared to if that activity were done on its own. If one can cook just as well regardless of whether or not one is listening to the radio, then there may be some important productivity gains from doing these activities together. However, if multitasking is due to behaviors such as students watching TV while studying, the benefits may be less clear.

2. Income-Generating Activities (IGAs)

About 29.5 percent of households in our sample have no income-generating activities (IGAs). This means that about 70 percent have at least one. Table IV.11 presents characteristics of these IGAs and their owners.[56] About 7 percent of the households with IGAs have electrified IGAs. Since we only sampled households without grid electricity at the time of the household listing, this suggests that most of these households had non-grid sources of electricity or else had IGAs located away from the home in locations that did have grid electricity.[57] When grid electricity becomes available to more households, this may open up opportunities for different types of IGAs and for changes in how the existing ones conduct business.[58]

Like the household heads, the owners were an average of about 40 years old and had about 6 years of completed education. On average, these IGAs started in 2002, meaning that they are about 9 years old. During our baseline survey, repair shops and small vendors were the most common forms of IGAs, respectively comprising about 40 percent and 35 percent of IGAs, on average.[59] Farmers are a smaller fraction, at around 16 percent.[60] On average, about 38.7 percent of the IGAs were located at the owner's home.

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[56] We present averages of each household's average IGA characteristics. Thus, our estimates are representative for households but not for IGAs.

[57] Indeed, 99 intervention group households did have IGAs located away from their homes with grid electricity. However, there were also 16 households in our intervention group that report having IGAs at home with grid electricity. These may have been connected between the time of the listing and the survey, though oddly there were 21 such households in the comparison group, where there was very little time between the listing and survey. Some of these IGAs may be based at home but also have other locations with grid access.

[58] We asked households about the energy used by their IGAs. Unfortunately, due to a translation problem, we cannot use the data on non-electric energy used by IGAs. See Appendix B for an explanation of this issue.

[59] The percentages are equal to 100 times the numbers of IGAs by category because these households have one IGA on average.

[60] However, 72 percent of the households in our sample have at least one household member whose employment status, reported in section B of the household survey, is identified as "farming."

Table IV.10. Adult Time Use (Hours per Day)

Variable	Intervention Group Mean
Work	
Wage labor in agriculture – female	0.15
Wage labor in agriculture – male	0.21
Wage labor in non-agriculture – female	0.27
Wage labor in non-agriculture – male	1.04
Nonwage farming activities – female	2.08
Nonwage farming activities – male	2.49
Other income-generating activities – female	1.96
Other income-generating activities – male	3.12
Study	
In school/reading/studying – female	0.15
In school/reading/studying – male	0.40
Chores	
Food processing and cooking – female	3.23
Food processing and cooking – male	0.42
Collecting fuel – female	0.72
Collecting fuel – male	0.20
Collecting water – female	0.99
Collecting water – male	0.27
Repairing clothes, basket, etc. – female	0.19
Repairing clothes, basket, etc. – male	0.17
Doing other household chores – female	2.19
Doing other household chores – male	0.33
Socializing	
Taking meals – female	0.80
Taking meals – male	0.83
Listening to radio – female	1.65
Listening to radio – male	2.43
Watching TV – female	0.17
Watching TV – male	0.32
Visiting neighbors or on other leisure activities – female	1.89
Visiting neighbors or on other leisure activities – male	2.80
Sleep	
Sleeping at night – female	8.75
Sleeping at night – male	8.52
Resting during the day – female	1.39
Resting during the day – male	1.52
Other Activities	
Other household activities – female	2.76
Other household activities – male	2.20
Multi-tasking	
Multitasking – female	4.69
Multitasking – male	2.28

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The means are weighted to adjust for sampling and nonresponse. Sample sizes for female-headed households range from 3,851 to 3,890. Sample sizes for male-headed households range from 2,973 to 2,980. We combined questions to create a few time use variables: time spent on food cooking and processing refers to responses to questions 4 and 10 on sections H and Q of the survey, and time spent on other activities refers to responses to questions 12 (bathing/hygiene), 13 (child care), 14 (religious practices), 21 (shopping), and 24 (other). See Appendix Table C.2 for sample size for each measure shown in this table.

Table IV.11. Income-Generating Activities

Variable	Intervention Group Mean
IGA Characteristics	
Household has no IGAs (percent)	29.5
Total number of IGAs	1.0
Household has electrified IGA if household has IGAs (percent)	7.1
Owner Characteristics	
Average age of IGA owners if household has IGAs	39.5
Average education of IGA owners if household has IGAs	6.0
Numbers of IGAs by Type	
Farmer	0.16
Small vendor	0.35
Medical	0.00
Manufacturing	0.08
Repair shops and other	0.40
Year Started	
Average year IGAs established if household has IGAs	2002
Location (Percentage at if household has IGAs)	
Household premise	38.7
Truck or vendors	6.7
Other location	54.6

Sources: Tanzania Energy Sector Baseline Household Survey.

Notes: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Valid skips and survey item nonresponse may have resulted in smaller sample sizes for specific measures. Variables with labels ending in, "if household has IGAs" are only calculated for households with IGAs. See Appendix Table C.2 for sample size for each measure shown in this table.

We present averages of each household's average IGA characteristics. Thus, our estimates are representative for households but not for IGAs.

Small vendors include those for which the household responded 2, 3, 4, 20, or 21 to question E2 or R2 regarding the IGA. Repair shops include those where the household responded 9, 14, 15, 16, 17, 18, 19, or 88. Manufacturing includes those where the household respondent 5, 6, 7, 8, 10, 11, 12, or 13. The farming and medical categories were identified on their own (1 and 22 respectively).

E. Poverty and Economic Well-Being

A major goal of MCC is to reduce poverty and improve economic growth. We collected a great deal of information on household income, assets, and consumption and used the income and consumption information to estimate poverty rates based on a variety of definitions.[61] We covered a number of consumption items related to electricity use, but since these households did not have access to the grid, there was little consumption in this area. That said, some of the households did have access to the grid, so we do see some electricity consumption. Our results for income, assets, consumption, and poverty are reported in Tables IV.12, 13, and 14 respectively.

[61] Due to a translation error, it appears we are missing wage-income information for about 12 percent of our sample. See Appendix B for an explanation of this issue.

Table IV.12. Household Income and Assets

Variable	Intervention Group Mean	
	TZS	USD
Annual Household Income		
Total	2,897,098	1,837
From IGAs	1,510,387	958
From top 3 IGAs only	1,122,308	712
Non-IGA income per Year	1,008,346	639
Wage Income for Households with Wage Earnings		
Total annual wages if household has wages	3,401,491	2,157
Average hourly wage if household has wages	1,532	0.97
Total annual farm wages if household has farm wages	946,964	600
Total annual nonfarm wages if household has nonfarm wages	3,581,166	2,271
Household Assets		
Total assets	9,059,556	5,745
Value of home	4,972,490	3,153
Household debt	63,432	40

Sources: Tanzania Energy Sector Baseline Household Survey.

Notes: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Valid skips and survey item nonresponse may have resulted in smaller sample sizes for specific measures. For variables with labels ending in "if household has wages," "if household has farm wages," "if household has nonfarm wages" or "if household has IGAs", we estimate conditional means, applicable to the subset of households with non-missing data. See Appendix Table C.2 for sample size for each measure shown in this table.

Due to a translation error, we are missing wage-income information for about 12 percent of our sample and we could only get wage information for those reporting in monthly units. See Appendix B for an explanation of this issue.

1 USD = 1,577 TZS

Table IV.13. Household Consumption per Year

Variable	Intervention Group Mean	
	TZS	USD
Total household consumption	2,769,502	1,756
Food	1,242,761	788
School fees and supplies	106,348	67
Medical expenses	48,864	31
Cigarettes and alcohol	64,376	41
Electricity	8,820	5.59
Satellite dish and cable TV	10,513	6.67
Light bulbs	3,531	2.24

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. We asked about summary measures of spending on energy in section F of the household survey (questions F6 and F9) and for detailed information in section K. The section K responses are somewhat larger and we use them here because we suspect that the section F estimates may have missed important items that were covered in section K. The annual amount spent on cigarettes and alcohol is equal to 52 times the weekly amount reported in Appendix Table C.2. The annual amount spent on electricity is based on section F of the survey, includes non-grid electricity, and is equal to 12 times the amount in the last 30 days reported in Appendix Table C.2.

1 USD = 1,577 TZS

Table IV.14. Poverty

Variable	Intervention Group Mean
Income Measures of Poverty	
Per-capita daily income (USD)	1.18
Makes less than US$1 income per capita per day (percent)	71.7
Makes less than US$2 income per capita per day (percent)	85.6
Consumption Measures of Poverty	
Per-capita daily consumption (USD)	1.13
Consumes less than US$1 per capita per day (percent)	63.5
Consumes less than US$2 per capita per day (percent)	88.2

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group.

Household income averaged around 2.9 million TZS per year (about $1,837 USD). Since there are about five members in each household, this suggests a per-capita average of around 592,696 TZS/year, which is about US$376 per person.[62] In comparison, the per-capita GDP in Tanzania was around US$529 per person in 2011 (World Bank 2012).

About one-third of this income is nonwage, non-IGA income.[63] A small fraction of households earn wages.[64] On average, the households earning wages receive about 1,532 TZS/hour (about US$1) and around 3.4 million TZS per year. The remainder of earnings comes from IGAs.

Not surprisingly, household assets are substantially larger than income, averaging over 9 million TZS (about US$5,735) per household. The bulk of these assets are in the home, and average around 5 million TZS (about US$3,150).

Reported consumption levels are close to the income levels, at around 2.8 million TZS per year. About 45 percent of this (1.24 million TZS) is spent on food. As noted in Table IV.2 above, these households spend around 30,912 TZS/month on energy—which implies about 371,000 TZS per year, or about 13.4 percent of their annual consumption.[65]

The size of one's house is another way of measuring economic well-being. Our data show that each household has an average of 2.7 bedrooms (not shown in the table IV.12). In comparison,

[62] This is based on an exchange rate of 1,577 TZS per US$1 and 4.89 people per household, the average in the intervention group.

[63] We include all responses to questions I19 and/or I20 as "nonwage, non-IGA income." Subquestions a, b, and e in questions I19 and I20 are written in a way that suggests that they would include IGA income. However, according to NRECA the IGA income was not included in questions I19 and I20 (NRECA 2012). The fact that our income and consumption numbers line up when we make this assumption suggests that this is correct.

[64] Due to a translation mistake, we could only get wage information for those reporting in monthly units. Fortunately most households reporting wages did so in this unit. See Appendix B for a discussion of this issue.

[65] We asked about summary measures of spending on energy in section F of the household survey (questions F6 and F9) and for detailed information in section K. The section K responses are somewhat larger and we use them here because we suspect that the section F estimates may have missed important items that were covered in section K.

about 34 percent of Tanzanian households have three or more rooms for sleeping, and most households have at least two bed rooms (NBS and ICF Macro 2011).

Poverty rates appear high based on either income or consumption-based estimates. We estimate that about 71.7 percent of the households are receiving less than US$1 per person per day in income and about 63.5 percent are consuming less than $1 per day. There are many households with much higher averages, however. Hence, the average per-capita income and consumption levels are well over US$1.

F. Variation by Gender

Empowering women is another major goal of MCC. We collected information by gender in numerous ways. First, we surveyed the male and female heads of household separately regarding their time use (discussed earlier) and income-generating activities. Second, we asked the primary respondent to report out separately on education, employment, wages, and health issues by gender.[66] Third, we asked both the males and females to report on income-generating activities.[67] Fourth, we asked the primary respondents to report on their own assets and assets of others in the households separately. This enables us to identify assets by gender for the subset of households with one male adult, one female adult, and no other adults in the home.[68]

The head of the household is female in about 23 percent of households even though 51 percent of household members are female, on average (Table IV.15). Similar to our finding, women head 23 percent of households in Tanzania (NBS and ICF Macro 2011). The key females are slightly younger than the key males (39 versus 43 years old). About 76 percent of the key females are married, compared to around 85 percent of the key males.[69]

The key males have somewhat more education than the key females (by over one year). About 26 percent of the key females have not had any education whereas 13 percent of the key males have not had any education. In comparison, 19 percent of Tanzanian women have not received any education, whereas a little over 9 percent of Tanzanian men have not received any education (NBS and ICF Macro 2011). Also, males in the households in our sample appear to experience somewhat fewer health problems than the females (13.1 percent for females versus 7.4 percent for males).

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[66] We asked both the primary and secondary respondents to report on the male wages, but use only the primary respondent answers in this report.

[67] There were some translation mistakes in the IGA section of the survey but, as discussed in Appendix B, it appears unlikely that they caused major problems in our resulting data, with one exception—we do not have valid data on the use of non-electric energy by IGAs.

[68] This is based on the assumption that child assets are negligible.

[69] This does not imply inconsistent responses because married couples do not always live together. If both are present and one reports being married then the other also reports being married at least 97 percent of the time. About 18 percent of the married key females report living without their husband, whereas about 30 percent of the married key males report living without their wives.

Table IV.15. Household Composition, Education, and Health by Gender (percentages, unless otherwise noted)

Variable	Intervention Group Mean
Household Composition	
Head of household is female	23.2
Percentage of household members who are female	51.1
Age – key female (years)	38.9
Age – key male (years)	43.0
Married – key female	75.8
Married – key male	84.6
Education	
Completed any education – key female	73.7
Highest grade completed – key female (grade level)	5.1
Completed any education – key male	87.1
Highest grade completed – key male (grade level)	6.3
Health	
Household has a person 15 years or older who was unable to work due to illness – household has females 15 or older	13.1
Household has a person 15 years or older who was unable to work due to illness –household has males 15 or older	7.4

Sources: Tanzania Energy Sector Baseline Household Survey.

Notes: The means are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. Valid skips and survey item nonresponse may have resulted in smaller sample sizes for specific measures. Variables for the key males, key females, and people 15 years or older are only calculated for households that had those types of members. See Appendix Table C.2 for sample size for each measure shown in this table.

We asked both the primary and secondary respondents to report on the male wages, but use only the primary respondent answers in this report.

We can only identify male and female earnings in households where we can identify their wages, IGA income and/or non-IGA, nonwage income.[70] Within these households, on average, males have almost 3 times as much income as females, with males earning over 2.1 million TZS per year versus less than 800 thousand TZS for females (Table IV.16). Interestingly, in the households where we identify nonwage, non-IGA income, the levels appear to be much closer (around 400,000 for females and 640,000 for males).[71] Males who have wage earnings earn about 1,863 TZS/hour compared to about 1,486 TZS/hour for females.[72]

[70] We identify wages only if they reported wage earnings in monthly units, as discussed in Appendix B. We identify IGA income only if they reported earning IGA income for that gender. We identify nonwage, non-IGA income only in "unitary" families (that is, those with no adults other than the head and spouse of that head (if present).

[71] In households with both spouses present, the males and females report about the same levels of non-IGA non-wage income – a little over 500,000 each.

[72] As discussed earlier, we can only estimate wages for households reporting wage earnings in monthly units. This is over half of those households reporting having any wage earnings.

Table IV.16. Income and Assets by Gender

Variables	Intervention Group Mean
Total Income	
Annual female income (TZS) if data identifies females	762,227
Annual male income (TZS) if data identifies males	2,180,614
Nonwage Income	
Unitary family: No adults except head and spouse of head (if present)	52.0%
Nonwage, non-IGA income/year – female in unitary family (TZS)	396,244
Nonwage, non-IGA income/year – male in unitary family (TZS)	640,010
Wage Income in Households with Wage Earnings	
Average hourly male wage if household has males with wages (TZS)	1,863
Average hourly female wage if household has females with wages (TZS)	1,486
Total male annual wages if household has males with wages (TZS)	3,331,401
Total female annual wages if household has females with wages (TZS)	2,597,208

Sources: Tanzania Energy Sector Baseline Household Survey.

Notes: The means are weighted to adjust for sampling and nonresponse. The sample size for annual female income is 3,320. The sample size for annual male income is 3,109. The sample size for households with one key male and one key female is 3,233. Sample sizes for unitary households are 2,201. Sample sizes for households with males with wages range from 391 to 394. Sample sizes for households with female with wages are 213. See Appendix Table C.2 for sample size for each measure shown in this table.

When calculating assets by gender, we assumed that the child assets are negligible. Also, we only identify nonwage, non-IGA income for households with no adults other than the head and spouse of the head (if present), but no other adults. We may be overestimating male IGA ownership slightly due to how the questions were asked, as explained in Appendix B.

On average, across all households with IGAs, men run more IGAs than women (Table IV.17).[73] Men also get more than 3 times as much IGA income as women and have more paid and unpaid staff, with the difference being larger for paid staff. Last, men use far more electricity in the IGAs they operate than women, suggesting that when electricity is introduced men may take more advantage of it than women. On the other hand, grid access may reduce gender differences in electricity use in IGAs if men are currently accessing electricity for IGAs primarily through IGAs outside the home and if women operate IGAs primarily at home.

G. Conclusion

In this chapter we have reviewed the characteristics of households in the intervention communities that are expected to get new T&D lines. The households in our sample appear to be similar in terms of size, but below average in terms of income compared to other households in Tanzania. We find that the households in our sample consume fuel with a great deal of energy content (about 867 kWh/month), but most of this is in the form of solid fuels and most of that is wood, suggesting that a great deal of the energy may not be used very efficiently and be wasted. The large amount of wood consumption also suggests that these households are producing a great deal of CO_2. We estimate 275 kg/month. The households also consume around 7.0 liters per month of liquid fuel and spend substantial amounts on batteries and generators for electricity. Our estimates suggest that these households might benefit from replacing much of their liquid fuel, batteries, and

[73] We may be over-estimating male IGA ownership slightly due to how the questions were asked, as explained in Appendix B.

generated electricity with grid electricity when it becomes available. In the area of gender differences, we find that males earn more than females and use far more electricity through IGAs than females.

Table IV.17. Income-Generating Activities by Gender

Variable	Intervention Group Mean
Number of IGAs	
Number of IGAs owned by females if household has a key female	0.47
Number of IGAs owned by males if household has a key male	0.63
Percentage of IGAs owned by men if household has IGAs	53.6
Income (TZS)	
Annual income from female operated IGAs if household has a key female	460,420
Annual income from male operated IGAs if household has a key male	1,542,431
Number of Employees in the Past 12 Months	
Number of paid staff in female operated IGAs if household has a key female	0.131
Number of paid staff in male operated IGAs if household has a key male	0.597
Number of unpaid staff in female operated IGAs if household has a key female	0.805
Number of unpaid staff in male operated IGAs if household has a key male	1.249
Annual IGA Electricity Expenditures (TZS)	
For female-headed IGAs if household has a key female	4,133
For male-headed IGAs if household has a key male	43,381

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The means are weighted to adjust for sampling and nonresponse. Sample sizes for households with IGAs are 3,266. Sample sizes range from 3,204 to 4,398. We identify wages only if they reported wage earnings in monthly units, as discussed in Appendix B. We identify IGA income only if they reported earning IGA income for that gender. We identify nonwage, non-IGA income only in “unitary” families (that is, those with no adults except the head and spouse of the head, if present). See Appendix Table C.2 for sample size for each measure shown in this table.

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V. CHARACTERISTICS OF ENTERPRISES IN THE STUDY

In this chapter we describe the characteristics of 59 businesses from the intervention and comparison groups in the Tanga region that responded to the baseline enterprise survey.[74] Due to the small sample size in each group, we do not present the characteristics of these businesses by intervention status, but instead examine baseline characteristics across all surveyed enterprises.[75] We look at key characteristics, such as the type of enterprise, attributes of the owner, and energy and telephone use, as well as assets, finance, and operation.

A. Basic Enterprise Characteristics

Table V.1 presents the basic characteristics of the surveyed enterprises. Small grocery shops, or *maduka*, make up about 63 percent of our sample. Another 12 percent are classified as other food enterprises, such as restaurants or bars. Tailors make up about 3 percent of the enterprises and the remaining 22 percent are classified as other types of enterprises.[76] A majority (58 percent) of the surveyed businesses were registered with the local or national government. The average number of years the businesses had been in operation was 7.5. On average, businesses were open about 12 hours per day. Almost three quarters (73 percent) were open all year and 70 were open every day of the month.

Little less than one third (29 percent) of the enterprises were owned by women. On average, the owners were just under 41 years of age. Over three-quarters of owners had at most a primary school education (76 percent) and about 29 percent had received some type of business training.

B. Energy and Telephone Use

The line extensions under the T&D activity may have a direct impact on enterprises' energy usage. This section summarizes the total electricity use, quality of electricity, non-electric energy usage, use of appliances, and telephone usage prior to the implementation of the T&D activity.

1. Total Electricity Use

More than half (56 percent) of the surveyed enterprises reported using electricity, and four in five (81 percent) reported using non-electric sources of energy (Table V.2). All but two of the enterprises that used electricity got it from the grid; the remaining two used solar photovoltaic system and batteries. Among the enterprises connected to the grid, on average they had been connected for 6.7 years. Electricity was available to these enterprises for 12.6 hours a day, on average. Across all 59 enterprises, the average spending on electricity in the month preceding the survey was 12,920 TZS.

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[74] In addition to the data on businesses collected through the baseline enterprise survey, respondents to the baseline household survey reported on income-generating activities, including more than 370 moderate-sized businesses (with more than six employees—the maximum found in the enterprise survey). We will use data on businesses from both of these sources to capture impacts of improved access to electricity on business development.

[75] Results for the intervention and comparison groups separately are presented Appendix Table C.5.

[76] The other types of enterprises include a total of 13 enterprises, with one of each of the following types: farming, butcher, sawmill, carpentry, automobile repair, and medical facility; the remaining seven enterprises were reported as "other" on the survey.

Table V.1. Basic Enterprise Characteristics

Enterprise Characteristic	N	Mean for All Enterprises
Percentage of enterprises that are:		
Small grocery shop (*duka*)	59	62.7
Food enterprise (restaurant/bar, food distributer)	59	11.9
Tailor	59	3.4
Other	59	22
Percentage of enterprises that are registered with the local or national government	59	57.6
Years since establishment	58	7.52
Number of hours open in a day	56	11.91
Percentage of enterprises open all year	59	72.9
Percentage of enterprises open every day of the month	59	69.5
Percentage of owners who are:		
Female	59	28.8
Highest education is primary or below	59	76.3
Received training	59	28.8
Age of the owner	59	40.85

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 59 enterprises. Survey item nonresponse may have resulted in smaller sample sizes for specific measures.

Table V.2. Sources of Electricity

Enterprise Characteristic	N	Mean for All Enterprises
Percentage of enterprises that use electricity	59	55.9
Percentage of enterprises that use non-electric sources of energy	59	81.4
Percentage of enterprises that obtain electricity from		
Grid	59	52.5
Solar photovoltaic system	59	1.7
Other	59	1.7
Amount spent on electricity in the previous month	59	12,920
Years connected to the grid	31	6.73
Hours electricity available per day	30	12.57

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 59 enterprises. Valid skips or survey item nonresponse may have resulted in smaller sample sizes for specific measures.

Among the 31 enterprises connected to the grid, all but one cited better lighting as a reason for connecting to the grid and two-thirds indicated that lighting was the primary use for electricity (Table V.3). Over half of the enterprises (64.5 percent) also cited improved efficiency as a reason for connecting to the grid. Other reasons for connecting to the grid were enhanced income (45 percent), grid electricity is cheaper than other fuels (35.5 percent), and grid electricity is more cost effective (16 percent). Twenty seven percent of the enterprises indicated that the primary use of electricity was for appliances or machinery.

Table V.3. Electricity-Related Considerations Among Electricity Using Enterprises

Enterprise Characteristic	N	Mean for All Enterprises
Percentage of enterprises reporting reason for connecting:		
Better lighting	31	93.5
Improved efficiency	31	64.5
Enhanced income	31	45.2
Electricity more cost effective	31	16.1
Electricity cheaper than other fuels	31	35.5
Percentage of enterprises reporting primary use of electricity in previous month:		
Lighting	33	66.7
Electrical appliances/machinery	33	27.3
Other	33	6.1
Connection fee (TZS)	29	329,655
Wiring cost (TZS)	29	22,759
Unofficial cost (e.g., bribe) (TZS)	29	276

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 33 enterprises that reported using electricity. Valid skips or survey item nonresponse may have resulted in smaller sample sizes for specific measures.

The connection fee was the largest start-up cost of electricity for enterprises connected to the grid, with an average cost of 329,665 TZS. The average cost of wiring for these enterprises was 22,759 TZS. On average, they also spent 276 TZS in unofficial costs (including bribes).

Half of the enterprises that were not connected to the grid said that high connection cost was the primary reason for not connecting and over half of the enterprises reported that improved productivity was a main reason for being interested in connecting to the grid (Table V.4). Lack of access to the grid was cited as the main reason for not connecting by 38.5 percent of enterprises; 11.5 percent reported "other" reasons. No enterprises reported high tariff as the main reason for not connecting to the grid. Four enterprises (15.4 percent) reported that better lighting was the main reason for wanting to connect to the grid. Another four indicated that they wanted a more cost effective source of energy or that electricity was cheaper than other fuels. Enhanced income was the main reason for wanting to connect to the grid reported by 11.4 percent of the enterprises.

Despite the high connection costs and lack of access to the grid, all 26 non-connected enterprises were interested in connecting to the national grid and six enterprises (23 percent) had submitted an application for connection.

2. Quality of Electricity Among Enterprises Using Any Form of Electricity

The expansion of the T&D grid has the potential to improve the quality of the electricity by reducing the number of power outages and the frequency of voltage fluctuations, both of which were common events among the surveyed enterprises. Outages require enterprises to seek alternative forms of power that can be quite costly. Fluctuations can damage sensitive electronic devices. This section summarizes the frequency of both power outages and voltage fluctuations at baseline.

Table V.4. Electricity-Related Considerations Among Enterprises Not Connected to the Grid

Enterprise Characteristic	N	Mean for All Enterprises
Percentage of enterprises reporting primary reason for not connecting:		
Grid not available	26	38.5
High connection cost	26	50.0
High tariff	26	0.0
Other	26	11.5
Percentage of enterprises reporting primary reason for wanting to connect:		
Better lighting	26	15.4
Improved productivity/efficiency	26	57.7
Enhanced income	26	11.5
Electricity more cost-effective	26	15.4
Percentage of enterprises interested in connecting to the national grid	26	100.0
Percentage of interested enterprises that submitted a connection application	26	23.1

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 26 enterprises that were not connected to the electric grid.

Power outages were common; more than three-quarters of the electrified enterprises reported having experienced them daily or a few times per week in the month preceding the survey. About 45 percent of enterprises reported having experienced outages weekly, and 29 percent reported that they occurred daily (Table V.5). Another 6.5 percent reported that outages occurred just a few times a month and 19 percent reported that outages occurred rarely. About 42 percent of enterprises reported using battery-operated lights or kerosene lamps during outages, about 26 percent used candles, and 10 percent used diesel generators. Over 38 percent of enterprises used some other form of energy during outages and 6.5 percent remained without power.

In the month preceding the survey, enterprises spent on average 24,988 TZS on backup sources of energy. This translates to roughly 6.5 percent of their previous month's revenues. In 2010, enterprises spent 23,478 TZS or about 10 percent of their monthly revenues on backup energy. Because the amount spent on backup energy is a nontrivial share of revenues, consistent access to electricity is likely to improve the profitability of these enterprises.

Voltage fluctuations were also common; a large majority of the enterprises using electricity reported experiencing voltage fluctuations either daily or a few times per week, both during the month and the calendar year preceding the survey. During the month prior to the survey, about 79 percent of the enterprises using electricity reported that voltage fluctuations occurred either daily or a few times a week (Table V.6). Another 9 percent said fluctuations occurred a few times and 12 percent reported that they occurred rarely during the month preceding the survey. Assessing the voltage fluctuation situation in 2010, the calendar year preceding the survey year, about 64 percent of the enterprises using electricity said fluctuations occurred either daily or a few times per week. Another 27 said that fluctuations happened a few times a month, 6 percent (two enterprises) said that they occurred rarely and 3 percent (one enterprise) reported no fluctuations in 2010.

Table V.5. Power Outages and Sources of Backup Energy Among Electricity Using Enterprises

Enterprise Characteristic	N	Mean for All Enterprises
Percentage of enterprises connected to the grid reporting power outages in the previous month:		
Daily	31	29.0
Few times a week	31	45.2
Few times a month	31	6.5
Rarely	31	19.4
Percentage of enterprises connected to the grid using the following energy sources during outages:		
Remain without power	31	6.5
Candle	31	25.8
Battery-operated light or kerosene lamp	31	41.9
Diesel generator	31	9.7
Other	31	38.7
Amount spent on backup sources of energy in the previous month	33	24,988
Amount spent on backup sources of energy per month in 2010	33	23,478

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 33 enterprises that reported using electricity. Valid skips or survey item nonresponse may have resulted in smaller sample sizes for specific measures.

Table V.6. Voltage Fluctuations Reported by Electricity Using Enterprises

Enterprise Characteristic	N	Mean for All Enterprises
Percentage of enterprises reporting voltage fluctuations in the previous month:		
Daily	33	27.3
Few times a week	33	51.5
Few times a month	33	9.1
Rarely	33	12.1
Percentage of enterprises reporting voltage fluctuations per month in 2010:		
Daily	33	21.2
Few times a week	33	42.4
Few times a month	33	27.3
Rarely	33	6.1
Never	33	3.0

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 33 enterprises that reported using electricity.

3. Non-Electric Energy Use

Increased access to the grid may provide cost-effective alternatives to non-electric sources of energy. Hence, we asked all enterprises about their non-electric energy use. In this section we summarize the non-electric energy usage in the surveyed enterprises in the Tanga region before the T&D activity was implemented.

Kerosene and dry cell batteries were the most common non-electricity sources, with 56 percent and 42 percent of enterprises using them, respectively (Table V.7). Bio-fuels (including wood, crop residue, straw, and dung) were used by about 19 percent of the enterprises. Another 15 percent used candles and 10 percent used charcoal. Seven percent used diesel or petrol, and only 2 percent (that is, one enterprise) used liquefied petroleum gas (LPG). In addition, two enterprises (3 percent) used car batteries to power appliances. Altogether, the surveyed enterprises used an average of 1.5 different non-electric energy sources.

Table V.7. Non-Electric Energy Use

Enterprise Characteristic	N	Mean for All Enterprises
Percentage of enterprises using the following non-electric sources of energy:		
Biofuels (wood, crop residue, straw/leaves, or dung)	59	18.6
Charcoal	59	10.2
Candles	59	15.3
Kerosene	59	55.9
Diesel or gasoline	59	6.8
LPG	59	1.7
Dry cell batteries	59	42.4
Car batteries	59	3.4
Number of different non-electric energy sources used	59	1.54

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 59 enterprises.

4. Electrical and Non-Electrical Energy Devices and Appliances

Table V.8 summarizes the use of electrical and non-electrical devices and appliances in the surveyed enterprises. We measure device and appliance use by appliance-hours. To calculate appliance-hours, we multiplied the number of devices or appliances by the number of hours that the item was used. We report appliance-hours only among enterprises that used these appliances (that is, those without the appliance are not included).

All of the surveyed enterprises used artificial light; the average hours of artificial light used per day (summing across all lights) was 21.8 hours.[77] The 21 enterprises that used a radio or CD player

[77] Sources of artificial light include fluorescent, incandescent, and energy-saving bulbs, as well as flashlights, candles, and kerosene lanterns. To calculate the hours of artificial light use, we multiplied the number of devices owned in each of the artificial light source categories by the average number of hours the device was used per day. The sum of the products across all artificial light sources represents the hours of artificial light used per day.

did so for an average of 8 hours per day. Six enterprises used a TV for an average of 7 hours a day. Cooking appliances, including traditional/charcoal stoves and kerosene stoves, were used for an average of 7.2 hours per day by 15 enterprises. Refrigerators were used in 18 enterprises for 8.7 hours a day on average. Twelve of the enterprises used air conditioners or fans; they averaged 6.7 hours of use per day. Irons were used in five enterprises for 1.72 hours per day on average. Of the 59 enterprises surveyed, 31 used either a bicycle or a motorcycle for business purposes.[78] The average number of hours these vehicles were used per day by these enterprises was 4.6 hours.

Table V.8. Use of Electrical and Non-Electrical Energy Devices and Appliances

Enterprise Characteristic	N	Mean for All Enterprises
Hours of use of appliance/device per day:		
Artificial light	59	21.8
Radio	21	8.0
TV	6	7.0
Cooking	15	7.2
Water heating	1	6.0
Refrigeration	18	8.7
AC and fan	12	6.7
Iron	5	1.7
Vehicle	31	4.6
Number of appliances/devices used	59	6.9
Number of electric lights	59	2.1
Number of sources of artificial light (light bulbs, flashlights, candles, kerosene lanterns, pressurized kerosene lanterns)	59	4.1
Liters of liquid fuel used by appliances per month	59	29.8
Kilograms of solid fuel used by appliances per month	13	4.4

Source: Tanzania Energy Sector Baseline Enterprise Survey

Notes: For the enterprise characteristics presented in this table, the analysis sample includes 59 enterprises. Valid skips or survey item nonresponse may have resulted in smaller sample sizes for specific measures.

To calculate the number of appliance/device hours, we multiplied the number of devices by the number of hours used.

The average number of electrical and non-electrical devices and appliances used across the 59 surveyed enterprises was 6.9. These enterprises had an average of just over two electric lights and four different sources for artificial lights. An average of 29.8 liters of fuel was used per month to operate the appliances in all enterprises. Only 13 enterprises used solid fuel; the average usage was 4.4 kg of solid fuel per month.

5. Telephone

Most enterprises used mobile phones for business purposes and with increased access to reliable electricity enterprises can expect to improve their ability to keep a charged phone on hand for employee use. Table V.9 presents statistics on mobile phone usage, charging locations, and expenditures related to mobile phones for the surveyed enterprises.

[78] Twenty-six enterprises used a bicycle and eight used a motorcycle.

Table V.9. Use of and Expenditures Related to Mobile Telephones

Enterprise Characteristic	N	Mean for All Enterprises
Percentage of enterprises that use a mobile phone for business	59	88.1
Percentage of enterprises in which employees always have access to a charged phone	52	73.1
Location phone is normally charged (percent):		
Home	52	11.5
Place of business	52	48.1
Another retail location	52	30.8
Other	52	9.6
Amount paid per month for mobile phone costs (airtime, repairs, charging, and other related costs)	52	17,415

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 59 enterprises. Valid skips have resulted in smaller sample sizes for specific measures.

A vast majority (88 percent) of the surveyed enterprises had access to and used a mobile telephone for business purposes. However, among the 52 enterprises with access to a mobile phone, less than three-quarters (73 percent) had a charged phone that employees could always access. The phone was normally charged in the place of business in 48 percent of the enterprises, but about 31 percent of the enterprises charged the phone at another retail location. The phone was normally charged at home for 11.5 percent of the enterprises that used a mobile phone; it was charged at some other location for the remaining 10 percent of businesses. If the mobile phone used by the enterprise is not also a personal phone, which may be charged at the owner's residence, increased access to electricity may increase the percentage of enterprises that have the ability to charge their phone at the place of business. The enterprises that used a mobile phone incurred an average monthly expenditure of 17,415 TZS for the mobile phone, including the costs of usage, repairs, and charging.

C. Assets, Finances, and Employees

This final section summarizes the assets, finance, and staff of the surveyed enterprises. For the enterprises that are currently not electrified, access to grid electricity may create opportunities for expanding their businesses, and also affect the way they operate. Access to more reliable electricity through the rehabilitation of the existing grid may open up opportunities also for the enterprises that are already electrified. These changes may not only affect their revenues, but also affect their financing and investment choices and how many employees they hire. In this section, we examine the situation of the surveyed enterprises with respect to their assets, sources of financing, and the number of employees they have before the new lines are built. When we have follow-up data on these enterprises, we will be able to assess how they changed over time compared to the baseline.

At the time of the baseline survey, the surveyed enterprises had a positive net worth, on average (Table V.10). The average total assets (16,513,254 TZS) of these enterprises far exceeded the average total debts (407,931 TZS) reported. We calculated the value of the enterprises' total assets based on their report on the market value of the land and the physical structure where the business operates (for the enterprises that owned them), as well as the market value of the inventories and other assets the enterprise had. The average current market value of inventories was 1,593,000 TZS.

Table V.10. Enterprise Assets, Finance, and Employees

Enterprise Characteristic	N	Mean for All Enterprises
Assets		
Market value of all assets (TZS)	59	16,513,254
Total debt (TZS)	58	407,931
Market value of all inventories (TZS)	59	1,593,000
Finance		
Percentage of enterprises that used the following as a source of finance for investment:		
Own resources	59	100
Banks/formal lenders	59	15.3
NGOs/microcredit organizations	59	0.0
Friends, relatives, neighbors	59	11.9
Informal money lenders	59	0.0
Other	59	8.5
Revenues in the previous month (TZS)	59	385,288
Revenues in 2010 (TZS)	58	2,871,483
Employees		
Percentage of enterprises with at least one employee	59	89.8
Number of employees	53	2.15
Number of permanent employees	53	1.76
Percentage of enterprises with at least one paid employee	59	25.4
Number of paid employees	53	0.62
Number of permanent paid employees	52	0.41
Percentage of enterprises with female employees	59	52.5
Percentage of enterprises with paid female employees	59	11.9
Average wage in enterprises with paid employees	15	83,000
Average male wage in enterprises with paid male employees	11	98,182
Average female wage in enterprises with paid female employees	7	43,571

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 59 enterprises. Valid skips or survey item nonresponse may have resulted in smaller sample sizes for specific measures.

All of the surveyed enterprises had used owner's resources to finance investments in the business at some point since the establishment of the enterprise (Table V.10). About 15 percent of the enterprises also used banks or other formal sources to finance investing in the enterprise. Another 12 percent of enterprises used family and friends as a source of financing, and 8.5 percent used some other source. No enterprises used loans from NGOs/microcredit organizations or informal money lenders to finance business investment. The average revenue in the month preceding the survey was 385,288 TZS and the average revenue in 2010 was 2,871,483 TZS or about 239,290 TZS per month.

Almost 90 percent of the surveyed enterprises (53 enterprises) had at least one employee but only 25 percent (15 enterprises) had paid employees. In the 53 enterprises that had employees, the average number of employees was 2.2, and the average number of permanent employees was 1.8. The average number of paid employees was 0.6 and the average number of permanent paid employees in these enterprises was 0.4. Over half of all 59 enterprises (52 percent) employed women, but only 12 percent had a paid female employee. In the 15 enterprises that had paid employees, the average monthly wage was 83,000 TZS. The average monthly wage for women was 43,517 TZS in the seven enterprises with female employees. Men were employed in 11 enterprises with an average monthly wage of 98,182 TZS—more than double that of women.

D. Variation by Gender

In this section we discuss a few key enterprise characteristics by gender of the owner. As noted in Section A of this chapter, about 29 percent of the surveyed enterprises had a female owner. In Table V.11, we present the mean for a number of key enterprise characteristics separately for female- and male-owned enterprises, and examine how the characteristics of the enterprises in our sample varied by the gender of the owner.[79]

There were no substantial differences by the gender of the owner in terms of the age of the enterprise, hours of operation, mobile phone usage, and having paid employees on staff (Table V.11). Enterprises owned by women were slightly older compared to those owned by men (8.3 years compared to 7.6 years) and stayed open for 10.8 hours compared to just over 12 hours for those owned by men. A large percentage of both female- and male-owned enterprises used mobile phones for business purposes, 88 percent and 89 percent, respectively. About 24 percent of female-owned enterprises had paid employees on staff, whereas 29 percent of male owned enterprises had paid staff.

Table V.11. Enterprise Characteristics by Gender of the Owner

Enterprise Characteristic	Mean for Enterprise with Female Owner	Mean for Enterprise with Male Owner
Years since establishment	8.3	7.6
Number of hours open in a day	10.8	12.3
Percentage of enterprises that use electricity	47.1	60.0
Amount spent on electricity in the previous month	3,765	15,822
Percentage of enterprises that use a mobile phone for business	88.2	88.9
Percentage of enterprises that own the land on which the enterprise operates	47.1	26.7
Percentage of enterprises that used a bank/formal source for financing investments	35.3	8.9
Market value of all assets (TZS)	4,641,000	20,666,667
Total debt (TZS)	619,412	298,409
Revenues in the previous month (TZS)	169,647	450,733
Percentage of enterprises with at least one paid employee	23.5	28.9
Sample size[a]	17	45

Source: Tanzania Energy Sector Baseline Enterprise Survey

Note: For the enterprise characteristics presented in this table, the analysis sample includes 59 enterprises. Valid skips or survey item nonresponse may have resulted in smaller sample sizes for specific measures.

[a]Three enterprises reported that they had both male and female owners; these enterprises were included in both groups reported in the table. Therefore, the comparison presented here captures whether having a female owner (with or without another male owner) influenced any of the key enterprise characteristics.

[79] Considering the small sample of enterprises available from the survey, we do not conduct any statistical test of the differences in enterprise characteristics by the gender of owner.

However, enterprises owned by men spent substantially more on electricity, had greater total assets, were larger in terms of revenues in the past month, and had lower debt compared to enterprises owned by women. Sixty percent of the enterprises owned by men used electricity compared to 47.1 percent of those owned by women. The differences in the amount spent on electricity were quite large: on average enterprises owned by men spent 15,822 TZS on electricity in the past month compared to the 3,765 TZS spent by female-owned enterprises. The reported market value of all assets was over 20 million TZS for male-owned enterprises, compared to 4.6 million for female-owned enterprises. Male-owned enterprises also reported taking in revenues of 450,733 TZS in the past month—over 2.5 times more than the 169,647 TZS reported by female-owned businesses.

A greater percentage of female-owned enterprises, on the other hand, owned their land (47.1 percent compared to 26.7 percent of male owned enterprises) and used loans from banks or other formal sources to finance investment in the enterprise (35.3 percent compared to 8.3 percent). It is noteworthy that enterprises that had a female owner were more likely to have used banks or other formal sources for financing investment. The greater reliance on loans from banks may in part help to explain the larger debt owed by female-owned enterprises.

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VI. BASELINE EQUIVALENCE OF STUDY GROUPS

In this chapter, we discuss baseline equivalence of the study groups. We compare the intervention and comparison group for the quasi-experimental evaluation of the T&D line extensions, and also the treatment and control group for the random assignment evaluation of the financing scheme initiative. Using data from the baseline household survey, we provide evidence that for each evaluation there is a counterfactual group (comparison or control) that is comparable to the corresponding intervention or treatment group at baseline.

A. Baseline Equivalence for the T&D Evaluation Using the Original Household Survey Sample

The household survey was conducted in a random subset of intervention communities, chosen to be representative of all communities receiving the new T&D lines, and comparison communities, selected to match the intervention communities as closely as possible using data from the baseline community survey. See Schurrer et al. (2011a, 2011b) for details on how these communities were chosen. Because the comparison communities were matched to the intervention counterparts using propensity score matching with community survey data, it was possible that on average the households in the intervention group would be similar to the households in the comparison group. Appendix Table C.1 compares the households in these two groups on all of the household-level characteristics presented in Chapter IV. We found that the intervention and comparison group were substantially and statistically different on a large number of characteristics. Many of these differences suggest that the intervention group is better off financially than the comparison group. For example, income, consumption, and assets are 20 percent to 40 percent higher in the intervention group than in the comparison group.

The differences between the intervention and comparison group households shown in Appendix C.1 are more than what we would expect based on chance alone. If the differences found were due to chance variation we would expect 1 percent of the baseline household characteristics we investigated to be statistically different at the 1 percent significance level, 5 percent to be statistically different at the 5 percent significance level or lower, and 10 percent to be statistically different at the 10 percent significance level or lower. As shown in Table VI.1, at each significance level the percentage of differences that were statistically significant was more than three-times the percentage we would expect by chance alone. This suggests that the characteristics of the households in the intervention group did not match well with those in the comparison group based on the baseline household survey data.

Table VI.1. Intervention–Comparison Group Differences Before Household-Level Matching: Percentages of Characteristics with Statistically Significant Differences, by Significance Level

Significance Level of Difference (Percent)	Percentages of Differences Statistically Significant Pre-Matching
10.0	32.9
5.0	22.1
1.0	12.2

Source: Tanzania Energy Sector Household Survey.

Notes: The pre-matching results use the sampling weights for the intervention group and the nonresponse weights for the intervention and comparison groups. The standard errors adjust for clustering by community. These results are based on the 213 variables that were covered in Chapter IV. Full results for all variables are available in Appendix Table C.1.

There are a number of possible explanations for this result. First, while the community survey was conducted in 2011, community leaders may have based many of their responses on older data, perhaps in some cases on the most recent census data from 2002. Communities that have experienced higher-than-average growth in the past decade may be more likely to get new lines, since lines are placed where they are likely to reach the most customers. In addition, once it was announced that new lines were going to be built (which may have happened many months before the household survey), some households may have migrated into those communities. For both these reasons, the reports of community leaders may systematically underestimate community well-being in the intervention group compared to the comparison group (those in communities not getting new lines).

Second, during the household survey, we had to replace seven comparison communities because all households within those communities were within 30 meters of existing lines or were already connected, and thus not eligible for the survey. (We selected comparison communities with existing lines because about a third of the intervention group communities already had existing lines.) We replaced these ineligible communities with seven others that were also covered in the community survey. The replacement communities were the best remaining matches; however, they were not as good matches as the original communities.

There are also a number of other issues that might have affected baseline equivalence, but that do not appear to be important factors based on our analyses.

We randomly selected 182 intervention communities from a larger set of 337 communities targeted to receive new lines at the time we were conducting the community survey. Since that time, we have been informed that four of these communities are not receiving new lines. Consequently, those four communities have been dropped from the current analysis. Together, they had only 38 households in our survey data; runs with and without these households show very similar results.[80]

Another issue to keep in mind when reviewing the household survey results is that there was a substantial lag time between the household listing and survey for the intervention communities but not for the comparison communities. For the intervention group, the lag was as long as several months in some cases. For the comparison group, it was generally only a few days. During the interim, some households may have moved out, meaning that the intervention group might have fewer relatively mobile households than the comparison group. In theory, this could affect our balance. To test for this possibility, we dropped households in both the intervention and comparison groups that had been there for less than 7.5 months. The results were very similar to those reported in Appendix Table C.1, so differential migration between the listing and survey does not appear to be an explanation for the lack of equivalence between the intervention and comparison group.

One other possible explanation for the differential that appears to not matter is related to how we selected subvillages within villages. In communities with multiple subvillages, we selected only one subvillage for the survey. In the intervention group, we selected the one with the highest percentage of households expecting to receive new lines. In the comparison group community

[80] We suspect that some additional intervention communities may not receive new lines and that some of the comparison group communities will receive new lines. We plan to adjust for any additional changes like this using standard crossover adjustment methods so that we can estimate impacts of the new lines on those who actually get access (Bloom 1984; Angrist et al. 1996).

chosen to match that intervention community, we selected the subvillage that matched most closely in terms of how the subvillage ranked based on size within the village. We checked to see how much this might matter by looking only at communities that had no subvillages (mostly the urban *mitaa*). The differential was larger in these communities than it was for the rural subvillages, suggesting that this method of choosing subvillages does not explain the intervention/comparison group differentials we observe.

B. Baseline Equivalence for the T&D Evaluation After Household-Level Matching

Considering the lack of baseline equivalence in household characteristics between the intervention and comparison group, we conducted another round of matching using household survey data to produce household weights that improve the quality of our matches across important characteristics and enhance our ability to make inferences about the impact of the T&D extension on household and community outcomes once we have follow-up data. We present a detailed technical discussion on this final stage of matching in Appendix A of this report.

While the intervention and comparison groups did not match well based on the household survey, there was substantial overlap in key characteristics. Table VI.2, below, summarizes the overlap in two key variables—income and assets.[81] Since we use propensity score matching, we only aim for overlap in the propensity score. There are three intervention group households at the extremes of the propensity score distributions that were dropped during the household-level matching process, as explained in Appendix A. We were able to match the rest of the intervention group to the comparison group.

Table VI.2. Income and Asset Distributions Before Household-Level Matching

	Income		Assets	
Measure	Intervention	Comparison	Intervention	Comparison
Mean	2,892,755	2,336,285	9,174,773	6,809,153
N	4,682	5,531	4,682	5,531
Percentiles				
99	26,370,000	23,600,000	85,560,000	70,030,000
95	10,600,000	8,160,000	34,600,000	25,900,000
90	6,800,000	4,810,000	20,400,000	13,900,000
75	2,760,000	2,200,000	7,950,000	6,000,000
50	1,050,000	920,000	4,050,000	2,885,000
25	380,000	330,000	874,000	600,000
10	110,000	100,000	260,000	150,000
5	35,000	20,000	100,000	36,000
1	0	0	0	0

Source: Tanzania Energy Sector Household Survey.

Notes: The pre-matching results use the sampling weights for the intervention group and the nonresponse weights for the intervention and comparison groups.

[81] In order to protect confidentiality of household survey respondents, we do not present the maximum (100th percentile) or minimum (0th percentile) of the income or asset distributions.

The household weights developed through the propensity score kernel matching resulted in a comparison group that is well matched to the intervention group. Full results for all household characteristics are shown in Appendix Table C.2.[82] Those results are summarized in Table VI.3 below. At each statistical significance level, the percentage of all the household characteristics for which we found statistically significant differences between the intervention and comparison group was close to what might occur by chance alone.[83] In other words, the matching weights for households in the comparison group were able to remove the systematic differences between the two groups of households that we found before matching at the household level.

Table VI.3. Intervention–Comparison Group Differences Pre and Post Household-Level Matching: Percentages of Characteristics with Statistically Significant Differences, by Significance Level

Significance Level of Difference (percent)	Percentages of Differences Statistically Significant	
	Pre-Matching	Post-Matching
10.0	32.9	9.9
5.0	22.1	4.2
1.0	12.2	0.5

Source: Tanzania Energy Sector Household Survey.

Notes: The pre-matching results use the sampling weights for the intervention group and the nonresponse weights for the intervention and comparison groups. The post-matching results use the sampling and nonresponse weights for the intervention group and the propensity score matching weights for the comparison group. The standard errors adjust for clustering by community. The post-matching results are based on the 213 variables that were covered in Chapter IV. None of the differences for the 14 variables that were used for matching are statistically significant and the results for the remaining variables are also similar to what we would expect by chance. Full results for all variables are available in Appendix Table C.2.

C. Baseline Equivalence for the Financing Scheme Evaluation Using the Original Household Survey Sample

The Tanzania energy sector evaluation will also estimate impacts of the financing scheme initiative. As discussed in Chapter II, we are using a random assignment evaluation design for the FS initiative. The initiative is being implemented in 29 treatment communities that were randomly selected in a public event. Two of these are in the Kigoma region, which was not covered by the baseline surveys; so we remain with 27 treatment communities for which we have data from the baseline household survey. The remaining 151 intervention communities constitute the control group, which will not be receiving the FS initiative. Appendix Table C.3 shows the difference between the treatment and control groups on all household characteristics discussed in Chapter IV. Table VI.4, below, summarizes the statistical differences that were found. The number of statistically

[82] The means for the intervention group differ slightly between Appendix Table C.1 and C.2 (pre- and post-match). This is because three households were dropped from the intervention group during the household-level matching process. These three households had propensity scores that are at the extremes of the propensity score distributions, as discussed in Appendix A.

[83] The propensity score matching method was designed to minimize the differences between intervention and comparison group households for the 14 characteristics used in the matching model. None of those differences are statistically significant. When we drop those characteristics, the differences for the remaining variables remain similar to what we would expect by chance (10.6 percent of the characteristics are statistically different at the 10 percent significance level, 4.5 percent are statistically different at the 5 percent significance level, and 0.5 percent are statistically different at the 1 percent significance level).

significant differences we found is similar to what would be expected by chance alone. In other words, households in the treatment and the control group for the FS initiative appear to be similar at baseline.

Table VI.4. Treatment-Control Group Differences: Percentages of Characteristics with Statistically Significant Differences, by Significance Level

Significance Level of Difference (Percent)	Percentages of Differences Statistically Significant
10.0	7.7
5.0	5.3
1.0	0.5

Source: Tanzania Energy Sector Household Survey.

Notes: Results are all weighted using the sampling and nonresponse weights. The standard errors adjust for clustering by community. These results are based on the 213 variables discussed in Chapter IV. Full results for all variables are available in Appendix Table C.3.

D. Baseline Equivalence for Enterprise Survey

We obtained survey data from 59 enterprises out of a target sample size of 64. Given the small sample size, our statistical power is low and it is likely difficult to detect differences. Appendix Table C.5 presents the means for the surveyed enterprises in the intervention and comparison groups. Table VI.5, below, summarizes the differences between the intervention and comparison groups across various enterprise characteristics. There are statistically significant differences between the two groups on a number of enterprise characteristics. For example, the intervention group has more assets, are more likely to be registered, but are less likely to be owned/operated by women than the comparison group. Also, enterprises in the intervention group are more likely to use radios/CD players, refrigerators, and AC units but less likely to use irons. If connected to the grid, they had been connected for a far shorter period, spend more on backup energy, and spent more to connect.

Table VI.5. Differences in Enterprise Characteristics Between Intervention and Comparison Group: Percentages of Characteristics with Statistically Significant Differences, by Significance Level

Significance Level of Difference (Percent)	Percentages of Differences Statistically Significant Pre-Matching
10.0	23.6
5.0	13.6
1.0	3.6

Source: Tanzania Energy Sector Enterprise Survey.

Notes: These data are unweighted. The standard errors adjust for clustering by community. The results are based on 110 of the 112 enterprise characteristics discussed in Chapter V. The other 2 variables had less than 2 observations in the comparison group. Full results for all enterprise characteristics are available in Appendix Table C.5.

Given the small sample sizes, it is not worthwhile to apply propensity score matching to the enterprise sample to generate intervention–comparison balance at baseline. At the same time, the statistically significant differences on many characteristics suggest that when we have data from the follow-up enterprise survey, applying the difference-in-differences method may result in biased estimates of impacts of the T&D line extension on enterprise outcomes. Thus, the impact estimates based on the enterprise survey data should be interpreted cautiously and treated as illustrative case studies.

VII. WILLINGNESS TO PAY: BASELINE ANALYSES

In this chapter, we present evidence on the current demand for energy in the intervention group households targeted to get new T&D lines. We analyze energy use and costs, as well as possible increases in use and potential savings from connecting to the newly extended T&D lines. These results are the first step for estimating willingness to pay for electricity, which in turn may be useful for updating the economic rate-of-return calculations for the T&D activity. In addition, these estimates may provide MCC and MCA-T with useful information to assess possible challenges associated with getting households connected to the grid. These results may also be useful for the planned communications campaign in the communities selected for the financing scheme initiative.

A. Conceptual Framework for Estimating Households' Willingness to Pay for Energy

Willingness to pay for energy refers to how much energy customers would demand at different prices. It is usually estimated using consumer reports of their own willingness to pay, or by using data on actual behaviors of households facing different prices for energy (World Bank 2008).[84] We plan to use data from the evaluation's follow-up household survey to measure behavioral changes associated with changes in the price of electricity induced by the T&D activity and the FS initiative to estimate customer willingness to pay for energy. Currently, we observe households facing only one set of prices for energy. At baseline, before the T&D activity is completed, intervention group households in the evaluation sample do not have access to grid electricity. Put differently, grid electricity is currently prohibitively expensive for the households in our sample because they are all located more than 30 meters from a line.[85] When we conduct the follow-up survey, we will observe what happens to the consumption of various types of energy when the cost of accessing grid electricity drops dramatically, because most (an estimated 70 percent) of the households in our sample will be within 30 meters of a new line. In addition, those covered by the FS initiative will pay a much lower connection fee.[86] In this baseline report, we focus on describing how much the households in the T&D communities are currently paying for different forms of energy and how much they would have to pay to get similar levels of energy when grid electricity becomes available. More specifically, we answer the following questions related to willingness to pay:

1. How much are households currently paying for energy each month?
2. How much could they save each month using grid electricity?
3. How much more output (for example, lumens of light, hours of TV, hours of cooking, energy content, and so on) could they afford each month, by using their savings from grid electricity?

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[84] A rigorous analysis of willingness to pay for energy would jointly consider multiple factors including the change in energy prices generated by having access to grid electricity, the potential for increased use of energy due to the lower prices, and the costs of connecting. While we consider each of these issues separately in this chapter, we do not attempt to pull them all together, given our lack of information on customer behavior. A complete analysis of willingness to pay would also consider issues such as consumer surplus and nonlinear demand curves (World Bank 2008).

[85] Households farther than 30 meters from an existing line are required to purchase additional poles in order to get connected. A single pole can cost more than the standard connection fees. Multiple poles are required for households going more than 70 meters from an existing line.

[86] The quantities of energy demanded could change for at least two reasons. First, the prices have changed. Second, incomes may change. In this chapter we are not attempting to estimate any changes in demand created by income shifts.

4. How do the fixed costs of grid electricity compare to their income and asset levels and to their potential monthly savings from switching to grid electricity?

While we believe the information provided here is valuable, it does have a few key limitations. First, the estimates are based on the energy constants provided in Appendix C. In most cases, those constants are not based on data from Tanzania—rather they are obtained from general information on the various appliances and energy sources discussed in this chapter. As such, while the energy constants are our best approximations, they may still differ substantially from the correct numbers for the sample of households in Tanzania.

Second, in generating the current estimates, we are focused on sample means. In reality, the conditions of individual households differ greatly in ways that will likely impact the effective prices they are paying and the percentage of households that would be likely to benefit from switching to grid electricity. At the same time, modeling household-level variation using the Tanzania energy sector baseline household survey data is beyond the scope of this report. In particular, it would be challenging to differentiate between random errors and true variation in price. By focusing on sample averages, we effectively minimize the potential for random errors to affect our results.

B. Background

While we cannot estimate willingness to pay for electricity for the communities receiving new lines using the data we currently have, previous research does enable us to compare the willingness to pay for electricity in rural areas of developing countries to the usage fees charged by TANESCO. In particular, the World Bank reports willingness to pay in the range of \$0.10 to \$0.40 per kWh for lighting and television alone (World Bank 2008).[87] This implies a willingness to pay between 158 and 631 TZS/kWh. Interestingly, the electricity tariffs TANESCO charges are in a similar range for some households. In particular, TANESCO charges 60 TZS per kWh for households that use less than 50 kWh/month and 221 TZS/kWh for regular household users. Of course electricity can provide many benefits beyond lights and TV. When the World Bank study added additional benefits related to education, health, and fertility, they estimate substantially larger benefits (\$60 per month for households consuming 30–40 kWh/month). This comes out to well over US\$1 per kWh (1,577 TZS), much more than what TANESCO charges currently.

While the benefits of getting electricity may be large in many communities, this may not necessarily be the case for the communities in our intervention group.[88] Hence, in Section C, below, discussing monthly costs of energy, we look at the first three questions mentioned in Section A. In Section C, we ignore the fixed connection fees and wiring costs and focus instead on the monthly tariffs and fuel costs for non-electric fuels. Connection fees and wiring costs are high but, in theory, can be amortized over time. In addition, homes that have been electrified may increase in value, suggesting that electrifying one's home could be viewed as a type of investment.[89] Thus, households with low discount rates that are not cash constrained might decide to connect to the grid primarily based on the monthly savings and not as much on the one-time fixed costs. Moreover, one can

[87] Their study covers a number of developing countries and considers consumer surplus and nonlinear demand curves.

[88] We are also ignoring the degree to which the tariffs and connection fees that TANESCO charges may differ from the actual costs of electricity generation and distribution, as discussed in Chapter IV, since the households do not have to pay the difference.

[89] We will estimate impacts of getting grid electricity on housing values when we have the follow-up data.

think of the estimated potential monthly savings from switching to grid electricity as an upper bound estimate of the total benefits, since the additional fixed costs effectively reduce the potential long-run savings.

Our results do suggest the potential for substantial monthly savings. However, many households in Tanzania may have relatively high discount rates and/or be cash constrained. Consequently, the fixed costs of connecting may deter them from connecting in spite of large benefits in terms of monthly savings. For this reason, we also look at the fixed costs of connecting to the grid in Section D below.

C. Monthly Costs of Energy

We use data both on uses of energy and on energy sources to address the first three questions listed in Section A related to the monthly costs of energy. These two sources of data allow us to generate two estimates of potential savings. Similarly, when conducting economic rate of return calculations, both sources of data could be used to provide alternative estimates.

1. Uses of Energy

In this section we address questions related to monthly costs of energy by looking at data on four potential uses of energy—light, TV, cooking, and mobile phones. We focus on light and TV based on earlier evidence that these are the primary uses of electricity in rural areas (World Bank 2008). We also present numbers related to cooking and mobile phones given their potential importance as outcomes of interest.

We start with light, based on previous evidence that light is the primary use of electricity in rural areas (World Bank 2008). Households in our sample report using regular kerosene lanterns for about 209 hours per month. During this time, we estimate that they are producing around 14,200 lumens of light.[90] If they used kerosene to get this light, we estimate it would cost around 5,784 TZS/month. If they switch to grid electricity they could get the same amount of light for only 212 TZS/month—so they could save almost their entire kerosene light bill.[91] This comes out to around 2.3 percent of average household income. Alternatively, if they take the money they are spending on kerosene and instead spend it on light using incandescent light bulbs and grid electricity, we estimate they could get an additional 373,321 lumens of light per month (Table VII.1).[92]

The World Bank (2008) report notes that the second most common use of grid electricity is likely to be for television. Currently, households in our survey report using TVs on average for about 8.7 hours per month (the average includes households without a television); but the mean for those

[90] This is a small fraction of the average in our sample for all light sources (72,000 lumens per month), because the few households with electricity are getting far more lumens of light. Households in the intervention group only report using pressure lamps for around 1.8 hours per month so we leave those out of this calculation. We estimate lumens using the constants in Appendix C and an estimate of 2,700 TZS/liter of fuel.

[91] We are ignoring the costs of purchasing lights (kerosene lamps and wicks or electric lights and bulbs). This may represent a fairly high fixed cost in the short run, as households switch from kerosene to electricity. It may matter somewhat less in the long-run, to the extent that any increased expenditures purchasing electric lights and light bulbs is offset by decreased expenditures purchasing kerosene lights and wicks.

[92] These estimates are based on the constants in Appendix C, a cost of 2,700 TZS/liter for kerosene, and our Chapter IV estimates of 67 lumen hours of light per TZS using grid electricity and 2.5 lumen-hours of light per TZS using a regular kerosene lamp.

without grid electricity is only 4.3 hours per month. If they are using a small generator to power their TV then we estimate a cost of approximately 945 TZS/kWh based on our analysis in Chapter IV. A small television consumes 0.12 kW of energy per hour (Appendix C). If they are using such a TV, this implies they are using about 0.52 kWh per month, at a monthly cost of 488 TZS. If they switched to grid electricity, we estimate they could run this television for 4.3 hours a month at a cost of only around 114 TZS—thus again saving over three-quarters of their energy bill related to TV.[93] Since so few people use televisions, this is a small fraction of household income. Alternatively, for 374 TZS/month they could be watching TV for an extra 14.1 hours per month using grid electricity compared to only 4.3 hours currently (Table VII.1).

Currently most of the households in our sample are probably using wood or charcoal for heating and cooking.[94] They use around 151 kg of these solid fuels per month. We estimate that this fuel has an energy content of around 788 kWh. These solid fuel sources are obtained for about 14,458 TZS per month, which implies a very low average cost per kWh (18.3 kWh), even lower than the lifeline cost of electricity (60 TZS/kWh). If electric cooking is far more efficient at converting energy content into useful output then it is possible some households will switch. However, evidence from rural Tanzania and from other rural areas in many other countries suggests that adoption of electric cooking and heating devices tends to be very low for many years after households get access to electricity (World Bank 2008; Madubansi and Shackleton 2006). In addition, as we showed in Chapter IV, cooking with wood may be far less expensive than cooking on an electric stove. People may switch away from wood in later years to other sources, as their income rises (Davis 1998), but in the shorter term we may not see large impacts of grid electricity on cooking fuel use unless households are convinced that it is cost-effective (Table VII.1).

In Chapter IV we reported that the intervention group households with mobile phones are charging their phones about 16 times per month at a cost of 3,809 TZS. However, only about 70 percent of households have mobile phones. Thus, the average across all households (with and without a mobile phone) comes out to 11.2 charges and 2,659 TZS per month. If charging a cell phone uses 0.02 kWh, this implies a cost of around 11,900 TZS/kWh currently, compared to a TANESCO tariff of only 221 TZS/kWh. Thus, once again, our estimates suggest that households with mobile phones could save almost all of their phone charging costs by switching to grid electricity, and likely could keep their phones charged at all times.[95] The estimated savings from using grid electricity to charge mobile phones is about 1.1 percent of annual household income when averaged across all households (Table VII.1).

2. Sources of Energy

In this section, we address questions related to monthly costs of energy by looking at data on four potential sources of energy: generators, batteries, liquid fuels, and solid fuels (keeping in mind that many generators are likely run using liquid fuels).

[93] About 10 percent of the households with televisions report currently having access to grid electricity.

[94] The households also report using kerosene stoves for around 4.8 hours per month.

[95] We estimate that on average, a household could use these savings to purchase 12 kWh/month of electricity—enough to charge a cell phone about 601 times.

Table VII.1. Estimated Monthly Benefits of Grid Electricity Based on Energy Uses

Question	Light	TV	Cooking	Mobile Phones
(1) How much are households currently paying for energy each month? (TZS)	5,784	488	14,458	2,659
(2) How much could they save each month using grid electricity? (TZS)	5,572	374	0	2,609
Percent of monthly household income	2.2	0.2	0.0	1.1
(3) How much more output could they afford each month by using their savings from grid electricity?	373,321 lumens	14.1 hours	0 hours	601 charges

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: Estimated for a household with average characteristics.

Our survey data suggest that on average the households in our sample are consuming around 11.4 kWh per month of electricity from generators and batteries (including the households that do use any electricity from these sources). We asked households about three types of generators—regular, solar, and hydro—but did not obtain cost data for these generators.[96] However, as noted in Chapter IV, we estimate a cost of around 945 TZS/kWh for a small regular generator that produces 2 kW per hour. Households report using those regular generators for an average of 5.6 hours per month, which implies they produce around 11.2 kWh/month of electricity and spend about 10,584 TZS/month for this source of electricity. To consume the same amount of electricity from the grid would cost about 2,475 TZS—thus, households could save about 77 percent of the cost of this type of electricity by switching to the grid, or around 8,108 TZS per month. Alternatively, they could use the 10,584 TZS to consume around 36.7 kWh per month of electricity—an amount that is more than three times the 11.4 kWh we estimate they are using currently (Table VII.2).

Table VII.2. Estimated Monthly Benefits of Grid Electricity Based on Energy Sources

Question	Regular Generators	Batteries	Liquid	Solid
(1) How much are households currently paying for energy each month? (TZS)	10,584	7,815	11,564	14,458
(2) How much could they save each month using grid electricity? (TZS)	8,108	7,789	5,705	0
(3) How much more energy content could they afford each month by using their savings from grid electricity? (kWh)	36.7	35.3	25.8	0

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: Estimated for a household with average characteristics.

The households in our sample reported using their solar generators for an average of 8.8 hours per month. This average includes the 117 households that report having solar generators as well as those in our sample that do not. We estimate this would produce approximately 0.358 kWh of

[96] This is because of a translation issue, as discussed in Appendix B.

electricity per month. Of course, it is possible that these households have far more effective solar power generators than the one we used, so this estimate may be off. Regardless, experts generally agree that solar power is more costly than grid electricity, though solar technology is improving quickly (IRENA 2012).

We did not ask households to report on their pico-hydro expenditures and only one household reported using this type of power. However, a recent World Bank report (ESMAP 2007a) estimates that pico-hydro would cost around TZS 235 per kWh. This is close to the TANESCO rate of 221 TZS/kWh. If there are fixed costs to changing to the grid, this might cause the household using pico-hydro to keep that system, since they already paid the fixed cost of purchasing the pico-hydro system.

Batteries are another source of energy that households use, especially for lights and radios. This includes both regular small batteries (size AA, AAA, and D) and car batteries for household use. Households report spending an average of 7,815 TZS per month for these types of batteries. We estimate that they obtain around 0.12 kWh per month of electricity from these batteries at an average cost of about 67,000 TZS/kWh compared to a cost of only 221 TZS/kWh for TANESCO power. Switching this energy over to grid electricity therefore would save them almost their entire battery bill of 7,815 TZS/month. Alternatively, they could use this money to purchase around 35 kWh of electricity per month, compared to the 0.12 kWh they are currently getting (Table VII.2).

As discussed in Chapter IV, households currently spend around 11,564 TZS/month on liquid fuels to obtain around 66.4 kWh of energy content, at a cost of around 174 TZS/kWh. This is less than the general use TANESCO tariff of 221 TZS/kWh but more than the 60 TZS/kWh lifeline tariff for the first 50 kWh. Ignoring differences in the relative efficiency of electricity versus kerosene, this suggests that some households might replace some of the liquid fuel they are using now with 50 kWh of TANESCO electricity at the lifeline rate. This could generate a savings of around 5,700 TZS per month. However, if they were to switch over all of their current spending to grid electricity, they would actually end up getting fewer kWh per month—around 52. Hence, we suspect they would not change over all of their liquid fuel use. The amount saved by using just 50 kWh per month at the lifeline rate would allow them to purchase an additional 25.8 kWh per month (Table VII.2). Of course the feasibility of switching from any of the liquid fuels depends on what households are doing with these fuels. If they are being used mostly for lighting, heating, and generating electricity, then such a switch might be feasible. If households are using these fuels for tools that must be used outside of the home, such as agricultural machines then this may be less feasible.

As noted earlier, the calculations above ignore the possibility that electricity is more efficient for producing output than kerosene. Our estimates in Chapter IV and in the section on lights above suggest that this is likely true for light—and the potential benefits from switching over light use to electricity are presented there. Our estimates for cooking suggest that switching from kerosene to electricity for cooking would not be cost-effective. Hence, our data suggest that few households may reduce their use of kerosene for cooking when they get access to the grid (Table VII.2).

As discussed in Chapter IV and above, we estimate that currently households are spending, on average, very little for each kWh of energy content they obtain from their solid fuels, and switching to grid electricity for cooking from solid fuels would not be cost-effective. Consequently, given this information alone, we estimate that, on average, very few households would switch from solid fuels to grid electricity and there is little potential for savings or gains in output from switching.

Some of the savings discussed above overlap. For example, the savings from using generators is in part due to savings on liquid fuels; thus, we cannot combine those two types of savings. However, the numbers above do enable us to estimate a summary scenario for possible savings per month from switching to grid electricity, without double-counting any of the potential savings. We do this by combining savings associated with the monthly fuel costs from kerosene lights, generators, batteries, and mobile phone charging. This comes out to a total of about 24,000 TZS ($15 US), or about 10 percent of monthly household income. On average, it represents a potential 90 percent savings compared to current expenditures on these items. These estimates are summarized in Table VII.3 below.

Table VII.3. Summary of Potential Savings from Switching to Grid Electricity

Description	Current Expenditures	Cost using Grid	Potential Savings	Potential Savings as Percentage of Current Expenditures
Energy Use				
Kerosene Lights (TZS)	5,784	212	5,572	96%
Generators (TZS)	10,584	2,475	8,108	77%
Batteries (TZS)	7,815	26	7,789	100%
Charging Mobile Phones (TZS)	2,659	49	6,209	98%
Expenditure				
Total per Month (TZS)	26,842	2,763	24,079	
Total per Year (TZS)	322,103	33,152	288,951	90%
Total per Year (USD)	204.25	21.02	183.23	

Sources: Tanzania Energy Sector Baseline Household Survey.

D. Fixed Costs of Connecting to Grid

The discussion above has focused on potential savings associated with paying the monthly tariff for electricity in place of the monthly fuel costs of alternative energy sources, but it ignores the fixed costs of getting connected. In this section, we discuss those fixed costs and compare them to household income, assets, and potential savings in monthly costs from switching to the grid.

Currently, the connection fee in Tanzania is around US$300, or around 470,000 TZS.[97] This represents about 16 percent of average annual household income and 5 percent of average household assets. Table VII.4 shows income and asset quartiles to give a better sense of what percentage of the Tanzanians in our sample might be able to pay this connection fee. The table suggests that at least one-quarter of the households in our sample earn less than the connection fee in a given year. However, half of the households earn at least twice that much and one-quarter earn more than five times that much.

The connection fee is much smaller relative to household assets. That said, it does represent more than half of total assets for those in the bottom quartile of assets. For households in the top two quartiles, the connection fee is less than one-eighth of total assets—but of course much of their

[97] This is an estimate including taxes.

assets are likely in the form of land and housing, items they may be unwilling to sell off to get connected to the grid.

Table VII.4. Quartiles of Annual Household Income and Assets

Percentile	Income (TZS)	Asset (TZS)
25	380,000	872,000
50	1,050,000	4,000,000
75	2,760,000	7,900,000

Sources: Tanzania Energy Sector Baseline Household Survey.

Note: The estimates are weighted to adjust for sampling and nonresponse. The analysis sample includes 4,679 households in the intervention group. The estimates presented in this table exclude three intervention group households that could not be matched to the comparison group, as explained in Appendix A. Consequently, these estimates do not exactly match those shown in Table VI.2.

Households also need to get wiring and electrical equipment in order to take advantage of the grid. The wiring could cost as little as around US$50 for a ready-board to as much as US$400 for a small house, based on discussions we have had with staff at MCA-T.[98] Results from our enterprise survey suggest that the wiring costs could be even lower, as enterprises report spending an average of only 22,759 TZS (around US$14) for wiring. However, respondents in our household survey that said they were using the national grid (in section L of the survey) reported spending an average of around 800,000 TZS (about US$507) on connection and wiring costs.[99] Thus, the fixed costs could be much larger than just the connection cost, or they might not be very much more, at least for some households.

While the fixed costs of connecting are large, the potential savings from getting grid electricity are also nontrivial. In the scenario above, we estimated a potential savings of about 289,000 TZS (about US$183) per year. This implies that it would take households more than a year and a half to save enough to pay off the connection fee, and a few more months to a year to pay off the costs of wiring and electrical equipment. That said, for households that are eligible for the financing scheme initiative and that are planning to use the lowest-cost option for wiring (a ready-board), the fixed costs may be US$50 or less—much less than six months of the average annual earnings for the households in our sample.

E. Conclusion

On average, households in the intervention group purchased a total of 867 kWh of energy content at an average price of about 36 TZS/kWh. The tariff for grid electricity will be higher than this, which suggests it is unlikely households will switch over all of their energy needs to grid electricity. This conclusion is consistent with the evidence available in the literature that at any given time households in developing countries tend to rely on a range of energy sources (Martins 2005, Hosier and Kipyonda 1993, Barnes and Qian 1992). However, prices vary by the type of energy and how it is used, and some forms of energy may be far more effective than others for specific

[98] A ready-board is a device that enables households to get connected to the grid without internally wiring their house. It only allows them to use a few light bulbs or small appliances.

[99] In order to increase the sample size we used households in the intervention group, the comparison group, and the communities that were dropped; the estimate is unweighted.

purposes (for example, electricity is much better at producing light than kerosene). Hence, it is likely that many households will switch over substantial fractions of their energy use to grid electricity when that becomes available.

Considering the potential output and energy use of various fuels, tools, and appliances, our analysis using the household survey data suggests that switching to grid electricity could generate significant cost savings on the margin for many of the households in our sample. At the same time, the fixed costs of getting connected to the grid represent a large percentage of total household income. These costs represent a smaller percentage of total assets—but many households in Tanzania may not be willing to sell off assets in order to get connected to electricity. Our estimates suggest that, on average, the savings households might get from switching to grid electricity in a given year would be less than the fixed costs of connecting but perhaps would be sufficient to cover the fixed costs over a period of a few years. For the households that could take advantage of the financing scheme initiative and use the lowest-cost option for wiring, the fixed costs may be less than six months of our estimate of average annual savings in monthly energy costs in our sample.

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VIII. CONCLUSION

A. Summary

Promoting access to electricity in developing countries is a policy area of growing interest (Moss 2012). Together, MCC and MCA-T are implementing a major project to do just that in Tanzania at a cost of about $207 million. In this report, we present findings from analysis of baseline data that have been collected as the first step in an evaluation designed to estimate impacts of this project. Our evaluation focuses on two major components of the project—an activity designed to provide new T&D lines to over 300 communities spread throughout seven regions of Tanzania, and a second financing scheme initiative that will provide low-cost connections to about 5,800 households in 29 of these communities.

The data we collected will enable us to use rigorous methods to estimate impacts of these two components of the Tanzania energy sector project. The communities receiving the new lines were chosen to optimize the benefit–cost ratio of the project. Hence, they are not directly comparable to other communities in Tanzania that currently lack electric lines. In order to address this issue, we plan to estimate impacts of the new T&D lines by comparing outcomes for households in the communities that receive the new lines with outcomes for a carefully chosen set of matched households in communities that do not receive the lines. The communities receiving the FS initiative were randomly assigned from among those receiving the T&D lines. Hence, we can estimate impacts of the FS initiative by comparing outcomes of households in the communities receiving the FS initiative (the treatment group households) with outcomes of those in other communities that get the T&D lines but not the FS initiative (the control group households). A key result from our analysis of baseline household data is that we were able to achieve baseline equivalence between the intervention and comparison group households that will be used to evaluate T&D line extensions and between the treatment and control group households that will be used to evaluate the FS initiative. Because we selected intervention communities that are expected to have a high percentage of households with access to the new electric lines, our results will not generalize to communities with less access to the new lines. However, the results will be of strong policy relevance since, in the long run, it is expected that most communities in Tanzania will have a high level of access to electricity.

The findings of our report also show that the data collected will provide a rich source of information to help inform rigorous evaluations. These data contain valuable information on communities, households, and businesses. In spring and fall 2011 we collected data for our evaluation from 362 communities, over 10,000 households, and 59 businesses. Together these data enable us to describe communities, households, and businesses in terms of energy use, health, education, community assets, income, poverty, and gender differences. Implementation of activities under the energy sector project will be completed in 2012. In 2014, we will collect follow-up data on the same outcomes from the sampled communities, households, and businesses. This will enable us to describe changes over time in key outcomes and to estimate impacts of these components of the energy sector project in Tanzania.

Data from the community survey show that the communities targeted for the T&D line extension currently lack many key facilities. About 14 percent of these communities have an electrified primary school. Similarly, about 18 percent have an electrified dispensary, 14 percent have an electrified repair shop, and only 15 percent have a police station, post office, or bank. Almost none have an electrified market.

Data from the household survey show that at baseline the households in these communities are low-income, use traditional forms of energy, and show expected gender differences. About 72 percent earn less than $1 per day per capita and about 45 percent of their consumption consists of food. On average, these households consume over 150 kg of wood and charcoal per month. Adult household members spend relatively little time in wage employment and spend much of their working hours in nonwage farming and other income-generating activities. Men spend far less time than women cooking, collecting fuel, collecting water, or doing other household chores. At the same time, men earned more than women, have more IGAs and employees, and use far more electricity in their IGAs.

Data from the enterprise survey show that all of the enterprises surveyed are small, with no more than six employees each. A large fraction (63 percent) of the enterprises are small grocery shops (*duka*), only 29 percent have female owners, 58 percent are registered with the local or national government, and 89 percent use mobile telephones for business purposes. More than half of these enterprises already use electricity from the grid, with two-thirds of the electrified businesses reporting lighting as the primary use of electricity. A majority of the electrified businesses also reported that they experience power outages and voltage fluctuations either daily or a few times a week, indicating the need for improving the quality and reliability of electricity.

A primary purpose of collecting the baseline data was to enable us to account for pre-existing differences when we estimate impacts of the T&D line extensions and the FS initiative. In addition, however, these data provide valuable baseline information on how much households might benefit from grid electricity. When we estimate total energy consumed per household in kWh it appears that these households are currently getting energy at a lower cost than what TANESCO charges for grid electricity—in large part because they get a large amount of wood (about 75kg per month) for free. This suggests that many households will not switch from solid fuel to grid electricity. At the same time, we estimate that many of these households would benefit from grid electricity because of savings that could be realized via electric lights, TV, and mobile phone charging. While the benefits are potentially large, it would still take most households from a few months to a few years to realize cost savings large enough to pay for the fixed costs of getting access to electricity. Hence, the financing scheme initiative, which enables low-cost connections, may provide valuable insights on the benefits of grid electricity in the absence of this potential barrier to connections.

B. Plans for Future Analysis

We plan to write an interim report in 2013, prior to compact close-out, and a final report in 2015 after our follow-up survey data have been collected. The interim report will include findings from analyses of administrative data that may enable us to estimate impacts of the T&D activity on electricity reliability and access and of the financing scheme initiative on connection rates. In our final report we will be able to estimate impacts of the T&D activity and FS initiative on a wide variety of outcomes ranging from energy use to health, education, pollution, employment, business formation, investments, income, and poverty.

MCC is also interested in updating the estimated economic rates of returns on their investments. In order to do this well, it will be useful to have willingness-to-pay information that is based on multiple points on the energy demand curves. We will be able to use the data collected for the impact evaluation to calculate willingness to pay for electricity for households facing three different prices for electricity. Those benefitting from the FS initiative will face the lowest connection cost; those who are in the other T&D communities but are not receiving the FS initiative will face the standard connection cost of about US$300; and those in the comparison communities will face the highest cost—basically the cost of running a line from the nearest grid point to their home—which is likely prohibitive in most cases.

We will also be able to use the survey data to capture implementation challenges—for example, we may find that many households and businesses connect but receive low-quality electricity. We will also complement the survey data with qualitative data planned to be collected in 2014 after project implementation is complete. These data will enable us to dig more deeply into the underlying issues that may be limiting access to and/or use of grid electricity, as well as to capture unanticipated benefits and costs.

MCC is also interested in addressing gender issues. With this in mind, our survey instruments were designed with a particular interest in capturing differences between males and females. We asked many questions about females and males separately and in households with both an adult female and male spouse, we interviewed both separately on issues related to time use, income-generating activities, and wages. These data showed strong baseline differences by gender; for example, greater use of electricity in income-generating activities by males than by females. We will continue to examine the gender differences in outcomes in future analyses under the energy sector evaluation.

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APPENDIX A

SAMPLING AND MATCHING WEIGHTS

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1. Nonresponse Sampling Weights for Intervention Group

For our intervention group, we created weights to adjust for sampling and survey nonresponse. Households in the intervention group were sampled based on approximate eligibility for a subsidy pilot intervention that was later replaced by the financing scheme. Approximate eligibility was based on whether or not the household appeared to have two or fewer rooms. The survey team made this determination during the household listing process in the intervention areas. They then oversampled those households so that 40 percent of the resulting sample qualified, compared to 25 percent in the sampling frame. We created sampling weights to adjust our sample to be representative of the full population in the intervention group. These sampling weights (SWi) were calculated as one over the probability of being sampled.

$SW_i = 1/Pr_i$ where Pr_i = probability household i was sampled.

We then adjusted these sampling weights for nonresponse using 18 categories for nonresponse. These categories were based on region and total migration (in-migration plus out-migration as reported in the community survey). First we created three categories for total migration. Then we calculated the response rate for each of these categories by region (R_i). Lastly, we multiplied the sampling weights by the inverse of response rates to create a final weight for the intervention group (W_i).

$W_i=SW_i/Ri$

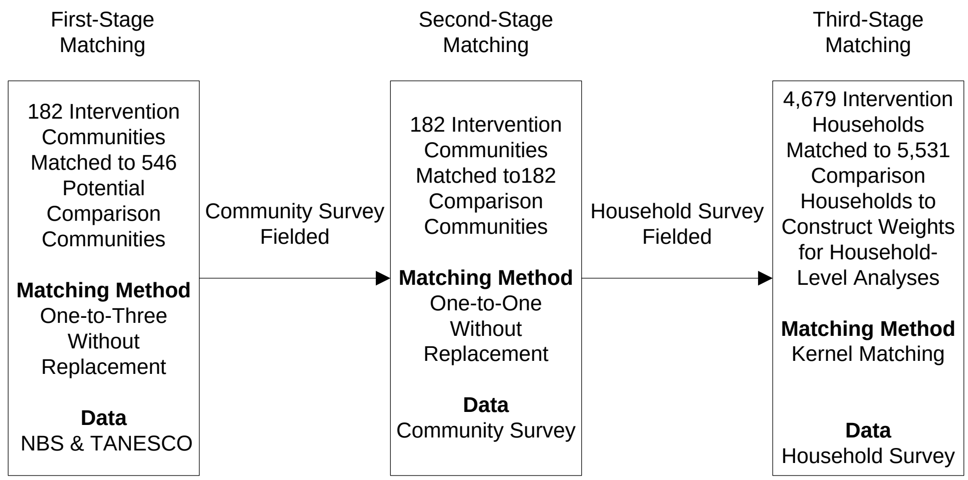
We also created weights for the comparison group to be used for pre-match comparisons. Consequently, the comparison group weights adjust for non-response by community but not for sampling since all households were sampled with equal probability within a community.

Choosing the number of households to sample in each comparison community was non-trivial. For the intervention group it was easy because we had the household listing long before we did the household survey. For the comparison group, however, we did not have the listing until the day before the household survey was done. Moreover, when we collected the household listing for the intervention group we learned that the community survey reports on community size were not always accurate. Consequently, we adjusted the community survey responses for the comparison group to obtain a better estimate of the number of eligible households. More precisely, we used the household listing data in the intervention group and regressed the number of eligible households in the community on the number reported in the community survey and other community characteristics. We then used the coefficients from this regression to create predicted community size variables for the comparison group.

2. Propensity Score Matching Weights for Comparison Group

Our initial set of 182 comparison communities was selected through two stages of propensity score matching. The first stage used data from the National Bureau of Statistics (NBS) and the Tanzania Electricity Supply Company (TANESCO) to identify a set of 546 potential comparison communities (Schurrer et al. 2011a). The community survey was fielded in these communities and the data were used to identify the 182 matched communities in the second stage of matching using a nearest neighbor algorithm (Schurrer et al. 2011b). The household survey was administered in 182 comparison and 182 intervention communities.[1] For this baseline report, we conducted a third stage of matching using household survey data to produce household weights that further improve the quality of our matches across important characteristics and enhance our future ability to make inferences about the impact of the T&D extension on household and community outcomes. We use a kernel matching method to construct a set of matched sample weights WM for the comparison group so that the weighted average of their outcomes could serve as a defensible counterfactual for those of the intervention group. Figure A.1 presents the three stages of matching. The remainder of this section describes the methodology used in this third stage of the propensity score matching and weight construction process.

Figure A.1. Stages of Matching Used to Identify Comparison Communities and Households



a. Estimation of the Propensity Score

The first step in the construction of the matched sample weights was the estimation of a logistic regression model, where the dependent variable $Interv_i$, indicating whether household *i* was a member of the intervention sample, was regressed on a *1xk* vector of baseline characteristics X_i:

$$\Pr(Interv_i = 1) = \Lambda(\mathbf{X}_i\gamma) = \frac{\exp(\mathbf{X}_i\gamma)}{1+\exp(\mathbf{X}_i\gamma)}, \quad (1)$$

Where γ is a *kx1* parameter vector.

To estimate (1), we weighted each intervention household by the nonresponse adjusted sample weight (described earlier in this appendix) from the household survey, W_i, and set the weights for the comparison group to one. From the estimation results, we obtained each comparison and intervention household's estimated propensity score as the predicted probability, $\hat{q} = \Lambda(\mathbf{X}_i\hat{\gamma})$, of belonging to the intervention sample.

[1] Seven of the original 182 comparison communities were replaced while the household survey was fielded because of a lack of eligible households (NRECA 2012, Table 5). The community in the set of 364 unmatched communities with the closest propensity score to the original matched community was selected as the replacement.

A critical methodological challenge for propensity score analysis is specifying a model that satisfies two important criteria. First, the model should include important observable characteristics that are likely correlated with the outcomes of interest, and predict membership in the intervention group. Second, the model needs to satisfy the balancing property in order to make inferences about the effect of the intervention on the outcomes (Rosenbaum and Rubin 1983). In theory, this means that for every value of the propensity score, there is no statistically significant difference between the intervention and comparison groups for the matching variables used to estimate the propensity score. In practice, the observations are divided into several blocks based on their propensity scores, and the balancing property is satisfied when there are no statistically significant differences between the intervention and comparison groups for the matching variables within each block.

To satisfy these two criteria, we iterated though a series of models that included household-level variables (1) thought to be correlated with characteristics that predict access to electricity and (2) with significant differences between intervention and comparison households. This covered many of our key outcomes related to income and energy. We also included gender of the household head, given the interest in gender differences. We started with a limited set of variables, performed the matching, and tested for post-match differences across a larger set of variables. We then re-specified the propensity score model, including variables that still had post-match differences that were statistically significant. Our final model satisfied the balancing property described above in all seven propensity score blocks and produced a sample that was balanced overall for the larger set of variables, as discussed in Chapter IV. The final propensity score regression included the following variables:

- Gender of the household head
- Household moved in the last 7.5 months
- TV hours per month
- Presence of any phone (mobile or landline)
- Total number of appliances
- House has an electrifiable roof
- Number of rooms in the house. Constructed three binary variables based on the distribution of the number of rooms:
  - Zero to two rooms (minimum to 25th percentile)
  - Two rooms (25th – 50th percentile)
  - Three to 20 rooms (50th percentile – maximum)
- Annual consumption (TZS)
- Total annual income (TZS)
- Total assets (TZS)
- Electricity expenditures per year (TZS)
- Electricity expenditures per year squared (TZS)
- Total amount spent on energy per year (TZS). Constructed four binary variables based on the distribution of the amount spent on energy:

- 0 – 90,000 (minimum – 50th percentile),
- 90,001 – 480,000 (50th – 75th percentile),
- 480,001 – 840,000 (75th – 99th percentile), and
- 840,000 – 3,204,000 (99th percentile – maximum)

- kWh per month from the electrical grid
- Non-electric energy made per month, including from small batteries (kWh)

After estimating the propensity score, we determined that there was sufficient overlap of the propensity scores between the intervention and comparison households to proceed with the kernel matching and creation of matched sample weights (described below). Table B.1 shows the summary statistics of the propensity scores by intervention status for the full set of intervention and comparison group households. While the means of the propensity score were similar, the difference between the intervention and comparison group propensity score means was statistically significant (t = -14.33), indicating that the two groups differ before applying the matching weights (as expected). Table B.1 suggests that the mean difference was in part due to the difference in the 25th percentile and in the 90th percentile and above.

Table A.1. Distribution of Propensity Scores by Intervention Status

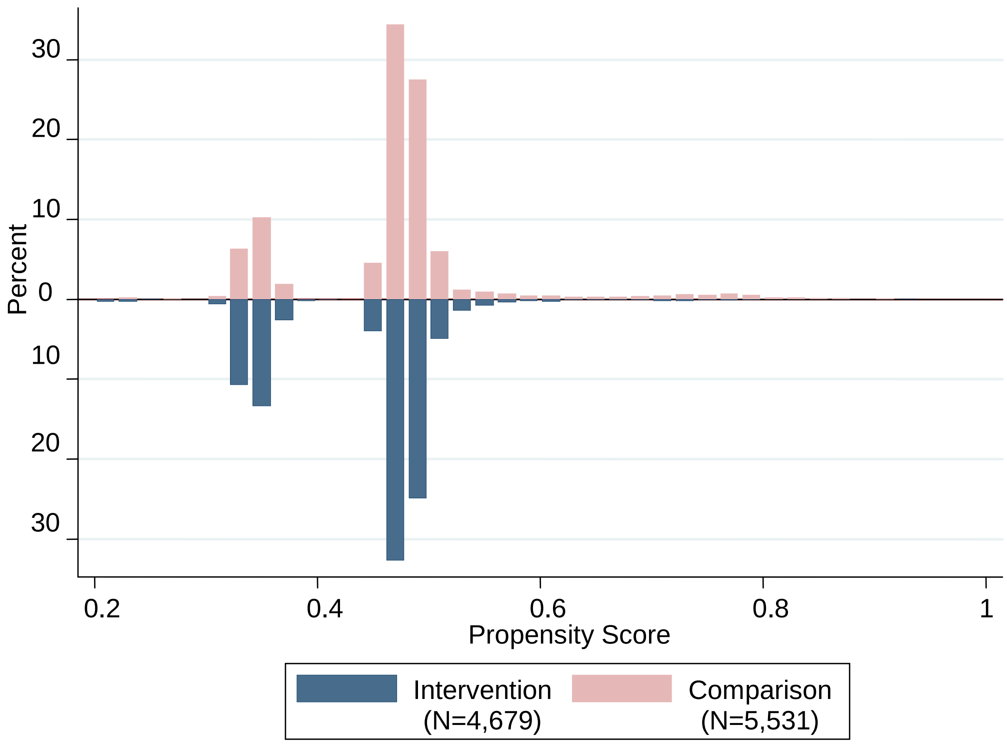
Intervention Status	N	Mean	Standard Deviation	Min	10th % ile	25th % ile	50th % ile	75th % ile	90th % ile	Max
Comparison	5,531	0.446	0.077	0.209	0.338	0.358	0.471	0.486	0.500	0.928
Intervention	4,682	0.469	0.086	0.208	0.344	0.461	0.475	0.490	0.512	0.964

Sources: Mathematica Analysis of Tanzania Energy Sector Baseline Household Survey.

There were two intervention households for which their propensity score was greater than the maximum score of the comparison households (that is, the intervention households were off-support), and one intervention household with a propensity score less than the minimum of the comparison households. These three households were dropped from subsequent analysis.[2] Figure A.2 shows substantial overlap between the propensity scores of the 5,531 comparison and remaining 4,679 intervention households, weighted by the nonresponse adjusted sample weight for the intervention group and one for the comparison group. While there was a great deal of overlap around the two modes, there were fewer comparison households at the right tail of the distribution and somewhat more in the modal group below 0.4.

[2] After dropping these three observations, the differences were still statistically significant (t = -14.29)

Figure A.2. Distribution of Propensity Scores Used to Construct Matched Sample Weights



b. Matching and Weight Construction

The propensity score $\hat{q}_i$ was used to perform the kernel matching and to construct the matched sample weights. Kernel matching is a nonparametric technique that uses the weighted averages of all observations in the comparison group to construct a matched comparison group. Larger weights are assigned to comparison households that are closer to intervention households in terms of propensity score. Thus, for example, the comparison households with propensity scores in the right tail of the distribution, as shown in Figure B.1, will receive larger weights relative to those near the modes. To describe this process, define *T* to be the set of intervention households and *C* to be the set of comparison households. Similar to Heckman et al. (1998), each comparison group member *i* was assigned a matched sample weight using the following formula:

(2) $$W_i^M = \sum_{j \in T} W_i^{KM}(j),$$

where *j* is the index for intervention households and W_i^{km}(j) is a weight based on the kernel matching given by

(3) $$W_i^{KM}(j) = \frac{W_j W_i K \;\; \hat{q}_j - \hat{q}_i}{\sum_{k \in C} W_k K \;\; \hat{q}_j - \hat{q}_k}$$

And K(.) is a symmetric Gaussian kernel function

(4) $$K(u) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{u}{h}\right)^2}$$

where *h*, the bandwidth, is positive. The weights for the comparison group households are set to one in equation (3). Following Silverman (1986), we select the optimal bandwidth that minimizes the mean integrated squared error given by

(5) $$h = 0.9 * A * N^{-\frac{1}{5}}$$

where $A = \min(IQR/1.34, \hat{\sigma})$ of the distribution of the propensity scores $\hat{q}$ *IQR* is the interquartile range of the sample, and *N* is the number of households.

Intuitively, when matching to intervention household *j*, equation (3) assigned a weight $W_i^{km}(j)$ to comparison *i* that decreased in the difference in propensity scores $|\hat{q}_j - \hat{q}_i|$ due to the shape of the kernel. Using equation (2), we summed these comparison weights across all intervention households, and the resulting W_i^M matched sample weights were used to estimate baseline differences. Because the kernel matching process did not change the intervention household weights, we defined $W_j^M = W_j$ for each intervention household.

c. Assessing Match Quality

After we conducted the kernel matching, we found no statistically significant differences between the intervention and comparison households for the individual variables in our model, and all of the variables were jointly insignificant. These results indicate that our model reduced the differences between the two groups along the covariates included in the propensity score model. We ran a series of linear regressions in which each characteristic was regressed on intervention status, first weighted by our initial sample weights W_i (pre-match) and then by our matched sample weights W_i^M (post-match). The standard errors in each regression were adjusted to account for clustering at the community level. In our pre-match regressions, intervention status was statistically significant at the 0.05 level (two-tailed test) for all variables *except*:

- Gender of the household head
- Presence of any phone
- House has two rooms
- Between 0–90,000 TZS spent on energy per year
- Between 90,001–480,000 TZS spent on energy per year
- Between 840,000–3,204,000 TZS spent on energy per year
- Non-electric energy made per month, including from small batteries (kWh)

After applying our match weights, no variables were statistically significant at the 0.10 level (two-tailed test). In our joint significance tests, we ran a logistic regression of intervention status on the vector of characteristics included in the propensity score model. We first ran the regression using the initial sample weights and then with the matched sample weights, adjusting the standard errors for clustering. The Wald χ^2 statistic for the pre-match model was 72.91 (df = 18)[3] with $p > \chi^2 = 0.00$ indicating that the variables were jointly significant in predicting intervention status. When our matched sample weights were applied, we fail to reject the hypothesis that the variables are jointly insignificant in predicting intervention status (Wald $\chi^2 = 8.26$, df = 18, $p > \chi^2 = 0.97$). Finally, we conducted a t-test of the propensity score by intervention status, weighted by the newly created matched weight. Prior to matching, the difference between the propensity scores was statistically significant, as discussed above. After matching, however, the differences were statistically insignificant (t = -1.28).

[3] The variable indicating a house with more than two rooms was dropped due to collinearity. As a result, there were 18 degrees of freedom for the chi-squared test rather than 19.

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APPENDIX B

HOUSEHOLD SURVEY ISSUES

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In this appendix, we document problems that occurred in the household survey and how we dealt with these problems.

1. Income-Generating Activities Data

In the English version of the survey, the primary respondent (usually a female) was asked to report on the "three most important" income-generating activities (IGAs) of the household whereas the secondary respondent (always a male) was asked to report on only his own. However, due to a translation error in the Swahili version, both respondents were asked to report on the "three most important" IGAs. In theory, this means that the answers would be the same. In practice, however, we estimate that there were approximately 1,600 IGAs covered by the secondary respondent but not by the primary respondent, compared to a total of 8,660 IGAs reported by the primary respondents alone. Thus, when we use all nonduplicated IGAs, about 16 percent were reported by only the secondary respondent. For this reason, we include the secondary respondent IGAs in our calculations.

To identify duplicate IGAs, we looked at IGAs that matched on six characteristics—type, location, electricity use, other energy use, year of formation, and number of employees. For the last two categories, we allowed the reports to differ by one in either direction. Using this definition, we found approximately 2,240 IGAs that were reported by both respondents and almost no duplicates within a respondent (that is, almost no cases of a respondent reporting more than one IGA that matched on all of these characteristics). Also, within the set of nine possible IGA matches that we are treating as nonmatches, we found much lower rates of matching on these characteristics. More precisely, about 74 percent of those potential pairs matched on fewer than five characteristics.

While we did not treat the duplicate records as separate IGAs, we did use information provided by the secondary respondent if the information the first respondent provided was missing. Using this method, we were able to include IGA income for over 100 additional households. In summary, the data on IGA income from the secondary respondent comprised about 40 percent of all IGA income (about 34 percent from the additional IGAs and about 6 percent from those where IGA income was missing for the primary respondent).

While it is clear that including the secondary respondent information on IGAs is helpful, this does not mean that we have captured all IGA information. Any household that had more than six IGAs would still have missing information. This problem seems unlikely to be substantial, as we have only one household reporting six IGAs and only about 100 reporting more than three. Thus, we suspect that the household survey data probably do capture almost all IGA income.

We present results in the main body of the report on IGA ownership and other characteristics by gender. It is possible that those results overestimate the percentage of IGAs owned by males. This is because we assumed that all of the IGAs reported by the male and not the female were run by the male. We did not ask the male to report on the ownership of the IGA, so we have no way to test this assumption. However, we think it unlikely that the female would have omitted an IGA that she operated.[4] Hence, we suspect this potential source of bias is likely small.

[4] The female respondent might have not reported her IGAs if she deemed them to be less important than the male's IGAs, but this would only matter if the household had more than three IGAs.

2. IGA Data on Non-Electric Energy

In the English version of the survey, question E15 asked about non-electric energy used to power "any equipment." Unfortunately, in the Swahili version of the instrument, "equipment" was translated as "machines." Of the over 6,000 households that reported the first IGA (E1a=1), only 5 percent reported needing to use non-electric energy. We suspect that the true fraction of IGAs with any equipment using non-electric energy is much higher, especially if equipment includes lights.

3. Wage Data

Due to translation errors, wage data are missing for about 11 percent of our sample. More precisely, we can only calculate wages and wage earnings for the 52 percent of households with wage earnings reported in monthly units. However, only about 22 percent of our sample reported earning wages, so we know that wage earnings are 0 for the remaining households.

In section J of the English version of the survey, we asked for the unit of payment (question J4), the number of units worked (J5), and the amount paid per unit (J6). Unit was translated as "*muda*" in the Swahili version of J5 (how long the respondent worked) and J6 (the wage per unit). However, the word *muda* does not appear in the unit question (J4). Hence, many interviewers may have believed that the financial amount reported in J6 should be the total earned during all of the units reported in question J5 rather than for just one of the units reported in J4. If all interviewers had interpreted the question that way then we could calculate total wages earned over the last year by using the numbers in J6. Unfortunately, the distribution of the data suggests that other interviewers interpreted the question to mean per unit worked as reported in J4. For example, a large fraction of the households that reported hourly earnings (16 out of 33) for the first respondent in section J, reported wages over US$60 per hour in question J6, suggesting that they reported the total earned during some longer "period" (or "*muda*") and not the amount per hour. Of these same households, 9 reported less than US$5, suggesting that they did report per hour.

Another important translation problem is that in the Swahili version, question J5 does not ask for the number of units worked (as the variable label from NRECA would suggest). Instead it asks for how long the person worked in the last 12 months. Not surprisingly almost all of the responses are in the 1–12 range, meaning that almost everyone interpreted this to mean months, even when they did not report earning monthly wages in J4. This means that if even when question J6 is per unit, we cannot get a total amount earned from wages unless the unit is months. As mentioned above, only about 22 percent of our sample report earning wages and most of them (52 percent) did report in monthly units. Those who report not earning wages have wage earnings set to 0. Hence, we are only missing wage earnings for about 11 percent of our total sample.

4. Generator Cost Questions

The baseline household survey questions contain breakdowns of hours of use by generator type (regular, solar, or hydro) but do not contain data on cost by generator type or even total generator costs. Section D of the baseline household survey includes questions about hours of use for three types of generators- regular, solar, and hydro. Section F of the survey includes two questions about generator costs—one on monthly costs (in the past 30 days) and the other on "purchase or repair" costs in the last 12 months. The section F questions in the English version of the survey ask about "Rent, fee, or lease payment for solar PV or generator system." This is ambiguous since it is not clear whether or not the word "solar" covers "generator systems." If it does, then this question only covers solar systems. If not, then this question covers costs for all three types of generators (regular, solar, and hydro). The Swahili version of the monthly cost question only asks about solar generators. Hence, the monthly costs might exclude regular and hydro generators. Regardless, we cannot calculate costs by generator type based on this question or get information about the costs of the fuel used for the regular generators. Section L also asks about monthly costs of electricity and if the source is solar. However, the monthly costs of solar power may be a small fraction of total solar costs which are likely primarily related to purchase of the solar panels and storage batteries.

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APPENDIX C

TABLES

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Table C.1. Pre-Matching Differences in Household Characteristics Between Intervention and Comparison Group (percentages, unless otherwise noted)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.1 Household Composition and Mobility									
Number of household members	4,682	4.9	2.4	5,531	4.8	2.3	0.1		0.20
Number of household members under 18	4,682	2.48	1.83	5,531	2.45	1.83	0.03		0.64
Head of household age	4,676	44.8	14.6	5,525	44.8	14.7	0.0		0.98
Household head is 18-24 years of age	4,676	3.1%	17.3%	5,525	3.3%	17.9%	-0.2%		0.60
Head of household married	4,682	72.8%	44.5%	5,530	73.8%	44.0%	-1.0%		0.51
Years in home	4,674	10.3	10.5	5,525	10.2	10.4	0.1		0.79
Moved in Last 7.5 Months	4,674	2.8%	16.4%	5,525	4.8%	21.4%	-2.1%	***	0.00
Characteristics Presented in Table IV.2 Total Energy and Electricity Use									
Monthly expenses on solid, liquid, battery, and grid energy (TZS)	4,682	31,619	66,123	5,531	26,089	68,836	5,531	**	0.04
Monthly energy content of solid, liquid, battery, and grid energy (kWh)	4,682	862	1,214	5,531	830	1,197	32		0.32
Electricity generated per month including batteries (kWh)	4,682	11.7	64.5	5,531	5.2	40.9	6.5	***	0.00
Monthly expenses for house batteries	4,682	3,383	9,774	5,531	2,798	7,381	585	**	0.02
Monthly household battery output (kWh)	4,682	0.02	0.08	5,530	0.02	0.03	0.00	***	0.01
Hours of car battery use per month	4,682	12.1	73.6	5,531	8.5	52.8	3.6	*	0.07
Monthly expenses for car batteries	4,671	4,505	27,014	5,511	3,792	29,979	713		0.36
Monthly electricity generated by car batteries (kWh)	4,681	0.10	0.76	5,527	0.08	0.64	0.02		0.23
Household uses generators	4,682	6.3%	24.3%	5,531	3.5%	18.3%	2.9%	***	0.00
Hours of energy generation per month including car batteries	4,682	26.6	129.7	5,531	16.0	96.8	10.6	***	0.00
Monthly electricity from generators (kWh)	4,682	11.6	64.4	5,531	5.2	40.8	6.5	***	0.00
Household uses grid electricity	4,682	1.1%	10.5%	5,531	0.1%	3.3%	1.0%	***	0.00
Monthly amount of grid electricity (kWh)	4,681	0.876	8.808	5531	0.117	5.12	0.759	***	0.00
Monthly expenses for grid electricity (TZS)	4,681	148	1,678	5,531	24	1346	124	***	0.00

Table C.1 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.3 Non-Electric Energy from Solid Fuel Sources									
Monthly non-electric output (kWh)	4,682	849	1,208	5,531	825	1,194	24		0.44
Monthly expenses for non-electric energy, solid and liquid (TZS)	4,682	26,244	60,331	5,531	22,722	67,477	3,521		0.14
Monthly amount of solid fuel used (kg)	4,682	149	206	5,531	154	230	-4		0.60
Monthly spending on solid fuel (TZS)	4,633	14,579	41,260	5,442	13,172	45,859	1,407		0.41
Monthly energy content of solid fuel (kWh)	4,682	782	1,004	5,531	778	1,159	4		0.90
Monthly amount of wood used (kg)	4,682	110	195	5,531	118	194	-8		0.43
Monthly amount of free wood (kg)	4,682	73	149	5,531	86	170	-12		0.16
Monthly amount of charcoal used (kg)	4,682	37	72	5,531	31	92	5		0.22
Monthly amount of free charcoal (kg)	4,682	2.2	27.7	5,531	3.2	72.0	-1.0		0.37
Monthly amount of crop residue used (kg)	4,682	2.7	18.3	5,531	3.7	71.2	-1.1		0.39
Monthly amount of free crop residue (kg)	4,682	2.1	14.0	5,531	3.5	70.8	-1.4		0.22
Monthly amount of straw used (kg)	4,682	0.0	1.4	5,531	0.2	3.1	-0.1	*	0.05
Monthly amount of free straw (kg)	4,682	0.0	1.1	5,531	0.1	2.6	-0.1	**	0.04
Monthly amount of dung used (kg)	4,682	0.0	0.0	5,531	0.1	2.8	-0.1	*	0.08
Monthly amount of free dung (kg)	4,682	0.0	0.0	5,531	0.1	2.8	-0.1	*	0.08
Monthly amount of candles used (kg)	4,682	0.6	4.8	5,531	0.8	6.0	-0.2		0.17
Monthly amount of free candles (kg)	4,682	0.0	0.1	5,531	0.0	1.5	0.0		0.19
Characteristics Presented in Table IV.4 Non-Electric Energy from Liquid Fuels									
Monthly amount of liquid fuel used (L)	4,682	7.1	68.7	5,531	4.9	25.7	2.2	*	0.06
Monthly spending on liquid fuel (TZS)	4,682	11,810	41,669	5,531	9,764	44,714	2,046	*	0.07
Monthly energy content of liquid fuel (kWh)	4,682	67.2	654.1	5,531	46.8	243.7	20.4	*	0.06
Monthly amount of kerosene used (L)	4,682	5.0	66.7	5,531	3.7	18.0	1.3		0.20
Monthly amount of free kerosene (L)	4,682	0.3	25.4	5,531	0.1	3.3	0.2		0.39
Monthly amount of gas used (L)	4,682	2.0	14.8	5,531	1.2	14.5	0.8	**	0.03
Monthly amount of free gas (L)	4,682	0.00	0.00	5,531	0.00	0.07	0.00		0.32
Monthly amount of LPG (L)	4,682	0.14	6.47	5,531	0.04	1.64	0.10		0.36
Monthly amount of free LPG (L)	4,682	0.00	0.00	5,531	0.01	0.80	-0.01		0.32

Table C.1 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.5 Tools and Appliances									
Number of appliances	4,682	7.0	4.8	5,531	6.2	3.9	0.8	***	0.00
Number of lights	4,682	2.9	2.2	5,531	2.6	1.7	0.3	***	0.00
Light-hours/month	4,682	327	314	5,531	295	271	31	***	0.00
Light lumen-hours/month	4,682	72,800	191,705	5,531	49,498	133,167	23,301	***	0.00
Water pump hours/month	4,682	1.1	18.5	5,531	0.6	14.0	0.5		0.19
Water liters per month from pumps	4,682	35,336	803,080	5,531	9,007	356,038	26,330		0.12
Radio and CD hours/month	4,682	58	123	5,531	44	102	15	*	0.09
TV hours/month	4,682	9.0	37.1	5,531	3.2	22.0	5.7	***	0.00
Cooking hours/month	4,682	195.9	131.9	5,531	187.0	132.1	8.8		0.11
Water heating hours/month	4,682	0.0	1.0	5,531	0.0	0.6	0.0		0.75
Refrigeration hours/month	4,682	12.3	103.1	5,531	5.8	67.2	6.5	**	0.03
AC fan hours/month	4,682	0.8	11.8	5,531	0.3	8.6	0.5	*	0.08
Someone in home has mobile phone	4,682	69.9%	45.9%	5,531	65.4%	47.5%	4.6%	*	0.10
Household has landline phone	4,682	0.2%	4.0%	5,531	0.1%	3.8%	0.0%		0.84
Total phone minutes/week if have a phone	2,611	195	1,648	2,935	151	428	44		0.27
Mobile phone recharges per week if have a mobile phone	3,135	3.7	3.4	3,569	3.4	3.8	0.3	*	0.06
Mobile phone recharge costs per week if have a mobile phone	3,118	878	1,108	3,556	833	1,290	45		0.22
Characteristics Presented in Table IV.6 Housing Materials									
Wall electrifiable	4,680	89.1%	31.2%	5,530	79.7%	40.2%	9.4%	***	0.00
Roof electrifiable	4,681	84.8%	35.9%	5,530	75.1%	43.2%	9.7%	***	0.00
House electrifiable	4,680	79.5%	40.4%	5,530	67.8%	46.7%	11.7%	***	0.00
Characteristics Presented in Table IV.7 Education									
Highest grade completed - household head	4,682	5.8	3.5	5,530	5.6	3.3	0.2		0.19
Completed any education - household head	4,682	81.6%	38.8%	5,530	80.4%	39.7%	1.2%		0.51
Completed primary education or more - household head	4,682	11.2%	31.6%	5,530	9.3%	29.0%	1.9%		0.14
Completed secondary education or more - household head	4,682	8.4%	27.8%	5,530	6.4%	24.5%	2.0%	*	0.08
Completed tertiary education - household head	4,682	2.1%	14.3%	5,530	0.9%	9.3%	1.2%	***	0.00
In school of those ages 5-14	3,173	75.0%	35.4%	3,778	74.9%	34.9%	0.1%		0.93
In an electrified school of those ages 5-24 in school	3,001	7.1%	21.6%	3,598	9.0%	24.1%	-1.9%		0.23

Table C.1 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.8 Student Time Use									
Hours/day at school - student	2,794	6.01	2.71	3,329	5.90	2.84	0.11		0.53
Hours/day reading and studying - student	2,794	0.98	1.13	3,329	1.01	1.15	-0.03		0.67
Average hours/day students study at home after sunset, ages 5-24	2,937	0.66	0.88	3,514	0.69	0.90	-0.03		0.36
Average hours/day students study at home during the day, ages 5-24	2,937	0.57	1.00	3,514	0.55	1.02	0.01		0.72
Hours/day collecting fuel - student	2,794	0.32	0.93	3,329	0.45	1.07	-0.13	**	0.01
Hours/day collecting water - student	2,794	0.68	0.93	3,329	0.75	0.96	-0.08	**	0.05
Hours/day listening to radio - student	2,794	0.58	1.15	3,329	0.52	1.06	0.06		0.27
Hours/day watching TV - student	2,794	0.22	0.74	3,329	0.13	0.57	0.09	**	0.04
Hours/day on other leisure activities - student	2,794	3.46	2.33	3,329	3.55	2.35	-0.09		0.37
Hours/day doing other household chores - student	2,794	0.99	1.09	3,329	0.97	1.02	0.02		0.60
Hours/day taking meals - student	2,794	0.78	0.65	3,329	0.80	0.64	-0.03		0.31
Hours/day on personal hygiene - student	2,794	0.51	0.60	3,329	0.55	0.71	-0.04		0.20
Hours/day resting during the day - student	2,794	0.79	1.39	3,329	0.85	1.32	-0.06		0.37
Hours/day sleeping at night - student	2,794	9.09	1.38	3,329	9.13	1.27	-0.04		0.52
Characteristics Presented in Table IV.9 Health Outcomes									
Adult had health problems in last 7 days	4,682	45.0%	49.8%	5,531	47.7%	49.9%	-2.7%		0.30
Adult (15 years or older) was unable to work due to illness in last 30 days	4,682	17.4%	38.0%	5,531	18.8%	39.0%	-1.4%		0.14
Child under 6 had health problems in last week, if any child	2,362	44.1%	49.8%	2,777	49.3%	49.9%	-5.3%	**	0.05
Child died if any born alive in last two years	1,196	8.7%	28.0%	1,443	10.4%	30.4%	-1.7%		0.19
Receive HIV/AIDS or other health information via radio or TV	4,682	64.1%	48.0%	5,531	64.4%	47.9%	-0.2%		0.87
Water source inside dwelling	4,681	4.6%	20.9%	5,531	4.8%	21.4%	-0.3%		0.83
Water source outside dwelling	4,681	37.9%	48.5%	5,531	46.0%	49.8%	-8.1%		0.13
Water source well and borehole	4,681	34.2%	47.5%	5,531	24.4%	42.9%	9.8%	**	0.02
Water source vendor, kiosk, truck/tanker service	4,681	5.4%	22.6%	5,531	4.0%	19.5%	1.4%		0.51
Water source river/lake/spring/pond/rain	4,681	33.8%	47.3%	5,531	37.1%	48.3%	-3.4%		0.36
Water source other	4,681	4.2%	20.1%	5,531	2.8%	16.5%	1.4%	*	0.07
Flush toilet	4,676	4.8%	21.4%	5,525	3.5%	18.4%	1.3%		0.15
Pit toilet	4,676	86.9%	33.7%	5,525	88.3%	32.1%	-1.4%		0.40
Latrine toilet	4,676	5.7%	23.1%	5,525	4.7%	21.1%	1.0%		0.32
Other toilet type	4,676	0.8%	9.2%	5,525	1.4%	11.7%	-0.5%		0.20
Monthly soot emissions (g)	4,682	149	215	5,531	145	224	4		0.49
Monthly CO_2 emissions (kg)	4,682	273	378	5,531	269	380	4		0.68

Table C.1 (continued)

Household Characteristic	Intervention Group			Comparison Group			Difference		P-Value
	N	Mean	Standard Deviation	N	Mean	Standard Deviation			
Characteristics Presented in Table IV.10 Adult Time Use									
Hours/day on wage labor in agriculture - female	3,854	0.14	1.00	4,618	0.15	0.96	-0.01		0.85
Hours/day on wage labor in agriculture - male	2,974	0.21	1.25	3,396	0.27	1.38	-0.06		0.25
Hours/day on wage labor in non-agriculture - female	3,854	0.28	1.55	4,618	0.27	1.51	0.01		0.89
Hours/day on wage labor in non-agriculture - male	2,974	1.04	3.05	3,394	1.13	3.14	-0.09		0.55
Hours/day in non-wage farming activities - female	3,854	2.05	2.82	4,618	1.91	2.73	0.14		0.45
Hours/day in non-wage farming activities - male	2,976	2.46	3.28	3,395	2.59	3.36	-0.12		0.56
Hours/day on other income generating activities - female	3,854	2.00	3.60	4,618	1.80	3.36	0.19		0.37
Hours/day on other income generating activities - male	2,976	3.14	4.57	3,394	2.62	4.18	0.52	*	0.05
Hours/day in school/reading/studying - female	3,893	0.15	0.68	4,668	0.15	0.64	0.01		0.78
Hours/day in school/reading/studying - male	2,981	0.39	1.19	3,405	0.47	1.39	-0.08	*	0.07
Hours/day on food processing and cooking - female	3,893	3.23	1.89	4,668	3.22	1.84	0.01		0.92
Hours/day on food processing and cooking - male	2,981	0.42	1.24	3,406	0.46	1.33	-0.04		0.31
Hours/day collecting fuel - female	3,854	0.71	1.36	4,618	0.86	1.43	-0.15	*	0.08
Hours/day collecting fuel - male	2,976	0.20	0.77	3,394	0.30	0.93	-0.09	***	0.01
Hours/day collecting water - female	3,854	0.98	1.10	4,618	1.08	1.14	-0.10	*	0.06
Hours/day collecting water - male	2,976	0.26	0.79	3,394	0.30	0.81	-0.04		0.36
Hours/day repairing clothes, basket, etc. - female	3,854	0.20	0.84	4,618	0.23	0.86	-0.03		0.27
Hours/Day repairing clothes, basket, etc. - male	2,976	0.18	0.85	3,394	0.17	0.83	0.01		0.68
Hours/day doing other household chores - female	3,854	2.19	1.39	4,618	2.23	1.39	-0.04		0.43
Hours/day doing other household chores - male	2,975	0.33	0.88	3,394	0.36	0.92	-0.03		0.26
Hours/day taking meals - female	3,854	0.80	0.61	4,618	0.85	0.65	-0.05	*	0.07
Hours/day taking meals - male	2,976	0.83	0.67	3,395	0.84	0.67	-0.01		0.76
Hours/day listening to radio - female	3,854	1.65	2.24	4,618	1.49	2.14	0.16		0.12
Hours/day listening to radio - male	2,976	2.43	2.53	3,395	2.37	2.50	0.06		0.63
Hours/day watching TV - female	3,854	0.18	0.75	4,618	0.08	0.49	0.09	***	0.01
Hours/day watching TV - male	2,976	0.32	0.96	3,394	0.19	0.79	0.14	**	0.02
Hours/day visiting neighbors or on other leisure activities - female	3,893	1.90	2.06	4,668	1.99	2.10	-0.09		0.28
Hours/day visiting neighbors or on other leisure activities - male	2,981	2.81	2.74	3,406	2.95	2.66	-0.14		0.28
Hours/day sleeping at night - female	3,854	8.75	1.14	4,618	8.75	1.16	0.01		0.88
Hours/day sleeping at night - male	2,976	8.52	1.49	3,394	8.47	1.67	0.05		0.48
Hours/day resting during the day - female	3,854	1.39	1.61	4,618	1.48	1.62	-0.09		0.14
Hours/day resting during the day - male	2,976	1.52	1.90	3,395	1.54	1.79	-0.03		0.73
Other household activities - female	3,893	2.75	2.32	4,668	3.00	2.42	-0.25	***	0.00
Other household activities - male	2,981	2.20	2.49	3,406	2.32	2.48	-0.13		0.21
Multitasking hours - female	4,682	4.67	5.98	5,531	4.88	6.02	-0.21		0.42
Multitasking hours - male	4,682	2.27	4.01	5,531	2.25	4.13	0.02		0.90

Table C.1 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.11 Income Generating Activities									
Household has no IGAs	4,682	29.3%	45.5%	5,531	29.0%	45.3%	0.3%		0.89
Total number of IGAs	4,682	1.0	0.9	5,531	1.0	0.9	0.0		0.60
Household has electrified IGA if household has IGAs	3,269	7.2%	26.1%	3,926	5.8%	23.3%	1.5%		0.11
Average age of IGA owners if household has IGAs	3,268	39.5	12.4	3,916	39.8	12.4	-0.2		0.61
Average education of IGA owners if household has IGAs	3,268	5.9	3.1	3,918	5.8	3.0	0.2		0.23
Number of farmer IGAs	4,682	0.16	0.39	5,531	0.22	0.46	-0.06	**	0.02
Number of small vendor IGAs	4,682	0.36	0.56	5,531	0.32	0.55	0.03		0.18
Number of medical IGAs	4,682	0.00	0.07	5,531	0.00	0.06	0.00		0.34
Number of manufacturing IGAs	4,682	0.08	0.30	5,531	0.08	0.28	0.01		0.39
Number of repair shops and other IGAs	4,682	0.41	0.63	5,531	0.41	0.63	0.00		0.93
Average year IGAs established if household has IGAs	3,216	2002	10	3,846	2001	10	1	**	0.05
Percentage of IGAs at household premise if household has IGAs	3,269	38.7%	45.7%	3,926	37.6%	44.5%	1.2%		0.53
Percentage of IGAs at truck or vendors if household has IGAs	3,269	6.7%	23.5%	3,926	7.2%	23.9%	-0.5%		0.55
Percentage of IGAs at other location if household has IGAs	3,269	54.6%	46.7%	3,926	55.2%	45.5%	-0.6%		0.74
Characteristics Presented in Table IV.12 Household Income and Assets									
Total annual income	4,682	2,892,755	7,911,781	5,531	2,336,285	6,398,476	556,470	**	0.05
Total annual wages if household has wages	550	3,240,734	12,961,977	637	2,123,862	5,240,365	1,116,872		0.12
Average hourly wage of household members if household has wages	553	1,479	4,041	641	1,067	2,303	413		0.11
Total annual farm wages if household has farm wages	46	927,519	2,023,113	35	605,730	749,513	321,789		0.34
Total annual non-farm wages if household has non-farm wages	510	3,410,439	13,432,112	601	2,214,317	5,378,838	1,196,122		0.13
Annual income from IGAs (TZS)	4,539	1,524,511	5,546,594	5,343	1,133,622	4,471,974	390,889	**	0.05
Annual income from top 3 IGAs only (TZS)	4,361	1,133,180	2,958,840	5,158	926,879	4,061,188	206,301		0.12
Non-wage, non-IGA income per year	4,682	1,013,012	2,364,144	5,531	996,343	3,291,763	16,669		0.86
Total assets	4,682	9,174,773	26,034,308	5,531	6,809,153	21,699,544	2,365,620	***	0.01
Value of home	4,682	5,050,557	17,337,771	5,531	3,611,905	7,590,619	1,438,652	***	0.01
Number of bedrooms	4,678	2.7	1.5	5,524	2.5	1.4	0.2	***	0.01
Household debt	4,618	-64,139	496,635	5,432	-50,587	445,396	-13,552		0.32
Characteristics Presented in Table IV.13 Consumption									
Annual consumption (TZS)	4,682	2,797,482	3,973,413	5,531	2,342,037	2,559,283	455,445	**	0.02
Annual food consumption (TZS)	4,682	1,249,502	1,152,583	5,531	1,174,232	1,130,923	75,271		0.32
Annual school fees and supplies (TZS)	4,682	108,304	1,224,145	5,531	74,227	462,502	34,077		0.11
Annual medical expenses (TZS)	4,682	49,275	123,719	5,531	45,538	123,888	3,738		0.35
Amount of money spent on cigarettes and alcohol in last 7 days (TZS)	4,682	1,264	4,940	5,531	1,119	4,244	144		0.33
Grid expenditures/mnth if use any	4,681	148	1,678	5,531	24	1,346	124	***	0.00
Annual spending on satellite dish and cable TV (TZS)	4,682	10,972	160,140	5,531	2,707	99,275	8,265	*	0.08
Annual spending on light bulbs (TZS)	4,682	3,415	61,128	5,531	1,445	21,414	1,970	*	0.08

Table C.1 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.14 Poverty									
Per capita daily income (USD)	4,682	1.18	2.85	5,531	0.96	2.41	0.22	**	0.04
Makes less than $1 (USD) income per capita per day	4,682	71.6%	45.1%	5,531	76.8%	42.2%	-5.2%	**	0.03
Makes less than $2 (USD) income per capita per day	4,682	85.5%	35.2%	5,531	89.4%	30.7%	-3.9%	***	0.01
Per capita daily consumption (USD)	4,682	1.14	1.54	5,531	1.01	1.41	0.13	*	0.06
Consumes less than $1 (USD) per capita per day	4,682	63.1%	48.3%	5,531	67.7%	46.7%	-4.5%		0.11
Consumes less than $2 (USD) per capita per day	4,682	87.9%	32.6%	5,531	90.4%	29.5%	-2.4%	*	0.05
Characteristics Presented in Table IV.15 Household Composition, Education, and Health by Gender									
Head of household is female	4,682	23.2%	42.2%	5,531	24.0%	42.7%	-0.8%		0.57
Percent of household members who are female	4,682	51.1%	22.9%	5,531	51.9%	22.9%	-0.8%		0.12
Age - key female	3,895	38.9	14.0	4,671	38.6	14.0	0.3		0.63
Age - key male	2,965	43.0	15.0	3,401	43.2	15.1	-0.1		0.82
Married - key female	3,897	75.8%	42.9%	4,673	75.8%	42.8%	0.0%		0.99
Married - key male	2,969	84.6%	36.2%	3,402	85.9%	34.8%	-1.3%		0.23
Completed any education - key female	3,897	73.7%	44.1%	4,672	75.1%	43.2%	-1.4%		0.50
Highest grade completed - key female	3,896	5.1	3.5	4,672	5.1	3.3	0.0		0.84
Completed any education - key male	2,972	87.1%	33.6%	3,406	85.3%	35.4%	1.8%		0.29
Highest grade completed - key male	2,972	6.3	3.2	3,406	6.0	3.2	0.3		0.14
Household has a person 15 years or older who was unable to work due to illness - household has females age 15 or older	4,402	13.2%	33.9%	5,275	14.6%	35.3%	-1.4%		0.11
Household has a person 15 years or older who was unable to work due to illness - household has males age 15 or older	4,046	7.4%	26.3%	4,788	8.5%	27.9%	-1.1%	*	0.09
Characteristics Presented in Table IV.16 Income and Assets by Gender									
Annual female income (TZS) if data identify females	4,473	762,788	2,327,939	5,309	704,001	3,612,006	58,787		0.54
Annual male income (TZS) if data identify males	3,607	2,168,747	7,383,363	4,315	1,553,389	4,607,648	615,358	**	0.02
Unitary family: Has key male and/or female but no other adults	4,682	52.0%	50.0%	5,531	54.9%	49.7%	-2.9%	*	0.05
Non-wage, non-IGA income/year - female in unitary family	2,464	394,569	1,284,923	3,037	418,580	1,895,301	-24,011		0.68
Non-wage, non-IGA income/year - male in unitary family	2,464	643,372	1,919,895	3,036	583,811	2,377,950	59,561		0.45
Average hourly male wage if household has males with wages	394	1,768	6,024	474	1,115	2,503	652		0.12
Average hourly female wage if household has females with wages	214	1,444	3,070	212	1,070	2,013	375		0.16
Total male annual wages if household has males with wages	391	3,147,168	11,612,901	471	2,028,175	4,870,914	1,118,994		0.15
Total female annual wages if household has females with wages	214	2,542,914	5,887,122	211	1,880,625	3,773,163	662,289		0.19

Table C.1 (continued)

Household Characteristic	Intervention Group N	Intervention Group Mean	Intervention Group Standard Deviation	Comparison Group N	Comparison Group Mean	Comparison Group Standard Deviation	Difference		P-Value
Characteristics Presented in Table IV.17 Income Generating Activities by Gender									
Number of IGAs owned by females if household has key female	4,401	0.478	0.578	5,258	0.492	0.576	-0.014		0.53
Number of IGAs owned by males if household has key male	4,098	0.626	0.713	4,834	0.637	0.724	-0.012		0.70
Percentage of IGAs owned by men if household has IGAs	3,268	53.4%	44.3%	3,918	52.1%	43.7%	1.3%		0.34
Annual income from IGAs - if household has key female	3,988	466,256	1,507,383	4,801	430,836	3,304,882	35,419		0.61
Annual income from IGAs - if household has key male	3,206	1,555,853	6,189,894	3,758	1,058,092	3,643,704	497,762	**	0.03
Number of IGA paid staff in the past 12 months - if household has key female	3,996	0.1	0.8	4,813	0.1	0.8	0.0		0.41
Number of IGA paid staff in the past 12 months - if household has key male	3,297	0.6	2.1	3,881	0.6	2.0	0.0		0.85
Number of IGA unpaid staff in the past 12 months - if household has key female	3,996	0.8	2.6	4,813	0.8	1.3	0.0		0.74
Number of IGA unpaid staff in the past 12 months - if household has key male	3,297	1.3	1.8	3,881	1.3	1.8	0.0		0.86
Annual IGA electricity expenditures for female-operated IGAs if household has key female	3,996	4,071	70,907	4,811	2,538	38,554	1,534		0.24
Annual IGA electricity expenditures for male-operated IGAs if household has key male	3,290	44,968	610,853	3,865	12,634	138,709	32,335	**	0.02

Source: Tanzania Energy Sector Baseline Household Survey

Notes: */**/*** Difference is statistically significantly different from zero at the .10/.05/.01 level using a two-tailed t-test.

Estimates presented in this table are weighted to adjust for sampling and survey nonresponse

Table C.2. Post-Matching Differences in Household Characteristics between Intervention and Comparison Group (percentages, unless otherwise noted)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.1 Household Composition and Mobility									
Number of household members	4,679	4.9	2.4	5,531	4.9	2.3	0.0		0.98
Number of household members under 18	4,679	2.48	1.83	5,531	2.50	1.84	-0.02		0.79
Head of household age	4,673	44.8	14.6	5,525	45.1	14.6	-0.3		0.63
Household head is 18-24 years of age	4,673	3.1%	17.3%	5,525	2.9%	16.8%	0.2%		0.68
Head of household married	4,679	72.8%	44.5%	5,530	75.1%	43.3%	-2.3%		0.13
Years in home	4,671	10.3	10.5	5,525	10.3	10.2	0.0		0.99
Moved in last 7.5 months	4,671	2.7%	16.3%	5,525	2.3%	15.0%	0.4%		0.25
Characteristics Presented in Table IV.2 Total Energy and Electricity Use									
Monthly expenses on solid, liquid, battery, and grid energy (TZS)	4,679	30,912	63,422	5,531	30,801	83,715	111		0.97
Monthly energy content of solid, liquid, battery, and grid energy (kWh)	4,679	867	1,232	5,531	854	1,119	13		0.68
Electricity generated per month including batteries (kWh)	4,679	11.5	63.6	5,531	11.6	58.0	-0.1		0.97
Monthly expenses for house batteries	4,679	3,382	9,733	5,531	2,987	7,927	395		0.12
Monthly household battery output (kWh)	4,679	0.02	0.08	5,530	0.02	0.03	0.00	**	0.05
Hours of car battery use per month	4,679	12.1	75.0	5,531	11.5	62.6	0.6		0.80
Monthly expenses for car batteries	4,669	4,433	26,926	5,511	5,481	37,294	-1,047		0.27
Monthly electricity generated by car batteries (kWh)	4,678	0.09	0.75	5,527	0.10	0.72	0.00		0.87
Household uses generators	4,679	6.2%	24.2%	5,531	6.6%	24.9%	-0.4%		0.71
Hours of energy generation per month including car batteries	4,679	26.5	132.0	5,531	25.4	126.7	1.2		0.78
Monthly electricity from generators (kWh)	4,679	11.4	63.5	5,531	11.5	57.9	-0.1		0.97
Household uses grid electricity	4,679	1.0%	10.0%	5,531	0.5%	6.7%	0.6%		0.11
Monthly amount of grid electricity (kWh)	4,678	0.82	8.60	5,531	0.35	7.65	0.47	*	0.08
Monthly expenses for grid electricity (TZS)	4,678	141	1,652	5,531	60	1,919	81		0.11

Table C.2 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.3 Non-Electric Energy from Solid Fuel Sources									
Monthly non-electric output (kWh)	4,679	855	1,226	5,531	842	1,112	13		0.69
Monthly expenses for non-electric energy, solid and liquid (TZS)	4,679	25,879	59,846	5,531	26,465	82,015	-587		0.83
Monthly amount of solid fuel used (kg)	4,679	151	209	5,531	152	218	-1		0.88
Monthly spending on solid fuel (TZS)	4,630	14,458	41,671	5,442	14,109	45,083	349		0.84
Monthly energy content of solid fuel (kWh)	4,679	788	1,020	5,531	784	1,057	4		0.89
Monthly amount of wood used (kg)	4,679	112	197	5,531	113	187	-2		0.86
Monthly amount of free wood (kg)	4,679	75	151	5,531	80	158	-6		0.51
Monthly amount of charcoal used (kg)	4,679	36	73	5,531	34	77	2		0.66
Monthly amount of free charcoal (kg)	4,679	2.3	29.7	5,531	2.6	49.0	-0.3		0.73
Monthly amount of crop residue used (kg)	4,679	2.8	18.8	5,531	3.6	71.6	-0.8		0.52
Monthly amount of free crop residue (kg)	4,679	2.2	14.3	5,531	3.4	71.3	-1.2		0.30
Monthly amount of straw used (kg)	4,679	0.0	1.3	5,531	0.1	2.9	-0.1		0.10
Monthly amount of free straw (kg)	4,679	0.0	1.1	5,531	0.1	2.4	-0.1	*	0.07
Monthly amount of dung used (kg)	4,679	0.0	0.0	5,531	0.1	3.1	-0.1	*	0.10
Monthly amount of free dung (kg)	4,679	0.0	0.0	5,531	0.1	3.1	-0.1	*	0.10
Monthly amount of candles used (kg)	4,679	0.6	4.8	5,531	0.9	6.4	-0.3	**	0.05
Monthly amount of free candles (kg)	4,679	0.0	0.1	5,531	0.0	1.6	0.0		0.19
Characteristics Presented in Table IV.4 Non-Electric Energy from Liquid Fuels									
Monthly amount of liquid fuel used (L)	4,679	7.0	69.4	5,531	6.1	32.5	1.0		0.46
Monthly spending on liquid fuel (TZS)	4,679	11,564	40,607	5,531	12,547	66,945	-983		0.59
Monthly energy content of liquid fuel (kWh)	4,679	66.4	661.5	5,531	57.5	307.7	8.9		0.47
Monthly amount of kerosene used (L)	4,679	5.0	67.6	5,531	3.9	18.0	1.1		0.28
Monthly amount of free kerosene (L)	4,679	0.4	26.7	5,531	0.1	3.3	0.3		0.37
Monthly amount of gas used (L)	4,679	1.9	14.2	5,531	2.1	21.1	-0.2		0.70
Monthly amount of free gas (L)	4,679	0.00	0.00	5,531	0.00	0.08	0.00		0.32
Monthly amount of LPG (L)	4,679	0.14	6.55	5,531	0.06	1.83	0.08		0.45
Monthly amount of free LPG (L)	4,679	0.00	0.00	5,531	0.01	0.92	-0.01		0.32

Table C.2 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.5 Tools and Appliances									
Number of appliances	4,679	7.0	4.7	5,531	6.9	4.6	0.1		0.77
Number of lights	4,679	2.9	2.1	5,531	2.9	2.1	0.0		0.84
Light-hours/month	4,679	326	312	5,531	335	339	-9		0.47
Light lumen-hours/month	4,679	71,911	189,755	5,531	73,466	218,604	-1,555		0.86
Water pump hours/month	4,679	1.1	18.7	5,531	0.8	15.3	0.4		0.36
Water liters per month from pumps	4,679	36,587	821,338	5,531	9,668	378,176	26,920		0.14
Radio and CD hours/month	4,679	58	123	5,531	50	108	8		0.36
TV hours/month	4,679	8.7	36.6	5,531	8.0	36.4	0.7		0.77
Cooking hours/month	4,679	196.0	132.2	5,531	198.8	143.5	-2.8		0.64
Water heating hours/month	4,679	0.0	1.0	5,531	0.0	0.9	0.0		0.70
Refrigeration hours/month	4,679	11.9	101.0	5,531	9.5	84.8	2.4		0.48
AC fan hours/month	4,679	0.8	11.9	5,531	0.4	7.9	0.4		0.20
Someone in home has mobile phone	4,679	69.8%	45.9%	5,531	69.0%	46.2%	0.7%		0.80
Household has landline phone	4,679	0.2%	4.1%	5,531	0.2%	4.1%	0.0%		0.96
Total phone minutes/week if have a phone	2,608	191	1,588	2,935	165	439	26		0.48
Mobile phone recharges per week if have a mobile phone	3,132	3.7	3.4	3,569	3.7	4.2	0.0		0.82
Mobile phone recharge costs per week if have a mobile phone	3,115	879	1,097	3,556	825	1,397	54		0.16
Characteristics Presented in Table IV.6 Housing Materials									
Wall electrifiable	4,677	89.0%	31.3%	5,530	83.6%	37.0%	5.4%	**	0.02
Roof electrifiable	4,678	84.8%	35.9%	5,530	84.3%	36.3%	0.4%		0.86
House electrifiable	4,677	79.3%	40.5%	5,530	76.0%	42.7%	3.3%		0.29
Characteristics Presented in Table IV.7 Education									
Highest grade completed - household head	4,679	5.8	3.5	5,530	5.8	3.4	0.0		1.00
Completed any education - household head	4,679	81.6%	38.8%	5,530	82.2%	38.2%	-0.7%		0.71
Completed primary education or more - household head	4,679	11.2%	31.6%	5,530	11.3%	31.6%	-0.1%		0.97
Completed secondary education or more - household head	4,679	8.4%	27.8%	5,530	8.1%	27.3%	0.3%		0.83
Completed tertiary education - household head	4,679	2.1%	14.3%	5,530	1.4%	11.9%	0.7%		0.23
In school of those ages 5-14	3,171	75.1%	35.3%	3,778	76.2%	34.2%	-1.1%		0.46
In an electrified school of those ages 5-24 in school	3,000	7.1%	21.6%	3,598	9.3%	25.1%	-2.3%		0.15

Table C.2 (continued)

Household Characteristic	Intervention Group N	Intervention Group Mean	Intervention Group Standard Deviation	Comparison Group N	Comparison Group Mean	Comparison Group Standard Deviation	Difference		P-Value
Characteristics Presented in Table IV.8 Student Time Use									
Hours/day at school - student	2,793	6.01	2.72	3,329	5.93	2.89	0.08		0.67
Hours/day reading and studying - student	2,793	0.98	1.13	3,329	1.02	1.16	-0.04		0.49
Average hours/day students study at home after sunset, ages 5-24	2,936	0.66	0.87	3,514	0.72	0.93	-0.06	*	0.09
Average hours/day students study at home during the day, ages 5-24	2,936	0.57	0.99	3,514	0.56	1.01	0.01		0.83
Hours/day collecting fuel - student	2,793	0.33	0.93	3,329	0.42	1.05	-0.09	*	0.08
Hours/day collecting water - student	2,793	0.68	0.93	3,329	0.74	0.97	-0.06		0.16
Hours/day listening to radio - student	2,793	0.58	1.15	3,329	0.57	1.09	0.01		0.79
Hours/day watching TV - student	2,793	0.22	0.73	3,329	0.18	0.66	0.04		0.46
Hours/day on other leisure activities - student	2,793	3.46	2.33	3,329	3.53	2.38	-0.08		0.46
Hours/day doing other household chores - student	2,793	0.99	1.09	3,329	0.98	1.04	0.01		0.86
Hours/day taking meals - student	2,793	0.78	0.65	3,329	0.80	0.64	-0.02		0.43
Hours/day on personal hygiene - student	2,793	0.51	0.60	3,329	0.56	0.77	-0.05		0.14
Hours/day resting during the day - student	2,793	0.79	1.40	3,329	0.86	1.37	-0.07		0.31
Hours/day sleeping at night - student	2,793	9.08	1.39	3,329	9.10	1.29	-0.01		0.82
Characteristics Presented in Table IV.9 Health Outcomes									
Adult had health problems in last 7 days	4,679	45.2%	49.8%	5,531	47.6%	49.9%	-2.5%		0.35
Adult (15 years or older) was unable to work due to illness in last 30 days	4,679	17.4%	37.9%	5,531	18.6%	38.9%	-1.2%		0.20
Child under 6 had health problems in last week, if any child	2,360	44.3%	49.8%	2,777	48.9%	49.6%	-4.7%	*	0.08
Child died if any born alive in last two years	1,194	8.6%	27.9%	1,443	10.2%	29.9%	-1.6%		0.25
Receive HIV/AIDS or other health information via radio or TV	4,679	64.2%	47.9%	5,531	66.3%	47.3%	-2.1%		0.18
Water source inside dwelling	4,678	4.4%	20.4%	5,531	5.4%	22.6%	-1.0%		0.43
Water source outside dwelling	4,678	37.8%	48.5%	5,531	46.8%	49.9%	-9.1%	*	0.10
Water source well and borehole	4,678	34.2%	47.5%	5,531	23.7%	42.6%	10.5%	**	0.01
Water source vendor, kiosk, truck/tanker service	4,678	5.5%	22.8%	5,531	4.2%	20.0%	1.4%		0.56
Water source river/lake/spring/pond/rain	4,678	33.9%	47.3%	5,531	37.4%	48.4%	-3.6%		0.33
Water source other	4,678	4.3%	20.3%	5,531	2.7%	16.1%	1.6%	**	0.04
Flush toilet	4,673	4.7%	21.2%	5,525	4.2%	20.0%	0.6%		0.56
Pit toilet	4,673	87.1%	33.5%	5,525	87.7%	32.8%	-0.7%		0.69
Latrine toilet	4,673	5.6%	23.0%	5,525	5.5%	22.9%	0.1%		0.94
Other toilet type	4,673	0.8%	9.1%	5,525	1.0%	9.9%	-0.1%		0.65
Monthly soot emissions (g)	4,679	150	216	5,531	151	241	-1		0.90
Monthly CO2 emissions (kg)	4,679	275	384	5,531	272	354	3		0.77

Table C.2 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.10 Adult Time Use									
Hours/day on wage labor in agriculture - female	3,851	0.15	1.01	4,618	0.14	0.95	0.01		0.87
Hours/day on wage labor in agriculture - male	2,973	0.21	1.26	3,396	0.26	1.35	-0.05		0.45
Hours/day on wage labor in non-agriculture - female	3,851	0.27	1.53	4,618	0.28	1.57	-0.02		0.77
Hours/day on wage labor in non-agriculture - male	2,973	1.04	3.05	3,394	1.19	3.23	-0.15		0.34
Hours/day in non-wage farming activities - female	3,851	2.08	2.83	4,618	1.88	2.73	0.20		0.29
Hours/day in non-wage farming activities - male	2,975	2.49	3.29	3,395	2.48	3.35	0.01		0.97
Hours/day on other income generating activities - female	3,851	1.96	3.58	4,618	2.00	3.53	-0.03		0.88
Hours/day on other income generating activities - male	2,975	3.12	4.56	3,394	2.73	4.26	0.39		0.15
Hours/day in school/reading/studying - female	3,890	0.15	0.68	4,668	0.16	0.70	-0.01		0.72
Hours/day in school/reading/studying - male	2,980	0.40	1.22	3,405	0.51	1.42	-0.12	**	0.02
Hours/day on food processing and cooking - female	3,890	3.23	1.90	4,668	3.24	1.87	-0.01		0.92
Hours/day on food processing and cooking - male	2,980	0.42	1.24	3,406	0.44	1.34	-0.03		0.52
Hours/day collecting fuel - female	3,851	0.72	1.36	4,618	0.80	1.40	-0.08		0.35
Hours/day collecting fuel - male	2,975	0.20	0.77	3,394	0.27	0.89	-0.06	*	0.07
Hours/day collecting water - female	3,851	0.99	1.11	4,618	1.05	1.13	-0.07		0.26
Hours/day collecting water - male	2,975	0.27	0.79	3,394	0.27	0.78	-0.01		0.81
Hours/day repairing clothes, basket, etc. - female	3,851	0.19	0.83	4,618	0.23	0.88	-0.04		0.15
Hours/Day repairing clothes, basket, etc. - male	2,975	0.17	0.84	3,394	0.17	0.84	0.00		0.86
Hours/day doing other household chores - female	3,851	2.19	1.39	4,618	2.25	1.42	-0.06		0.32
Hours/day doing other household chores - male	2,974	0.33	0.88	3,394	0.34	0.91	-0.01		0.67
Hours/day taking meals - female	3,851	0.80	0.62	4,618	0.85	0.64	-0.05	*	0.07
Hours/day taking meals - male	2,975	0.83	0.67	3,395	0.83	0.67	-0.01		0.85
Hours/day listening to radio - female	3,851	1.65	2.24	4,618	1.63	2.22	0.03		0.82
Hours/Day Listening to Radio - Male	2,975	2.43	2.54	3,395	2.50	2.52	-0.06		0.60
Hours/day watching TV - female	3,851	0.17	0.74	4,618	0.15	0.69	0.02		0.62
Hours/day watching TV - male	2,975	0.32	0.96	3,394	0.29	0.97	0.03		0.62
Hours/day visiting neighbors or on other leisure activities - female	3,890	1.89	2.06	4,668	1.94	2.05	-0.04		0.59
Hours/day visiting neighbors or on other leisure activities - male	2,980	2.80	2.72	3,406	2.87	2.66	-0.07		0.60
Hours/day sleeping at night - female	3,851	8.75	1.14	4,618	8.71	1.18	0.05		0.32
Hours/day sleeping at night - male	2,975	8.52	1.49	3,394	8.43	1.67	0.09		0.20
Hours/day resting during the day - female	3,851	1.39	1.62	4,618	1.42	1.61	-0.03		0.66
Hours/day resting during the day - male	2,975	1.52	1.89	3,395	1.49	1.77	0.03		0.68
Other household activities - female	3,890	2.76	2.32	4,668	3.01	2.44	-0.25	***	0.00
Other household activities - male	2,980	2.20	2.49	3,406	2.45	2.67	-0.25	**	0.05
Multitasking hours - female	4,679	4.69	6.01	5,531	5.09	6.17	-0.41		0.14
Multitasking hours - male	4,679	2.28	4.02	5,531	2.38	4.26	-0.10		0.49

Table C.2 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.11 Income Generating Activities									
Household has no IGAs	4,679	29.5%	45.6%	5,531	28.1%	44.9%	1.4%		0.52
Total number of IGAs	4,679	1.0	0.9	5,531	1.1	0.9	-0.1		0.24
Household has electrified IGA if household has IGAs	3,267	7.1%	25.8%	3,926	7.0%	25.8%	0.0%		0.97
Average age of IGA owners if household has IGAs	3,266	39.5	12.4	3,916	39.9	12.4	-0.4		0.41
Average education of IGA owners if household has IGAs	3,266	6.0	3.1	3,918	6.0	3.0	0.0		0.98
Number of farmer IGAs	4,679	0.16	0.40	5,531	0.22	0.47	-0.06	**	0.03
Number of small vendor IGAs	4,679	0.35	0.56	5,531	0.33	0.56	0.02		0.33
Number of medical IGAs	4,679	0.00	0.07	5,531	0.01	0.08	0.00		0.79
Number of manufacturing IGAs	4,679	0.08	0.30	5,531	0.08	0.29	0.00		0.98
Number of repair shops and other IGAs	4,679	0.40	0.63	5,531	0.42	0.64	-0.02		0.57
Average year IGAs established if household has IGAs	3,214	2002	10	3,846	2001	10	1	*	0.09
Percentage of IGAs at household premise if household has IGAs	3,267	38.7%	45.7%	3,926	37.9%	44.8%	0.8%		0.68
Percentage of IGAs at truck or vendors if household has IGAs	3,267	6.7%	23.5%	3,926	7.0%	23.8%	-0.3%		0.72
Percentage of IGAs at other location if household has IGAs	3,267	54.6%	46.6%	3,926	55.1%	45.7%	-0.5%		0.80
Characteristics Presented in Table IV.12 Household Income and Assets									
Total annual income	4,679	2,897,098	8,128,439	5,531	2,793,553	7,547,546	103,545		0.75
Total annual wages if household has wages	549	3,401,491	13,899,573	637	2,354,959	5,584,742	1,046,532		0.20
Average hourly wage of household members if household has wages	552	1,532	4,298	641	1,161	2,431	371		0.19
Total annual farm wages if household has farm wages	46	946,964	2,064,526	35	637,369	783,154	309,596		0.37
Total annual non-farm wages if household has non-farm wages	509	3,581,166	14,406,452	601	2,448,586	5,730,190	1,132,580		0.20
Annual income from IGAs (TZS)	4,536	1,510,387	5,590,282	5,343	1,383,623	5,513,098	126,764		0.57
Annual income from top 3 IGAs only (TZS)	4,358	1,122,308	2,948,897	5,158	1,097,552	4,570,432	24,756		0.87
Non-wage, non-IGA income per year	4,679	1,008,346	2,339,757	5,531	1,154,085	3,643,193	-145,739		0.15
Total assets	4,679	9,059,556	25,179,380	5,531	12,605,840	73,890,238	-3,546,284		0.45
Value of home	4,679	4,972,490	16,593,791	5,531	4,359,244	9,385,926	613,246		0.32
Number of bedrooms	4,675	2.7	1.5	5,524	2.7	1.5	0.0		0.82
Household debt	4,615	-63,432	491,981	5,432	-58,924	482,058	-4,508		0.75
Characteristics Presented in Table IV.13 Consumption									
Annual consumption (TZS)	4,679	2,769,502	3,882,798	5,531	2,651,931	3,106,134	117,572		0.56
Annual food consumption (TZS)	4,679	1,242,761	1,146,218	5,531	1,262,688	1,229,331	-19,927		0.80
Annual school fees and supplies (TZS)	4,679	106,348	1,195,598	5,531	98,567	693,159	7,781		0.74
Annual medical expenses (TZS)	4,679	48,864	122,064	5,531	50,561	133,699	-1,698		0.70
Amount of money spent on cigarettes and alcohol in last 7 days (TZS)	4,679	1,238	4,807	5,531	1,155	4,441	83		0.58
Grid expenditures/mnth if use any	4,678	141	1,652	5,531	60	1,919	81		0.11
Annual spending on satellite dish and cable TV (TZS)	4,679	10,513	156,458	5,531	8,178	163,547	2,336		0.70
Annual spending on light bulbs (TZS)	4,679	3,531	65,079	5,531	3,406	36,361	125		0.94

Table C.2 (continued)

	Intervention Group			Comparison Group					
Household Characteristic	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**		**P-Value**
Characteristics Presented in Table IV.14 Poverty									
Per capita daily income (USD)	4,679	1.18	2.88	5,531	1.12	2.89	0.06		0.60
Makes less than $1 (USD) income per capita per day	4,679	71.7%	45.0%	5,531	74.1%	43.8%	-2.4%		0.33
Makes less than $2 (USD) income per capita per day	4,679	85.6%	35.1%	5,531	87.5%	33.0%	-1.9%		0.20
Per capita daily consumption (USD)	4,679	1.13	1.50	5,531	1.11	1.59	0.02		0.77
Consumes less than $1 (USD) per capita per day	4,679	63.5%	48.2%	5,531	64.6%	47.8%	-1.1%		0.71
Consumes less than $2 (USD) per capita per day	4,679	88.2%	32.3%	5,531	88.6%	31.8%	-0.4%		0.78
Characteristics Presented in Table IV.15 Household Composition, Education, and Health by Gender									
Head of household is female	4,679	23.2%	42.2%	5,531	23.1%	42.2%	0.1%		0.973
Percent of household members who are female	4,679	51.1%	23.0%	5,531	52.0%	22.5%	-0.9%	*	0.091
Age - key female	3,892	38.938	14.009	4,671	38.821	13.852	0.117		0.854
Age - key male	2,964	43.012	15.041	3,401	43.664	15.117	-0.652		0.252
Married - key female	3,894	0.758	0.429	4,673	0.769	0.423	-0.011		0.497
Married - key male	2,968	0.846	0.363	3,402	0.869	0.339	-0.024	**	0.031
Completed any education - key female	3,894	0.737	0.441	4,672	0.769	0.423	-0.032		0.127
Highest grade completed - key female	3,893	5.06	3.465	4,672	5.285	3.342	-0.224		0.243
Completed any education - key male	2,971	0.871	0.336	3,406	0.871	0.337	0		1.000
Highest grade completed - key male	2,971	6.259	3.257	3,406	6.244	3.271	0.015		0.94
Household has a person 15 years or older who was unable to work due to illness - household has females age 15 or older	4,399	0.131	0.338	5,275	0.145	0.353	-0.014		0.11
Household has a person 15 years or older who was unable to work due to illness - household has males age 15 or older	4,043	0.074	0.264	4,788	0.081	0.275	-0.007		0.265
Characteristics Presented in Table IV.16 Income and Assets by Gender									
Annual female income (TZS) if data identify females	4,470	762,227	2,372,461	5,309	823,291	3,855,775	-61,065		0.562
Annual male income (TZS) if data identify males	3,604	2,180,614	7,580,110	4,315	1,867,459	5,800,072	313,156		0.289
Unitary family: Has key male and/or female but no other adults	4,679	52.0%	50.0%	5,531	54.0%	49.8%	-2.0%		0.216
Non-wage, non-IGA income/year - female in unitary family	2,462	396,244	1,306,724	3,037	472,467	1,866,942	-76,223		0.231
Non-wage, non-IGA income/year - male in unitary family	2,462	640,010	1,878,940	3,036	678,119	2,612,541	-38,108		0.653
Average hourly male wage if household has males with wages	394	1,863	6,459	474	1,206	2,623	656		0.154
Average hourly female wage if household has females with wages	213	1,486	3,245	212	1,204	2,199	282		0.328
Total male annual wages if household has males with wages	391	3,331,401	12,456,279	471	2,205,692	5,091,441	1,125,709		0.197
Total female annual wages if household has females with wages	213	2,597,208	6,219,414	211	2,168,989	4,129,063	428,219		0.44

Table C.2 (continued)

Household Characteristic	Intervention Group N	Intervention Group Mean	Intervention Group Standard Deviation	Comparison Group N	Comparison Group Mean	Comparison Group Standard Deviation	Difference		P-Value
Characteristics Presented in Table IV.17 Income Generating Activities by Gender									
Number of IGAs owned by females if household has key female	4,398	0.474	0.578	5,258	0.506	0.580	-0.031		0.171
Number of IGAs owned by males if household has key male	4,095	0.626	0.710	4,834	0.647	0.736	-0.022		0.477
Percentage of IGAs owned by men if household has IGAs	3,266	53.6%	44.2%	3,918	51.6%	43.7%	2.0%		0.163
Annual income from IGAs - if household has key female	3,985	460,420	1,499,212	4,801	503,492	3,565,038	-43,072		0.58
Annual income from IGAs - if household has key male	3,204	1,542,431	6,250,340	3,758	1,304,322	5,033,401	238,110		0.364
Number of IGA paid staff in the past 12 months - if household has key	3,993	0.131	0.794	4,813	0.125	0.802	0.006		0.797
Number of IGA paid staff in the past 12 months - if household has key male	3,295	0.597	2.077	3,881	0.662	2.195	-0.065		0.431
Number of IGA unpaid staff in the past 12 months - if household has key female	3,993	0.805	2.529	4,813	0.826	1.425	-0.021		0.761
Number of IGA unpaid staff in the past 12 months - if household has	3,295	1.249	1.792	3,881	1.322	1.934	-0.073		0.432
Annual IGA electricity expenditures for female-operated IGAs if household has key female	3,993	4,133	72,139	4,811	4,039	49,341	95		0.951
Annual IGA electricity expenditures for male-operated IGAs if household has key male	3,288	43,381	586,726	3,865	16,923	157,778	26,458	*	0.052

Source: Tanzania Energy Sector Baseline Household Survey

Notes: */**/*** Difference is statistically significantly different from zero at the .10/.05/.01 level using a two-tailed t-test.

Estimates presented in this table are weighted to adjust for sampling, survey nonresponse, and matching.

Table C.3. Differences in Household Characteristics between Treatment and Control Groups (percentages, unless otherwise noted)

Household Characteristic	Treatment Group			Control Group			Difference		P-Value
	N	Mean	Standard Deviation	N	Mean	Standard Deviation			
Characteristics Presented in Table IV.1 Household Composition and Mobility									
Number of household members	696	5.0	2.4	3,986	4.9	2.4	0.1		0.33
Number of household members under 18	696	2.56	1.82	3,986	2.47	1.84	0.10		0.32
Head of household age	696	43.5	13.2	3,980	45.0	14.9	-1.5		0.32
Household head is 18-24 years of age	696	2.7%	16.1%	3,980	3.2%	17.5%	-0.5%		0.52
Head of household married	696	73.4%	43.9%	3,986	72.7%	44.6%	0.7%		0.77
Years in home	690	10.4	10.2	3,984	10.3	10.5	0.1		0.93
Moved in last 7.5 months	690	2.1%	14.1%	3,984	2.9%	16.7%	-0.8%		0.23
Characteristics Presented in Table IV.2 Total Energy and Electricity Use									
Monthly expenses on solid, liquid, battery, and grid energy (TZS)	696	35,627	66,525	3,986	30,933	66,036	4,694		0.35
Monthly energy content of solid, liquid, battery, and grid energy (kWh)	696	830	904	3,986	867	1,261	-38		0.59
Electricity generated per month including batteries (kWh)	696	14.3	74.7	3,986	11.3	62.5	3.1		0.68
Monthly expenses for house batteries	696	4,330	11,133	3,986	3,221	9,508	1,109		0.18
Monthly household battery output (kWh)	696	0.03	0.03	3,986	0.02	0.08	0.00		0.60
Hours of car battery use per month	696	17.8	99.6	3,986	11.1	68.0	6.7		0.19
Monthly expenses for car batteries	693	3,398	23,185	3,978	4,694	27,625	-1,296		0.30
Monthly electricity generated by car batteries (kWh)	696	0.10	0.89	3,985	0.10	0.74	0.01		0.91
Household uses generators	696	8.0%	27.0%	3,986	6.0%	23.8%	2.0%		0.30
Hours of energy generation per month including car batteries	696	41.6	184.6	3,986	24.0	117.4	17.6	*	0.06
Monthly electricity from generators (kWh)	696	14.2	74.8	3,986	11.2	62.4	3.1		0.68
Household uses grid electricity	696	0.013	0.114	3986	0.011	0.103	0.003		0.76
Monthly amount of grid electricity (kWh)	696	0.91	8.37	3,985	0.87	8.88	0.04		0.95
Monthly expenses for grid electricity (TZS)	696	130	1,494	3,985	151	1,708	-20		0.82

Table C.3 (continued)

Household Characteristic	Treatment Group			Control Group			Difference		P-Value
	N	Mean	Standard Deviation	N	Mean	Standard Deviation			
Characteristics Presented in Table IV.3 Non-Electric Energy from Solid Fuel Sources									
Monthly non-electric output (kWh)	696	814	894	3,986	855	1,254	-41		0.58
Monthly expenses for non-electric energy, solid and liquid (TZS)	696	28,863	61,371	3,986	25,795	60,144	3,068		0.37
Monthly amount of solid fuel used (kg)	696	142	191	3,986	151	208	-8		0.68
Monthly spending on solid fuel (TZS)	687	15,589	27,816	3,946	14,406	43,175	1,183		0.63
Monthly energy content of solid fuel (kWh)	696	754	868	3,986	787	1,026	-32		0.67
Monthly amount of wood used (kg)	696	100	186	3,986	111	196	-11		0.63
Monthly amount of free wood (kg)	696	70	145	3,986	74	150	-4		0.86
Monthly amount of charcoal used (kg)	696	38	49	3,986	36	76	1		0.83
Monthly amount of free charcoal (kg)	696	2.9	17.2	3,986	2.1	29.2	0.8		0.52
Monthly amount of crop residue used (kg)	696	3.9	25.8	3,986	2.4	16.7	1.5		0.54
Monthly amount of free crop residue (kg)	696	2.6	14.9	3,986	2.0	13.9	0.5		0.69
Monthly amount of straw used (kg)	696	0.0	0.0	3,986	0.1	1.5	-0.1		0.13
Monthly amount of free straw (kg)	696	0.0	0.0	3,986	0.0	1.2	0.0		0.12
Monthly amount of dung used (kg)	696	0.0	0.0	3,986	0.0	0.0	0.0		.
Monthly amount of free dung (kg)	696	0.0	0.0	3,986	0.0	0.0	0.0		.
Monthly amount of candles used (kg)	696	0.9	5.5	3,986	0.5	4.7	0.4	*	0.07
Monthly amount of free candles (kg)	696	0.0	0.0	3,986	0.0	0.2	0.0		0.18
Characteristics Presented in Table IV.4 Non-Electric Energy from Liquid Fuels									
Monthly amount of liquid fuel used (L)	696	6.3	22.7	3,986	7.2	73.8	-0.9		0.53
Monthly spending on liquid fuel (TZS)	696	13,490	53,675	3,986	11,522	39,199	1,967		0.30
Monthly energy content of liquid fuel (kWh)	696	60.2	215.3	3,986	68.4	703.2	-8.2		0.54
Monthly amount of kerosene used (L)	696	4.3	15.8	3,986	5.1	72.0	-0.8		0.52
Monthly amount of free kerosene (L)	696	0.0	0.1	3,986	0.4	27.5	-0.4		0.24
Monthly amount of gas used (L)	696	2.0	16.0	3,986	2.0	14.6	0.0		0.99
Monthly amount of free gas (L)	696	0.00	0.00	3,986	0.00	0.00	0.00		.
Monthly amount of LPG (L)	696	0.06	1.32	3,986	0.16	6.99	-0.10		0.48
Monthly amount of free LPG (L)	696	0.00	0.00	3,986	0.00	0.00	0.00		.

Table C.3 (continued)

Household Characteristic	Treatment Group N	Treatment Group Mean	Treatment Group Standard Deviation	Control Group N	Control Group Mean	Control Group Standard Deviation	Difference		P-Value
Characteristics Presented in Table IV.5 Tools and Appliances									
Number of appliances	696	7.1	4.8	3,986	7.0	4.8	0.1		0.65
Number of lights	696	2.9	2.0	3,986	2.9	2.2	0.0		0.88
Light-hours/month	696	351	298	3,986	322	316	29	**	0.05
Light lumen-hours/month	696	80,854	183,960	3,986	71,420	193,014	9,434		0.43
Water pump hours/month	696	0.6	10.2	3,986	1.2	19.6	-0.7		0.27
Water liters per month from pumps	696	704	12,338	3,986	41,268	870,236	-40,565	**	0.03
Radio and CD hours/month	696	67	137	3,986	57	121	10		0.59
TV hours/month	696	8.6	35.8	3,986	9.0	37.4	-0.5		0.89
Cooking hours/month	696	205.2	132.5	3,986	194.3	131.8	11.0		0.26
Water heating hours/month	696	0.0	0.0	3,986	0.0	1.0	0.0		0.29
Refrigeration hours/month	696	11.0	98.9	3,986	12.5	103.8	-1.5		0.77
AC fan hours/month	696	0.7	8.6	3,986	0.8	12.3	-0.1		0.88
Someone in home has mobile phone	696	75.2%	42.9%	3,986	69.0%	46.3%	6.1%		0.11
Household has landline phone	696	0.0%	0.0%	3,986	0.2%	4.3%	-0.2%	**	0.01
Total phone minutes/week if have a phone	430	180	358	2,181	197	1,796	-17		0.72
Mobile phone recharges per week if have a mobile phone	497	3.8	3.4	2,638	3.7	3.4	0.1		0.68
Mobile phone recharge costs per week if have a mobile phone	497	904	1,076	2,621	873	1,114	31		0.64
Characteristics Presented in Table IV.6 Housing Materials									
Wall electrifiable	696	88.2%	32.0%	3,984	89.3%	31.0%	-1.0%		0.76
Roof electrifiable	696	87.3%	33.0%	3,985	84.4%	36.4%	3.0%		0.46
House electrifiable	696	80.2%	39.5%	3,984	79.3%	40.6%	0.9%		0.86
Characteristics Presented in Table IV.7 Education									
Highest grade completed - household head	696	6.1	3.3	3,986	5.8	3.5	0.4		0.22
Completed any education - household head	696	85.2%	35.3%	3,986	81.0%	39.3%	4.2%		0.21
Completed primary education or more - household head	696	12.0%	32.2%	3,986	11.1%	31.5%	0.9%		0.66
Completed secondary education or more - household head	696	8.4%	27.5%	3,986	8.4%	27.8%	0.0%		0.99
Completed tertiary education - household head	696	1.9%	13.7%	3,986	2.1%	14.4%	-0.2%		0.85
In school of those ages 5-14	476	74.9%	34.8%	2,697	75.1%	35.5%	-0.2%		0.95
In an electrified school of those ages 5-24 in school	454	5.4%	17.4%	2,547	7.4%	22.2%	-2.1%		0.39

Table C.3 (continued)

Household Characteristic	Treatment Group N	Treatment Group Mean	Treatment Group Standard Deviation	Control Group N	Control Group Mean	Control Group Standard Deviation	Difference	P-Value
Characteristics Presented in Table IV.8 Student Time Use								
Hours/day at school - student	422	5.97	2.85	2,372	6.02	2.69	-0.05	0.90
Hours/day reading and studying - student	422	1.06	1.21	2,372	0.97	1.12	0.10	0.44
Average hours/day students study at home after sunset, ages 5-24	444	0.65	0.80	2,493	0.66	0.89	-0.01	0.83
Average hours/day students study at home during the day, ages 5-24	444	0.59	0.99	2,493	0.57	1.00	0.02	0.81
Hours/day collecting fuel - student	422	0.38	0.98	2,372	0.31	0.92	0.07	0.50
Hours/day collecting water - student	422	0.67	0.85	2,372	0.68	0.94	-0.01	0.83
Hours/day listening to radio - student	422	0.68	1.26	2,372	0.56	1.13	0.11	0.24
Hours/day watching TV - student	422	0.23	0.77	2,372	0.22	0.73	0.01	0.87
Hours/day on other leisure activities - student	422	3.42	2.29	2,372	3.46	2.34	-0.04	0.85
Hours/day doing other household chores - student	422	1.09	1.13	2,372	0.97	1.08	0.12	0.27
Hours/day taking meals - student	422	0.80	0.61	2,372	0.77	0.65	0.02	0.65
Hours/day on personal hygiene - student	422	0.60	0.83	2,372	0.50	0.54	0.10	0.13
Hours/day resting during the day - student	422	0.82	1.35	2,372	0.79	1.40	0.03	0.85
Hours/day sleeping at night - student	422	9.03	1.37	2,372	9.10	1.38	-0.07	0.51
Characteristics Presented in Table IV.9 Health Outcomes								
Adult had health problems in last 7 days	696	42.6%	49.1%	3,986	45.4%	49.9%	-2.8%	0.64
Adult (15 years or older) was unable to work due to illness in last 30 days	696	15.4%	35.8%	3,986	17.8%	38.3%	-2.4%	0.10
Child under 6 had health problems in last week, if any child	373	44.1%	49.4%	1,989	44.1%	49.8%	0.0%	1.00
Child died if any born alive in last two years	210	9.2%	28.9%	986	8.5%	27.8%	0.7%	0.82
Receive HIV/AIDS or other health information via radio or TV	696	63.5%	47.8%	3,986	64.2%	48.0%	-0.7%	0.76
Water source inside dwelling	696	5.8%	23.1%	3,985	4.4%	20.5%	1.4%	0.67
Water source outside dwelling	696	32.6%	46.5%	3,985	38.8%	48.8%	-6.2%	0.58
Water source well and borehole	696	27.8%	44.5%	3,985	35.3%	47.9%	-7.5%	0.33
Water source vendor, kiosk, truck/tanker service	696	5.0%	21.7%	3,985	5.5%	22.8%	-0.5%	0.87
Water source river/lake/spring/pond/rain	696	42.1%	49.0%	3,985	32.3%	46.9%	9.8%	0.44
Water source other	696	4.4%	20.3%	3,985	4.2%	20.1%	0.2%	0.91
Flush toilet	696	3.4%	18.0%	3,980	5.1%	21.9%	-1.6%	0.17
Pit toilet	696	88.4%	31.8%	3,980	86.7%	34.0%	1.7%	0.48
Latrine toilet	696	6.3%	24.0%	3,980	5.6%	22.9%	0.7%	0.70
Other toilet type	696	0.6%	7.6%	3,980	0.9%	9.4%	-0.3%	0.40
Monthly soot emissions (g)	696	142	197	3,986	151	218	-8	0.61
Monthly CO2 emissions (kg)	696	261	301	3,986	275	390	-15	0.59

Table C.3 (continued)

Household Characteristic	Treatment Group N	Treatment Group Mean	Treatment Group Standard Deviation	Control Group N	Control Group Mean	Control Group Standard Deviation	Difference		P-Value
Characteristics Presented in Table IV.10 Adult Time Use									
Hours/day on wage labor in agriculture - female	573	0.16	1.06	3,281	0.14	0.99	0.03		0.70
Hours/day on wage labor in agriculture - male	453	0.22	1.35	2,521	0.21	1.23	0.01		0.90
Hours/day on wage labor in non-agriculture - female	573	0.34	1.73	3,281	0.27	1.52	0.07		0.49
Hours/day on wage labor in non-agriculture - male	453	1.08	3.11	2,521	1.03	3.03	0.05		0.80
Hours/day in non-wage farming activities - female	573	1.81	2.70	3,281	2.09	2.84	-0.28		0.46
Hours/day in non-wage farming activities - male	454	2.40	3.43	2,522	2.47	3.25	-0.07		0.84
Hours/day on other income generating activities - female	573	2.66	4.15	3,281	1.88	3.49	0.77		0.29
Hours/day on other income generating activities - male	454	3.37	4.62	2,522	3.10	4.57	0.27		0.65
Hours/day in school/reading/studying - female	583	0.14	0.62	3,310	0.15	0.69	-0.02		0.71
Hours/day in school/reading/studying - male	454	0.42	1.30	2,527	0.39	1.17	0.03		0.76
Hours/day on food processing and cooking - female	583	3.30	1.85	3,310	3.22	1.90	0.08		0.70
Hours/day on food processing and cooking - male	454	0.48	1.54	2,527	0.40	1.18	0.08		0.26
Hours/day collecting fuel - female	573	0.62	1.26	3,281	0.72	1.38	-0.11		0.54
Hours/day collecting fuel - male	454	0.25	0.95	2,522	0.20	0.73	0.06		0.49
Hours/day collecting water - female	573	0.88	1.03	3,281	1.00	1.12	-0.12		0.18
Hours/day collecting water - male	454	0.30	0.81	2,522	0.26	0.78	0.04		0.65
Hours/day repairing clothes, basket, etc. - female	573	0.17	0.81	3,281	0.20	0.85	-0.03		0.43
Hours/Day repairing clothes, basket, etc. - male	454	0.14	0.70	2,522	0.18	0.87	-0.04		0.34
Hours/day doing other household chores - female	573	2.09	1.37	3,281	2.20	1.40	-0.11		0.14
Hours/day doing other household chores - male	454	0.32	0.81	2,521	0.33	0.89	-0.01		0.88
Hours/day taking meals - female	573	0.81	0.67	3,281	0.80	0.60	0.01		0.77
Hours/day taking meals - male	454	0.86	0.75	2,522	0.82	0.65	0.03		0.52
Hours/day listening to radio - female	573	1.82	2.36	3,281	1.62	2.22	0.19		0.34
Hours/Day Listening to Radio - Male	454	2.68	2.90	2,522	2.39	2.45	0.29		0.18
Hours/day watching TV - female	573	0.18	0.80	3,281	0.18	0.74	0.00		1.00
Hours/day watching TV - male	454	0.31	0.95	2,522	0.32	0.97	-0.01		0.91
Hours/day visiting neighbors or on other leisure activities - female	583	1.73	1.86	3,310	1.93	2.09	-0.20	*	0.07
Hours/day visiting neighbors or on other leisure activities - male	454	2.58	2.55	2,527	2.85	2.77	-0.27		0.21
Hours/day sleeping at night - female	573	8.59	1.19	3,281	8.78	1.13	-0.19	**	0.03
Hours/day sleeping at night - male	454	8.21	1.78	2,522	8.57	1.43	-0.36	**	0.02
Hours/day resting during the day - female	573	1.35	1.64	3,281	1.39	1.61	-0.05		0.72
Hours/day resting during the day - male	454	1.54	1.86	2,522	1.51	1.90	0.03		0.84
Other household activities - female	583	2.62	2.32	3,310	2.78	2.32	-0.16		0.24
Other household activities - male	454	2.05	2.43	2,527	2.22	2.50	-0.17		0.32
Multitasking hours - female	696	4.79	6.55	3,986	4.65	5.88	0.14		0.83
Multitasking hours - male	696	2.25	3.90	3,986	2.28	4.03	-0.03		0.91

Table C.3 (continued)

Household Characteristic	Treatment Group N	Treatment Group Mean	Treatment Group Standard Deviation	Control Group N	Control Group Mean	Control Group Standard Deviation	Difference		P-Value
Characteristics Presented in Table IV.11 Income Generating Activities									
Household has no IGAs	696	25.8%	43.4%	3,986	29.9%	45.9%	-4.1%		0.44
Total number of IGAs	696	1.1	0.8	3,986	1.0	0.9	0.1		0.44
Household has electrified IGA if household has IGAs	509	5.9%	23.6%	2,760	7.5%	26.5%	-1.6%		0.30
Average age of IGA owners if household has IGAs	509	39.5	12.5	2,759	39.5	12.4	0.0		0.98
Average education of IGA owners if household has IGAs	509	6.2	3.0	2,759	5.9	3.1	0.3		0.26
Number of farmer IGAs	696	0.12	0.34	3,986	0.16	0.40	-0.05		0.27
Number of small vendor IGAs	696	0.46	0.63	3,986	0.34	0.55	0.12	**	0.03
Number of medical IGAs	696	0.00	0.03	3,986	0.01	0.08	0.00	**	0.03
Number of manufacturing IGAs	696	0.07	0.27	3,986	0.08	0.30	-0.02		0.40
Number of repair shops and other IGAs	696	0.42	0.63	3,986	0.41	0.63	0.02		0.76
Average year IGAs established if household has IGAs	499	2003	9	2,717	2002	10	1		0.47
Percentage of IGAs at household premise if household has IGAs	509	39.5%	45.9%	2,760	38.6%	45.7%	0.9%		0.74
Percentage of IGAs at truck or vendors if household has IGAs	509	6.2%	21.7%	2,760	6.7%	23.8%	-0.5%		0.81
Percentage of IGAs at other location if household has IGAs	509	54.2%	46.8%	2,760	54.7%	46.7%	-0.5%		0.87
Characteristics Presented in Table IV.12 Household Income and Assets									
Total annual income	696	3,063,131	6,001,556	3,986	2,863,573	8,200,084	199,559		0.70
Total annual wages if household has wages	97	2,081,792	2,301,652	453	3,475,703	14,233,494	-1,393,911		0.11
Average hourly wage of household members if household has wages	97	1,092	1,000	456	1,557	4,422	-465		0.12
Total annual farm wages if household has farm wages	10	688,413	739,448	36	986,520	2,258,967	-298,108		0.51
Total annual non-farm wages if household has non-farm wages	88	2,213,029	2,364,172	422	3,647,869	14,717,811	-1,434,840		0.12
Annual income from IGAs (TZS)	682	1,685,195	4,380,827	3,857	1,496,617	5,728,115	188,577		0.65
Annual income from top 3 IGAs only (TZS)	662	1,340,266	3,699,788	3,699	1,096,835	2,804,700	243,432		0.33
Non-wage, non-IGA income per year	696	1,113,670	2,522,372	3,986	995,771	2,335,314	117,899		0.44
Total assets	696	10,601,760	39,363,367	3,986	8,930,353	22,924,205	1,671,407		0.54
Value of home	696	5,984,098	32,397,792	3,986	4,890,656	13,033,282	1,093,442		0.56
Number of bedrooms	695	2.7	1.9	3,983	2.7	1.4	0.0		0.94
Household debt	686	-63,640	389,455	3,932	-64,224	513,087	585		0.98
Characteristics Presented in Table IV.13 Consumption									
Annual consumption (TZS)	696	3,064,025	5,137,200	3,986	2,751,828	3,732,090	312,197		0.41
Annual food consumption (TZS)	696	1,297,434	1,207,373	3,986	1,241,292	1,142,702	56,142		0.73
Annual school fees and supplies (TZS)	696	94,257	391,746	3,986	110,710	1,316,606	-16,453		0.58
Annual medical expenses (TZS)	696	46,251	80,412	3,986	49,794	129,808	-3,543		0.48
Amount of money spent on cigarettes and alcohol in last 7 days (TZS)	696	1,348	5,751	3,986	1,249	4,785	99		0.75
Grid expenditures/mnth if use any	696	130	1,494	3,985	151	1,708	-20		0.82
Annual spending on satellite dish and cable TV (TZS)	696	1,241	41,401	3,986	12,639	172,644	-11,397	**	0.03
Annual spending on light bulbs (TZS)	696	1,677	12,499	3,986	3,713	66,041	-2,036		0.12

Table C.3 (continued)

Household Characteristic	Treatment Group N	Treatment Group Mean	Treatment Group Standard Deviation	Control Group N	Control Group Mean	Control Group Standard Deviation	Difference		P-Value
Characteristics Presented in Table IV.14 Poverty									
Per capita daily income (USD)	696	1.21	2.27	3,986	1.18	2.94	0.04		0.86
Makes less than $1 (USD) income per capita per day	696	69.8%	45.6%	3,986	71.9%	45.0%	-2.1%		0.68
Makes less than $2 (USD) income per capita per day	696	84.6%	35.9%	3,986	85.7%	35.0%	-1.2%		0.73
Per capita daily consumption (USD)	696	1.19	1.98	3,986	1.14	1.45	0.06		0.71
Consumes less than $1 (USD) per capita per day	696	62.7%	48.0%	3,986	63.2%	48.3%	-0.5%		0.94
Consumes less than $2 (USD) per capita per day	696	88.5%	31.7%	3,986	87.8%	32.7%	0.7%		0.80
Characteristics Presented in Table IV.15 Household Composition, Education, and Health by Gender									
Head of household is female	696	25.4%	43.2%	3,986	22.8%	42.0%	2.6%		0.27
Percent of household members who are female	696	52.0%	23.3%	3,986	50.9%	22.9%	1.1%		0.37
Age - key female	583	37.7	12.8	3,312	39.1	14.2	-1.4		0.27
Age - key male	449	42.4	13.1	2,516	43.2	15.3	-0.7		0.55
Married - key female	584	76.1%	42.5%	3,313	75.8%	43.0%	0.3%		0.90
Married - key male	451	84.9%	35.4%	2,518	84.5%	36.4%	0.4%		0.82
Completed any education - key female	584	77.6%	41.6%	3,313	73.0%	44.5%	4.6%		0.22
Highest grade completed - key female	584	5.5	3.4	3,312	5.0	3.5	0.6	**	0.05
Completed any education - key male	451	91.1%	28.1%	2,521	86.4%	34.5%	4.8%	*	0.07
Highest grade completed - key male	451	6.7	3.0	2,521	6.2	3.3	0.5		0.11
Household has a person 15 years or older who was unable to work due to illness - household has females age 15 or older	653	12.5%	32.8%	3,749	13.3%	34.1%	-0.9%		0.59
Household has a person 15 years or older who was unable to work due to illness - household has males age 15 or older	595	5.0%	21.6%	3,451	7.8%	27.1%	-2.9%	***	0.00
Characteristics Presented in Table IV.16 Income and Assets by Gender									
Annual female income (TZS) if data identify females	670	836,404	2,040,620	3,803	750,049	2,374,969	86,355		0.49
Annual male income (TZS) if data identify males	546	2,176,879	5,087,303	3,061	2,167,334	7,722,149	9,545		0.98
Unitary family: Has key male and/or female but no other adults	696	50.9%	49.6%	3,986	52.2%	50.0%	-1.3%		0.57
Non-wage, non-IGA income/year - female in unitary family	359	437,236	1,062,504	2,105	387,448	1,319,204	49,788		0.58
Non-wage, non-IGA income/year - male in unitary family	359	691,692	1,965,015	2,105	635,306	1,912,452	56,385		0.69
Average hourly male wage if household has males with wages	63	1,213	1,080	331	1,866	6,552	-653		0.17
Average hourly female wage if household has females with wages	41	1,081	1,066	173	1,529	3,371	-448		0.21
Total male annual wages if household has males with wages	63	2,056,215	1,986,624	328	3,341,713	12,642,138	-1,285,497		0.15
Total female annual wages if household has females with wages	41	1,741,782	1,936,167	173	2,729,561	6,469,085	-987,780		0.16

Table C.3 (continued)

Household Characteristic	Treatment Group N	Treatment Group Mean	Treatment Group Standard Deviation	Control Group N	Control Group Mean	Control Group Standard Deviation	Difference		P-Value
Characteristics Presented in Table IV.17 Income Generating Activities by Gender									
Number of IGAs owned by females if household has key female	655	0.551	0.593	3,746	0.465	0.575	0.085	**	0.03
Number of IGAs owned by males if household has key male	622	0.602	0.655	3,476	0.630	0.722	-0.028		0.59
Percentage of IGAs owned by men if household has IGAs	509	49.5%	43.4%	2,759	54.1%	44.4%	-4.6%	*	0.06
Annual income from IGAs - if household has key female	600	544,451	1,522,203	3,388	452,610	1,504,550	91,840		0.30
Annual income from IGAs - if household has key male	491	1,661,651	4,698,057	2,715	1,537,217	6,423,331	124,434		0.80
Number of IGA paid staff in the past 12 months - if household has key	601	0.2	1.1	3,395	0.1	0.7	0.1		0.16
Number of IGA paid staff in the past 12 months - if household has key male	499	0.6	1.9	2,798	0.6	2.1	0.0		0.80
Number of IGA unpaid staff in the past 12 months - if household has key female	601	0.9	1.5	3,395	0.8	2.8	0.1		0.35
Number of IGA unpaid staff in the past 12 months - if household has	499	1.3	1.8	2,798	1.2	1.8	0.1		0.75
Annual IGA electricity expenditures for female-operated IGAs if household has key female	601	5,431	91,902	3,395	3,834	66,518	1,596		0.63
Annual IGA electricity expenditures for male-operated IGAs if household has key male	498	35,358	336,166	2,792	46,634	647,750	-11,276		0.59

Source: Tanzania Energy Sector Baseline Household Survey

Notes: */**/*** Difference is statistically significantly different from zero at the .10/.05/.01 level using a two-tailed t-test.

Estimates presented in this table are weighted to adjust for sampling and survey nonresponse

Table C.4. Descriptive Statistics for Communities in the Intervention Group (percentages, unless otherwise noted)

	Intervention Group		
Community Characteristic	**N**	**Mean**	**Standard Deviation**
Characteristics Presented in Table III.1. Basic Community Characteristics			
Number of households in the community	178	1,004	1,327
Percentage classified as villages	178	71.9	45.1
Distance to nearest district or regional capital (km)	178	30.02	25.72
Price of residential land per acre (TZS)	177	4,624,746	13,983,397
Price of residential land per acre in villages (TZS)	128	1,036,172	1,743,201
Price of residential land per acre in *mitaa* (TZS)	49	13,998,980	24,184,190
Characteristics Presented in Table III.2. Electricity and Other Energy Sources in the Community			
Access to Grid Electricity			
Percentage with access to the existing electrical grid (community leader report)	178	41.6	49.4
Average percentage of households in the community connected to the grid	178	11.4	24
Percentage that had a power line project in the past two years	178	12.4	33
Access to Other Sources of Electricity			
Percentage of communities in which any household uses:			
Isolated grid power system	178	24.7	43.3
Community, privately owned, or small individual generator	178	84.3	36.5
Solar lanterns, windmills, or other electrical sources	178	23.6	42.6
Access to Other Energy Sources			
Percentage of communities where the following are available for purchase:			
Kerosene	178	96.1	19.5
Diesel or petrol	178	50.6	50.1
Firewood, charcoal, or dung	178	86	34.8
Characteristics Presented in Table III.3. Sources of Income and Business Activities in the Community			
Main source of income is farming, livestock, fishing, or hunting (percent)	178	86.5	34.3
Percentage of communities that have:			
Weekly market	178	25.3	43.6
Repair shop	178	61.8	48.7
Tea or coffee shops/guest house/hotel	178	93.8	24.1
Percentage of communities that have:			
Electrified weekly market	178	0.6	7.5
Electrified repair shop	178	14	34.8
Electrified tea or coffee shops/guest house/hotel	178	33.1	47.2
Number of different types of businesses	178	698.9	260.6
Percentage of the different types of businesses that use electricity	178	35.7	30.4

Table C.4 (continued)

	Intervention Group		
Community Characteristic	**N**	**Mean**	**Standard Deviation**
Characteristics Presented in Table III.4. Public Institutions and Facilities in the Community			
Schools			
Percentage of communities that have a pre-primary or primary school	178	89.3	31
Percentage of communities that have an electrified pre-primary or primary school	178	13.5	34.3
Distance to nearest pre-primary or primary school (km)	178	0.98	5.56
Percentage of communities that have a secondary school	178	42.1	49.5
Percentage of communities that have an electrified secondary school	178	15.2	36
Distance to nearest secondary school (km)	178	2.78	4.3
Health Facilities			
Percentage that have a dispensary	177	36.7	48.3
Percentage that have an electrified dispensary	177	17.5	38.1
Distance to nearest dispensary (km)	177	272.9	539.6
Percentage that have a health center, laboratory, or hospital	178	12.9	33.6
Percentage that have an electrified health center, laboratory, or hospital	178	11.8	32.3
Distance to nearest a health center, laboratory, or hospital (km)	178	1,104	1,238
Percentage for which nearest health center, laboratory, hospital is electrified	178	98.9	10.6
Distance to obtain a vaccination (km)	178	0.73	2.51
Distance to obtain an X-ray (km)	178	25.19	23.02
Distance to obtain a malaria test (km)	178	7.02	9.88
Distance to obtain an HIV test (km)	178	4.5	6.88
Civic Institutions (Police Station, Post Office, or Bank)			
Percentage with a police station/post office/bank	178	15.2	36
Main Source of Water			
Percentage with piped water as the main source	178	36.5	48.3
Percentage with well or borehole as the main source	178	40.4	49.2
Percentage with spring, river/lake, and rain water as the main source	178	22.5	41.9
Percentage with vendor or other sources	178	0.6	7.5

Table C.4 (continued)

	Intervention Group		
Community Characteristic	**N**	**Mean**	**Standard Deviation**
Characteristics Presented in Table III.5. Community Infrastructure and Development Projects			
Percentage that have working mobile phone service	178	98.3	12.9
Percentage in which most people a mobile phone	178	48.9	50.1
Percentage connected to a landline phone	178	20.8	40.7
Percentage accessible by paved roads	178	61.8	48.7
Percentage with bus access to other towns	178	77	42.2
Percentage that had the following development projects in the past two years			
Primary or secondary School	178	57.9	49.5
Road	178	61.2	48.9
Market	178	10.7	31
Water	178	36	48.1
Health center	178	34.3	47.6
Percentage that have the following projects planned in the next two years			
Primary or secondary School	178	72.5	44.8
Road	178	62.4	48.6
Market	178	35.4	48
Water	178	57.3	49.6
Health center	178	61.8	48.7

Sourece: Tanzania Energy Sector Baseline Community Survey
Estimates presented in this table are unweighted.

Table C.5. Differences in Enterprise Characteristics Between Intervention and Comparison Group (percentages, unless otherwise noted)

	Intervention Group			Comparison Group					
Outcome	**N**	**Mean**	**Standard Deviation**	**N**	**Mean**	**Standard Deviation**	**Difference**	**t**	**P-Value**
Table V.1. Basic Enterprise Characteristics									
Percentage of enterprises that are:									
Small grocery shop (*duka*)	32	75	44	27	48.1	50.9	26.9	2.09 *	0.06
Food enterprise (restaurant/bar, food distributor)	32	6.3	24.6	27	18.5	39.6	-12.3	-1.84 *	0.10
Tailor	32	3.1	17.7	27	3.7	19.2	-0.6	-0.20	0.84
Other	32	15.6	36.9	27	29.6	46.5	-14	-0.83	0.43
Percentage of enterprises that are registered with the local or national government	32	78.1	42	27	33.3	48	44.8	2.85 **	0.02
Years since establishment	32	6.53	7.29	26	8.73	8.67	-2.2	-1.26	0.24
Number of hours open in a day	30	12.18	4.24	26	11.6	5	0.59	0.67	0.52
Percentage of enterprises open all year	32	75	44	27	70.4	46.5	4.6	0.31	0.77
Percentage of enterprises open every day of the	32	65.6	48.3	27	74.1	44.7	-8.4	-0.46	0.65
Percent of owners:									
Female	32	18.8	39.7	27	40.7	50.1	-22	-3.53 ***	0.01
Highest education is primary or below	32	65.6	48.3	27	88.9	32	-23.3	-1.57	0.15
Received training	32	34.4	48.3	27	22.2	42.4	12.2	0.92	0.38
Age of the owner	32	39.88	11.72	27	42	11.22	-2.13	-0.79	0.45
Table V.2. Sources of Electricity									
Percentage of enterprises that use electricity	32	68.8	47.1	27	40.7	50.1	28	1.07	0.31
Percentage of enterprises that use non-electric sources of energy	32	75	44	27	88.9	32	-13.9	-1.30	0.22
Percentage of enterprises that obtain electricity from									
Grid	32	65.6	48.3	27	37	49.2	28.6	1.02	0.33
Solar photovoltaic system	32	3.1	17.7	27	0	0	3.1	0.81	0.44
Other	32	0	0	27	3.7	19.2	-3.7	-1.06	0.31
Amount spent on electricity in the previous month	32	20,613	38,365	27	3,804	7,071	16,809	2.12 *	0.06
Years connected to the grid	21	4.74	5.93	10	10.9	13.07	-6.16	-2.48 **	0.03
Hours electricity available per day	21	12.86	3.58	9	11.89	3.52	0.97	0.83	0.43

Table C.5 (continued)

Enterprise Characteristic	Intervention Group			Comparison Group					
	N	Mean	Standard Deviation	N	Mean	Standard Deviation	Difference	t	P-Value
Table V.3. Electricity-Related Considerations Among Enterprises Connected to the Grid									
Percentage of enterprises reporting reason for connecting:									
Better lighting	21	95.2	21.8	10	90	31.6	5.2	0.49	0.63
Improved efficiency	21	57.1	50.7	10	80	42.2	-22.9	-2.22 *	0.05
Enhanced Income	21	47.6	51.2	10	40	51.6	7.6	0.49	0.64
Electricity more cost-effective	21	19	40.2	10	10	31.6	9	1.08	0.31
Electricity cheaper than other fuels	21	23.8	43.6	10	60	51.6	-36.2	-1.86 *	0.09
Percentage of enterprises reporting primary use of electricity in previous month:									
Lighting	22	68.2	47.7	11	63.6	50.5	4.5	0.20	0.84
Electrical appliances/machinery	22	22.7	42.9	11	36.4	50.5	-13.6	-0.60	0.56
Other	22	9.1	29.4	11	0	0	9.1	14.83 ***	0.00
Connection fee (TZS)	20	419,500	1,785,328	9	130,000	209,045	289,500	2.99 **	0.01
Wiring cost (TZS)	20	7,400	27,085	9	56,889	86,057	-49,489	-1.74	0.11
Unofficial cost (e.g., bribe) (TZS)	20	0	0	9	889	2,667	-888.89	-1.21	0.25
Table V.4. Electricity-Related Considerations Among Enterprises Not Connected to the Grid									
Percentage of enterprises reporting primary reason for not connecting:									
Grid not available	10	70	48.3	16	18.8	40.3	51.3	2.58 **	0.03
High connection cost	10	20	42.2	16	68.8	47.9	-48.8	-2.27 **	0.05
High tariff	10	0	0	16	0	0	0	.	1.00
Other	10	10	31.6	16	12.5	34.2	-2.5	-0.25	0.81
Percentage of enterprises reporting primary reason for wanting to connect:									
Better lighting	10	20	42.2	16	12.5	34.2	7.5	0.55	0.60
Improved productivity/efficiency	10	60	51.6	16	56.3	51.2	3.8	0.16	0.87
Enhanced income	10	10	31.6	16	12.5	34.2	-2.5	-0.23	0.82
Electricity more cost-effective	10	10	31.6	16	18.8	40.3	-8.8	-0.75	0.47
Percentage of enterprises interested in connecting to the national grid	10	100	0	16	100	0	0	.	.
Percentage of interested enterprises that submitted a connection application	10	30	48.3	16	18.8	40.3	11.3	0.72	0.49

Table C.5 (continued)

Enterprise Characteristic	Intervention Group N	Intervention Group Mean	Intervention Group Standard Deviation	Comparison Group N	Comparison Group Mean	Comparison Group Standard Deviation	Difference	t	P-Value
Table V.5. Power Outages and Sources of Backup Energy Among Enterprises Connected to the Grid									
Percentage of enterprises reporting power outages in the previous month:									
Daily	21	28.6	46.3	10	30	48.3	-1.4	-0.08	0.94
Few times a week	21	52.4	51.2	10	30	48.3	22.4	1.24	0.24
Few times a month	21	0	0	10	20	42.2	-20	-1.19	0.26
Rarely	21	19	40.2	10	20	42.2	-1	-0.08	0.94
Percentage of enterprises using the following energy sources during outages:									
Remain without power	21	4.8	21.8	10	10	31.6	-5.2	-0.62	0.55
Candle	21	23.8	43.6	10	30	48.3	-6.2	-0.34	0.74
Battery-operated light or kerosene lamp	21	28.6	46.3	10	70	48.3	-41.4	-2.98 **	0.01
Diesel generator	21	4.8	21.8	10	20	42.2	-15.2	-1.48	0.17
Other	21	52.4	51.2	10	10	31.6	42.4	5.05 ***	0.00
Amount spent on backup sources of energy in the previous month	22	15,273	33,293	11	44,418	94,511	-29,146	-1.28	0.23
Amount spent on backup sources of energy per month in 2010	22	32,467	47,797	11	5,500	9,917	26,967	7.31 ***	0.00
Table V.6. Voltage Fluctuations Reported by Electricity-Using Enterprises									
Percentage of enterprises reporting voltage fluctuations in the previous month:									
Daily	22	27.3	45.6	11	27.3	46.7	0	0.00	1.00
Few times a week	22	59.1	50.3	11	36.4	50.5	22.7	1.54	0.15
Few times a month	22	4.5	21.3	11	18.2	40.5	-13.6	-0.87	0.41
Rarely	22	9.1	29.4	11	18.2	40.5	-9.1	-0.71	0.49
Percentage of enterprises reporting voltage fluctuations per month in 2010:									
Daily	22	22.7	42.9	11	18.2	40.5	4.5	0.29	0.78
Few times a week	22	50	51.2	11	27.3	46.7	22.7	2.08 *	0.06
Few times a month	22	27.3	45.6	11	27.3	46.7	0	0.00	1.00
Rarely	22	0	0	11	18.2	40.5	-18.2	-1.42	0.19
Never	22	0	0	11	9.1	30.2	-9.1	-1.16	0.27

Table C.5 (continued)

Enterprise Characteristic	Intervention Group N	Intervention Group Mean	Intervention Group Standard Deviation	Comparison Group N	Comparison Group Mean	Comparison Group Standard Deviation	Difference	t	P-Value
Table V.7. Non-Electric Energy Use									
Percentage of enterprises using the following non-electric sources of energy:									
Biofuels (wood, crop residue, straw/leaves, or dung)	32	12.5	33.6	27	25.9	44.7	-13.4	-1.36	0.20
Charcoal	32	12.5	33.6	27	7.4	26.7	5.1	1.14	0.28
Candles	32	15.6	36.9	27	14.8	36.2	0.8	0.07	0.95
Kerosene	32	43.8	50.4	27	70.4	46.5	-26.6	-1.40	0.19
Diesel or gasoline	32	0	0	27	14.8	36.2	-14.8	-2.15 *	0.06
LPG	32	0	0	27	3.7	19.2	-3.7	-1.06	0.31
Dry cell batteries	32	37.5	49.2	27	48.1	50.9	-10.6	-0.45	0.66
Car batteries	32	0	0	27	7.4	26.7	-7.4	-1.71	0.12
Number of different non-electric energy sources used	32	1.22	0.94	27	1.93	1.17	-0.71	-1.78	0.10
Table V.8. Use of Electrical and Non-Electrical Energy Devices and Appliances									
Appliance/device hours per day:									
Artificial light hours	32	21	36.7	27	22.69	45.61	-1.69	-0.23	0.82
Radio hours	14	9.21	3.98	7	5.43	5.09	3.79	2.74 **	0.02
TV hours	5	6	3.74	1	12	n.a.	-6	.	.
Cooking hours	8	5.29	3.93	7	9.43	7.07	-4.14	-1.78	0.11
Water heating hours	1	6	n.a.	0	n.a.	n.a.	n.a	.	.
Refrigeration hours	12	10.17	3.01	6	5.67	4.59	4.5	2.39 **	0.04
AC and fan hours	10	7.4	3.17	2	3	4.24	4.4	1.98 *	0.08
Iron hours	3	0.87	0.51	2	3	1.41	-2.13	-2.87 **	0.02
Vehicle hours	14	4.86	5.68	17	4.37	2.95	0.49	0.26	0.80
Number of appliances/devices used	32	6.97	8.9	27	6.82	6.59	0.15	0.12	0.90
Number of electric lights	32	2.09	3.55	27	2.07	4.7	0.02	0.02	0.98
Number of sources of artificial light (light bulbs, flashlights, candles, kerosene lanterns, pressurized kerosene lanterns)	32	3.81	5.94	27	4.41	5.68	-0.6	-0.59	0.57
Liters of liquid fuel used by appliances per month	32	29.73	68.6	27	29.87	51.64	-0.14	-0.01	1.00
Kilograms of solid fuel used by appliances per month	7	3.06	2.37	6	5.97	3.84	-2.91	-1.93 *	0.08

Table C.5 (continued)

Enterprise Characteristic	Intervention Group N	Intervention Group Mean	Intervention Group Standard Deviation	Comparison Group N	Comparison Group Mean	Comparison Group Standard Deviation	Difference	t	P-Value
Table V.9. Use of and Expenditures Related to Mobile Telephones									
Percentage of enterprises that use a mobile phone for business	32	90.6	29.6	27	85.2	36.2	5.4	0.62	0.55
Percentage of enterprises in which employees always have access to a charged phone	29	82.8	38.4	23	60.9	49.9	21.9	1.36	0.20
Location phone is normally charged (percent):									
Home	29	17.2	38.4	23	4.3	20.9	12.9	2.08 *	0.06
Place of business	29	58.6	50.1	23	34.8	48.7	23.8	1.08	0.31
Another retail location	29	17.2	38.4	23	47.8	51.1	-30.6	-1.54	0.15
Other	29	6.9	25.8	23	13	34.4	-6.1	-0.66	0.52
Amount paid per month for mobile phone costs (airtime, repairs, charging, and other related costs)	29	20,600	34,239	23	13,400	17,782	7,200	0.68	0.51

Table C.5 (continued)

Enterprise Characteristic	Intervention Group N	Intervention Group Mean	Intervention Group Standard Deviation	Comparison Group N	Comparison Group Mean	Comparison Group Standard Deviation	Difference	t	P-Value
Table V.10. Enterprise Assets, Finance, and Employees									
Assets									
Market value of all assets (TZS)	32	24,906,875	107,920,000	27	6,565,259	15,427,367	18,341,616	2.64 **	0.02
Total debt (TZS)	31	647,742	1,706,471	27	132,593	268,380	515,149	2.12 *	0.06
Market value of all inventories (TZS)	32	1,638,125	3,004,494	27	1,539,519	4,043,229	98,606	0.11	0.91
Finance									
Percentage of enterprises that used the following as a source of finance for investment:									
Own resources	32	100	0	27	100	0	0	.	1.00
Banks/formal lenders	32	9.4	29.6	27	22.2	42.4	-12.8	-1.20	0.26
NGOs/microcredit organizations	32	0	0	27	0	0	0	.	1.00
Friends, relatives, neighbors	32	12.5	33.6	27	11.1	32	1.4	0.20	0.85
Informal money lenders	32	0	0	27	0	0	0	.	1.00
Other	32	3.1	17.7	27	14.8	36.2	-11.7	-2.41 **	0.04
Revenues in the previous month (TZS)	32	286,563	523,238	27	502,296	1,902,220	-215,734	-0.80	0.44
Revenues in 2010 (TZS)	32	3,751,875	8,304,383	26	1,787,923	2,810,306	1,963,952	1.63	0.13
Employees									
Percentage of enterprises with at least one employee	32	90.6	29.6	27	88.9	32	1.7	0.20	0.85
Number of employees	29	2.1	0.77	24	2.21	1.35	-0.11	-0.29	0.78
Number of permanent employees	29	1.86	0.88	24	1.63	1.06	0.24	0.93	0.37
Percentage of enterprises with at least one paid employee	32	21.9	42	27	29.6	46.5	-7.8	-0.60	0.56
Number of paid employees	29	0.48	0.99	24	0.79	1.53	-0.31	-0.69	0.50
Number of permanent paid employees	29	0.45	0.99	23	0.35	0.71	0.1	0.39	0.70
Percentage of enterprises with female employees	32	50	50.8	27	55.6	50.6	-5.6	-0.40	0.69
Percent of enterprises with paid female employees	32	9.4	29.6	27	14.8	36.2	-5.4	-0.58	0.58
Average wage in enterprises with paid employees	7	110,952	189,988	8	58,542	52,896	52,411	0.57	0.58
Average male wage in enterprises with paid male employees	5	138,000	225,211	6	65,000	59,582	73,000	0.60	0.56
Average female wage in enterprises with paid female employees	3	46,667	28,868	4	41,250	26,575	5,417	0.95	0.36

Source: Tanzania Energy Sector Baseline Enterprise Survey

Notes: */**/*** Difference is statistically significantly different from zero at the .10/.05/.01 level using a two-tailed t-test.

n.a. = not applicable. Estimates presented in this table are unweighted.

Table C.6. Energy and Pollution Produced per Unit of Different Energy Sources

Survey Question Number	Fuel Type	Energy Produced	Energy Produced Unit	Carbon Emissions (Global Warming)	Carbon Emissions Unit	Black Carbon Produced (Indoor Pollution)	Black Carbon Unit
K_a	Fuel Wood	15.5[e]	MJ/kg	1.52[f]	kg CO2/kg of fuel	0.85[g]	g BC/kg fuel
K_b	Crop Residues	15.525[a]	MJ/kg	1.13[b]	kg CO2/kg of fuel	0.64[h]	g BC/kg fuel
K_c	Straws/Leaves	17.5[a]	MJ/kg	1.17[i]	kg CO2/kg of fuel	1.52[j]	g BC/kg fuel
K_d	Animal Waste/Dung	12[a]	MJ/kg	1.70[j]	kg CO2/kg of fuel	0.12[d]	g BC/kg fuel
K_e	Charcoal	29.4[i, k]	MJ/kg	2.36[l]	kg CO2/kg of fuel	1.0[i]	g BC/kg fuel
K_f	Candles	0.58[m]	MJ/candle	0.05[n]	kg CO2/candle	0.024[o]	g BC/candle

[e] http://physics.info/energy-chemical/, downloaded September 19, 2012. For crop residues, we averaged the energy density of the following biomass fuels: maize cobs and stalks, rice hulls and straw, coffee husks, and cotton hulls and stalks. For straws/leaves, we averaged the energy density of alfalfa, rice, and wheat.

[f] http://ehs.sph.berkeley.edu/krsmith/publications/00_zhang_1.pdf. We took the mean emission factors of CO_2.

[g] http://ww.w.earthjustice.org/sites/default/files/black-carbon/bond-et-al-2004.pdf, downloaded September 19, 2012. We took the average of the two values for wood in Table 9. We based black carbon emissions of diesel/gasoline on middle distillate oil for generators in Table 5 and adjusted from kg to liters using an assumption of 0.84 kg/liter for gas and 0.54 for LPG.

[h] http://www.fao.org/docrep/013/i1756e/i1756e11.pdf, downloaded September 19, 2012.

[i] http://jenkins.ucdavis.edu/projects/RiceStraw/RiceStrawDocs/SummersEBS216FinalReport.pdf. We took the mean emission factors of CO_2.

[j] http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1999/08/15/000009265_3961002175510/Rendered/PDF/multi_page.pdf. We converted the energy content of LPG in MJ/kG to MJ/liter assuming a density of 0.46 KG per liter for LPG. The MJ/KG data were obtained from Table 6.

[k] http://www.scscertified.com/lcs/docs/Global_warming_full_9-6-07.pdf, downloaded September 19, 2012. For the energy content of wood, we used the number on page 10/26 of this document.

[l] http://www.mendeley.com/research/emission-factors-wood-charcoal-fired-cookstoves-1/. We took average of the minimum and maximum CO_2 and CH_4 emission factors and added them together after taking CH_4's global warming potential into consideration.

[m] http://dwb4.unl.edu/Chem/CHEM869M/CHEM869MMats/PSWCBL09.pdf, downloaded September 19, 2012. We assume a 0.12 kg candle.

[n] http://enochthered.wordpress.com/2008/03/31/earth-hour-candles-and-carbon/, downloaded September 19, 2012. We assume a five-hour burn time for a candle and a weight of 0.025 kg.

[o] http://lib3.dss.go.th/fulltext/Journal/Environ%20Sci.%20Technology1998-2001/1999/no.14/14,1999%20vol.33,no14,p.2352-2362.pdf. We averaged four types of paraffin candles: 2, 4A, 4B, and 4E.

Table C.6 ***(continued)***

Survey Question Number	Fuel Type	Energy Produced	Energy Produced Unit	Carbon Emissions (Global Warming)	Carbon Emissions Unit	Black Carbon Produced (Indoor Pollution)	Black Carbon Unit
K_g	Kerosene [p]	43 [h]	MJ/kg	3.13 [b]	kg CO2/kg of fuel	0.9 [c]	g BC/kg
K_h	Diesel/Gasoline	33.95 [a, q]	MJ/Liter	2.31 [r]	kg CO2/liter of fuel	7.1 [c]	g BC/liter
K_i	LPG	24.3 [h]	MJ/Liter	1.49 [p]	kg CO_2/Liter of fuel	0.96 [c]	g BC/liter
K_j_D	Dry Cell Batteries, D	0.005 [s]	kWh/battery				
K_j_AA	Dry Cell Batteries, AA	0.0004 [q]	kWh/battery				
K_j_AAA	Dry Cell Batteries, AAA	0.0007 [q]	kWwh/battery				
K8	Car Batteries	0.425 [t, u]	kWh/battery				
L7	Grid Electricity	0.017 [v]	kWh/TZS	0.185 [w]	kg CO_2/kWh	0 [x]	g/kWh

Source: Prepared by authors' with assistance from DHInfrastructure based on available information from professional and media sources, as well as product information provided by the manufacturers.

[p] We change these numbers to be per liter in the analysis since the survey questions are per liter.

[q] http://www.mitenergyclub.org/assets/2008/11/15/Units_ConvFactors.MIT_EnergyClub_Factzseet.v8.pdf. Based on this document, one liter of diesel is 0.837 kg and one liter of LPG is 0.540 kg.

[r] http://www.carbontrust.com/media/18223/ctl153_conversion_factors.pdf, downloaded September 19, 2012. For diesel/gas, we used the rate for petroleum.

[s] http://www.allaboutbatteries.com/Energy-tables.html.

[t] http://www.donrowe.com/inverters/inverter_faq.html#how_long. A small car battery can be expected to store around 250 watt-hours.

[u] http://hypertextbook.com/facts/2002/RaymondTran.shtml. Because we were not sure what kinds of car batteries are available in Tanzania, we averaged the value noted in #18 and the most common value in this source (0.6).

[v] http://www.tanesco.co.tz/index.php?option=com_content&view=article&id=63&Itemid=205.

[w] http://www.shadlock.co.uk/energy/misc/convertf.htm. We assumed new grid energy produced by diesel fuel.

[x] We could not find any websites claiming that grid electricity produced soot.

Table C.7. Energy-Consuming Devices: Energy Use, Pollution, and Output Estimates

Survey Question Number	Energy-Consuming Devices	Energy Use	Energy Use Unit	Energy Produced	Energy Produced Unit	Carbon Emissions (Global Warming)[a]	Carbon Emissions Unit	Black Carbon Produced (Internal Pollution)	Black Carbon Unit	Output	Output Unit
D1	Fluorescent Light Bulb	0.015[b]	kWh			0.9	g CO_2/hr			900[b]	Lumens
D2	Incandescent Light Bulb	0.060[c]	kWh			3.6	g CO_2/hr			890[b]	Lumens
D3	Energy-Saving Bulb	0.01[b]	kWh			0.62	g CO_2/hr			725[b]	Lumens
D4	Flashlight	0.0009[d]	kWh			0.05	g CO_2/hr			281[e]	Lumens
D5	Candle Hours	NA[f]				10.69[g]	g CO_2/ candle/hr	0.005[h]	g BC/ candle hr	13[g]	Lumens
D6	Kerosene Lantern	8.2[i, j]	g/hr			25.67[k]	g CO_2/hr	0.007[l]	g BC/hr	68[l]	Lumens

[a] The following formula was use to calculate carbon emission rates for D1, D2, D3, D4, D10, D16, D17, D18, D19, D20, D21, D24, D26, D27, D28, D29, D30, D31, D32, D33, D34, D40, D41, G1, and G7: Energy Use*Emissions from the National Grid (from Responsible Tourism Tanzania: http://www.rttz.org/who-we-are/ghg/. The website states, "…emissions [by electricity generation] from the national grid are 0.060 KG/CO2 per kWh."

[b] http://www.efi.org/factoids/lumens.html. We used 15W bulbs because 15W is the size that is approximately in the middle/high range of the CFL bulb wattages in the EFI table (#3). For the energy use and the output of energy-saving bulb, we averaged the two higher LED bulb wattages and lumens from the EFI table.

[c] http://www.capetown.gov.za/en/EnvironmentalResourceManagement/EnergyEfficiency/Documents/SLH%20energy%20audit%20pp%2044-47.pdf. 70W is the average wattage of three typical wattage levels for incandescent bulbs (40, 60, 100). On further consideration, however, we revised this down to 60, as a 70W bulb is uncommon.

[d] http://www.amazon.com/12V-75mA-Incandescent-Flashlight-Bulb/dp/B007Z7QB9A. The calculation for the flashlight energy use is Watts = Volts x Amps; 12 volts x 9 milliamps = 0.0009 kilowatts.

[e] http://www.dewalt.com/tools/cordless-flashlight-bulbs-dw9043.aspx, accessed Sept. 19, 2012.

[f] This number was not needed for our estimates. We use the fuel source data on candles to estimate energy use from candles.

[g] http://enochthered.wordpress.com/2008/03/31/earth-hour-candles-and-carbon/.

[h] http://lib3.dss.go.th/fulltext/Journal/Environ%20Sci.%20Technology1998-2001/1999/no.14/14,1999%20vol.33,no14,p.2352-2362.pdf. Our estimate is based on the average elemental carbon emissions rate of the paraffin candle types from Table 1 in this study (0.94 g bc/kg paraffin). We assume a weight of 0.025 kg per candle.

[i] http://evanmills.lbl.gov/pubs/pdf/offgrid-lighting.pdf. We assumed that the kerosene lantern consumes 0.010 liters of kerosene per hour based on the LBL study. Thus, we calculate g/hr as follows: 820 g/L * 0.010 l/hr = 8.2 g/hr fuel consumption.

Table C.7 ***(continued)***

Survey Question Number	Energy-Consuming Devices	Energy Use	Energy Use Unit	Energy Produced	Energy Produced Unit	Carbon Emissions (Global Warming)[a]	Carbon Emissions Unit	Black Carbon Produced (Internal Pollution)	Black Carbon Unit	Output	Output Unit
D7	Pressurized Kerosene Lantern	85 [m]	g/hr			266.1 [i, k]	g CO_2/hr	0.077 [l]	g BC/hr	1,300 [k]	Lumens
D8	Traditional or Charcoal Stove	560[m]	g/hr			11,524.8[n]	g CO_2/hr	0.56[o]	g BC/hr		
D9	Kerosene Stove	114.8[p, q]	g/hr			359.4 [i, k]	g CO_2/hr	0.10 [l]	g BC/hr		
D10	Electric Stove	3 [c]	kWh			180	g CO_2/hr				
D11	Gas Cooker	45[r]	g/hr			139.05 [k, s]	g CO_2/hr	0.0234 [l]	g BC/hr		

(continued)

[j] http://www.engineeringtoolbox.com/liquids-densities-d_743.html. The density of kerosene is 820 g/L.

[k] http://ehs.sph.berkeley.edu/krsmith/publications/00_zhang_1.pdf. The amount of CO_2 produced by kerosene is 0.13E+3. GHG emissions for gas are derived as follows. The average grams of CO2 emissions per kg of fuel burned is 3090 (or 3.09 kg per kg of fuel burned). This was converted to grams per kg and then multiplied by the conversion factor of grams per liter for LP gas, which is noted in #30.

[l] http://nariphaltan.virtualave.net/lantern.htm. This is the middle of the range for fuel consumption of a Petromax pressurized kerosene lantern. We took the average of the two numbers in row 3, column 5 of Table 2.

[m] http://tatedo.org/cms/images/researchdocs/charcoal%20study.pdf. We assumed 2.8 kg/charcoal per day consumption (average from this study) and 5 hours per day spent cooking (also the average from this study).

[n] http://www.energia-africa.org/fileadmin/files/media/reports/Nigeria/Seedfunding%20case%20study%20Penetrating%20LPG%20Use%20in%20Lagos%20State.pdf. This value was obtained using the following formula: CO_2 emissions from charcoal stove (g of CO2/MJ) and charcoal energy content (MJ/kg of charcoal) and stove energy use (kg charcoal/hour).

[o] http://www.fao.org/docrep/013/i1756e/i1756e11.pdf. This source says the estimated rate of black carbon emissions from charcoal-making is 0.2g/kg. This was multiplied by the corresponding energy use rate.

[p] http://www.commercialfuelsolutions.co.uk/pages.php?pageid=2. The specific gravity of diesel fuel is 0.82/kg.

[q] http://www.alibaba.com/product-gs/377568170/641_Kerosene_Stove.html. This product consumes 0.14 liters of kerosene per hour. In order to convert this to g/hr, the team multiplied the rate and the specific gravity of diesel fuel together.

[r] http://www.alibaba.com/product-gs/445388627/gas_stove.html. This product consumes 45 grams of gas per hour.

[s] http://www.mitenergyclub.org/assets/2008/11/15/Units_ConvFactors.MIT_EnergyClub_Factzseet.v8.pdf. Based on this document, one liter of diesel is 0.837 kg and one liter of LPG is 0.540 kg.

Table C.7 ***(continued)***

Survey Question Number	Energy-Consuming Devices	Energy Use	Energy Use Unit	Energy Produced	Energy Produced Unit	Carbon Emissions (Global Warming)[a]	Carbon Emissions Unit	Black Carbon Produced (Internal Pollution)	Black Carbon Unit	Output	Output Unit
D12	Car or Motor Cycle Battery (for household use)			0.5010[t]	kWh						
D13	Generator Set	0.7[u]	Liters/hr	2.0000[v]	kWh						
D14	Solar PV System			0.0408[w]	kWh						
D15	Pico-Hydro System			0.45[x]	kWh						
D16	Television	0.12[y]	kWh			7.2	g CO_2/hr				
D17	Air Conditioner	2.25[z]	kWh			135	g CO_2/hr				
D18	Electric Fan	0.02375[aa]	kWh			1.43	g CO_2/hr				

[t] http://answers.yahoo.com/question/index?qid=20100307191621AAeC7iS.

[u] This is calculated using the same methodology used to calculate fuel consumption of a diesel motor (D25).

[v] http://siteresources.worldbank.org/EXTENERGY/Resources/336805-1157034157861/ElectrificationAssessmentRptAnnexesFINAL17May07.pdf, accessed September 19, 2012. This is based on a 2 kW diesel generator, which is the smallest diesel generator set specified in the World Bank document. We did not find a basis for assuming a generator size used for home power production, so we used the smallest.

[w] http://www.fnu.zmaw.de/fileadmin/fnu-files/publication/working-papers/Ondraczek_2011_Working-Paper-FNU_195.pdf. Accessed September 19, 2012. We estimate this using the formula, (50*0.17*8760)/((8760/24)*5)/1000. This is an estimate of the average over five hours, assuming a 50W panel. However, solar PV systems produce varying amounts of energy throughout the day, so a standard per-hour metric is not possible. We assume a 50W solar system (based on the system sizes in the cited source) with a capacity factor of 17 percent. This is a typical capacity factor for this location. This assumes that the system produces electricity for five hours during the day. The formula here calculates the hourly electricity generated by the system during the hours when it is generating. It does this by multiplying the average hourly generation over the entire year by 24 to get the average daily generation. It then divides that amount by the number of hours when the system is generating (5).

[x] http://www.fnu.zmaw.de/fileadmin/fnu-files/publication/working-papers/Ondraczek_2011_Working-Paper-FNU_195.pdf. For the pico-hydro system, the capacity factor is 45 percent. However, the actual energy production of a small hydropower system can vary significantly; it can be from a 1 kW system up to several MW in size. It is important to understand that this is highly site specific and will vary significantly from respondent to respondent. We have chosen 1kW here as the low end of the range, in order to be conservative.

[y] http://www.myprius.co.za/D04%2010%20-%20%20Bredekamp%20A.pdf. We averaged together multiple types of TVs, DVD players, and mini hi-fis that are common in South Africa. For sound equipment, we took numbers for different types of mini hi-fis.

[z] http://www.absak.com/library/power-consumption-table. We averaged two types of A/C units together: room and central. We also took the average of two types of electric fans: ceiling and table.

Table C.7 ***(continued)***

Survey Question Number	Energy-Consuming Devices	Energy Use	Energy Use Unit	Energy Produced	Energy Produced Unit	Carbon Emissions (Global Warming)[a]	Carbon Emissions Unit	Black Carbon Produced (Internal Pollution)	Black Carbon Unit	Output	Output Unit
D19	VCD/DVD Player	0.007[z]	kWh			0.45	g CO_2/hr				
D20	Radio/CD Player	0.035[aa]	kWh			2.1	g CO_2/hr				
D21	Electric Water Pump	0.125[aa]	kWh			7.51	g CO_2/hr			1,620*	L/hr
D22	Diesel Water Pump	1,397.5[aa, aa]	g/hr			4174.13[aa]	g CO_2/hr	10.02[l, t]	g BC/hr	60,000[bb, cc]	L/hr
D23	Manual Water Pump	0	g/hr			0	g CO_2/hr	0	g BC/hr	1,200[dd, ee, ff, gg]	L/hr
D24	Electric Motor	100[hh]	kWh			6000	g CO_2/hr				
D25	Diesel/Gasoline Motor	2,176.2[ii]	g/hr			6500[jj]	g CO_2/hr	15.60 [l, t]	g BC/hr		

[aa] http://www.sei-international.org/mediamanager/documents/Publications/Air-land-water-resources/carbon-footprint-agricultural-development.pdf.

[bb] http://www.amazon.com/DuroMax-XP904WP-4-Cycle-Powered-Portable/dp/B000MX9RQ8/ref=sr_1_1?s=hi&ie=UTF8&qid=1343954059&sr=1-1&keywords=Diesel+water+pump.

[cc] http://icmsa.co.za/Water%20pump-South%20Africa.htm. The average of three different types of water pumps (700 l/min and 1600 l/min are from this source; 427 gal/min is from #31) was 1305, but we decided to use a number a bit below the average based on the idea that the water pumps they have may be relatively less powerful.

[dd] http://sunshineworks.com/stainless-steel-deep-well-hand-pump.htm.

[ee] http://www.simplepump.com/OUR-PUMPS/Hand-Operated.html.

[ff] http://solution4africa.com/product-hand-pump.html.

[gg] http://www.newsolarpump.com/comparison/hand-water-pump/hand-pump-afridev-pumps.html. We averaged different types of electric water pumps from this source, #33, #34, and #35 together.

[hh] http://essay.utwente.nl/58510/1/scriptie_G_Maleko.pdf. Electric/diesel motors are used to run grain mills in Tanzania. These mills serve the whole community rather than just single households.

[ii] http://iopscience.iop.org/1748-9326/6/3/034002/pdf/1748-9326_6_3_034002.pdf. 7.5 kWh diesel motor consumes 2.6 liters of diesel per hour. We took the average of the high and low fuel consumption per kWh estimates (pg. 4) and multiplying them by the kW output of the diesel generator. Then, we converted this to gram from liter.

Table C.7 *(continued)*

Survey Question Number	Energy-Consuming Devices	Energy Use	Energy Use Unit	Energy Produced	Energy Produced Unit	Carbon Emissions (Global Warming)[a]	Carbon Emissions Unit	Black Carbon Produced (Internal Pollution)	Black Carbon Unit	Output	Output Unit
D26	Electric Tools**	1.015[kk, ll]	kWh			60.88	g CO_2/hr				
D27	Sewing Machine	0.1 [aa]	kWh			6	g CO_2/hr				
D28	Sound Equipment	0.0225 [z]	kWh			1.2	g CO_2/hr				
D29	Iron	0.98 [c]	kWh			58.8	g CO_2/hr				
D30	Washing Machine	3 [c]	kWh			180	g CO_2/hr				
D31	Vacuum Cleaner	1 [c]	kWh			60	g CO_2/hr				
D32	Microwave Oven	1.23 [c]	kWh			73.8	g CO_2/hr				
D33	Water Heater	5[mm]	kWh			300	g CO_2/hr				
D34	Computer	0.13 [c]	kWh			8.04	g CO_2/hr				
D40	Satellite Dish	0.05[nn]	kWh			3	g CO_2/hr				
D41	Refrigerator/Freezer	0.16 [c]	kWh			9.48	g CO_2/hr				
G1	Land Line Phone	0.002 [c]	kWh			0.12	g CO_2/hr				
G7	Cell Phone (charger)	0.009 [c]	kWh			0.54	g CO_2/hr				

Source: Prepared by authors' with assistance from DHInfrastructure based on available information from professional and media sources, as well as product information provided by the manufacturers.

Notes: *Please see Table C.8 for all the electric water pumps that were identified to calculate the output.

**Please see Table C.9 for all the tools that were identified to calculate the energy use.

(continued)

[jj] http://www.repp.org/repp_pubs/pdf/devGGas.pdf. This source states that a typical kerosene CO_2 emission factor ranges from 2.4 to 2.5 kg/liter. We converted liter to g and then multiplied it with diesel/gasoline motor's EUse.

[kk] http://www.chinafrica.asia/industrial-machineries/electric-tools/.

[ll] http://www.made-in-china.com/. After finding jig saws (520, 350, 710, and 710), electric chain saws (1600, 1300, 1300, and 1300), rotary hammers (800, 850, 1050, 1120, 500, 500, 800, 850, and 850), and circular saws (1350, 1200, 1050, 1500, 1200, 1500, 1400, and 1300) that look similar to the ones in #40, we averaged across all of their energy use rates.

[mm] http://www.energysavers.gov/your_home/appliances/index.cfm/mytopic=10040/. We averaged 4500 W and 5500 W.

[nn] http://www.erakiprelec.co.za/wattage-consumption.html.

Table C.8. Conversion Factors for Water Pumps

#	Units	Liters/Minute	Type	Source	Depth
40	Liters/Minute	40	Electric	http://www.amazon.com/HP-ELECTRIC-WATER-PUMP/dp/B005FGQNYQ	well
558	Gal/Hour	35	Electric	http://www.amazon.com/Wayne-SWS100-1-Horsepower-Cast-Shallow/dp/B002BDU6SA/ref=sr_1_8?s=hi&ie=UTF8&qid=1343953773&sr=1-8&keywords=Electric+water+pump+for+well	5 feet
10	gal/minute	38	Electric	http://www.amazon.com/Flotec-FP4012-00L-Shallow-Well-Pump/dp/B0002YXB14/ref=pd_sim_sbs_hi_4	25 feet
300	gal/hour	19	Electric	http://www.simplepump.com/OUR-PUMPS/Motorized.html	well
7.5	gal/minute	28	Electric	http://www.grainger.com/Grainger/DAYTON-Shallow-Well-Jet-Pump-System-4HEZ9?cm_mmc=CSE:Shopping-_-Pumps-_-Well%20Pumps-_-4HEZ9&srccode=cii_13736960&cpncode=32-145833708-2	5 ft
6.1	gal/minute	23	Electric	http://www.grainger.com/Grainger/DAYTON-Shallow-Well-Jet-Pump-System-4HEZ9?cm_mmc=CSE:Shopping-_-Pumps-_-Well%20Pumps-_-4HEZ9&srccode=cii_13736960&cpncode=32-145833708-2	10 ft
5	gal/minute	19	Electric	http://www.grainger.com/Grainger/DAYTON-Shallow-Well-Jet-Pump-System-4HEZ9?cm_mmc=CSE:Shopping-_-Pumps-_-Well%20Pumps-_-4HEZ9&srccode=cii_13736960&cpncode=32-145833708-2	15 ft
4	gal/minute	15	Electric	http://www.grainger.com/Grainger/DAYTON-Shallow-Well-Jet-Pump-System-4HEZ9?cm_mmc=CSE:Shopping-_-Pumps-_-Well%20Pumps-_-4HEZ9&srccode=cii_13736960&cpncode=32-145833708-2	20 ft

Source: Prepared by authors' with assistance from DHInfrastructure based on available information from professional and media sources, as well as product information provided by the manufacturers.

Table C.9. Conversion Factors for Electric Tools

	Rated Input Power (W)	Source
Jig saws		http://www.made-in-china.com/products-search/hot-china-products/Jig_Saw.html
	520	http://ykjingchuang.en.made-in-china.com/product/RobJWyzYhqhp/China-Jig-Saw-CJ65AR-.html
	350	http://zjdejin.en.made-in-china.com/product/zqjmCMnyQwWd/China-Professional-Power-Tools-Jig-Saw-MIQ-DJ-55-.html
	710	http://ebictools.en.made-in-china.com/product/BMvQcSjVkKWE/China-Jig-Saw-JS8002-.html
	710	http://jufeng.en.made-in-china.com/product/vBtnVhKHXQWe/China-Electric-Woodworking-Jig-Saw-GT-JS100B-.html
Electric Chain Saws		
	1600	http://sfdtools.en.made-in-china.com/product/fblEAxiVvFcU/China-GS-amp-CE-Approved-1600W-14-quot-Chain-Saw.html
	1300	http://cnpowertectools.en.made-in-china.com/product/CoZnvIFcPsVD/China-1-3kw-16-quot-Electric-Chain-Saw-PT71015-.html
	1300	http://realtime.en.made-in-china.com/product/EbCxriXDEZcv/China-Electric-Chain-Saw-ECS405-1300B-.html
	1300	http://kaibangtools.en.made-in-china.com/product/oMcxpGzjhTDw/China-Electric-Chain-Saw-MS1-405-.html
	1300	http://wellzoom.en.made-in-china.com/product/uMpJnAvoaZkr/China-Electric-Chain-Saw-CW9016-.html
Rotary Hammers		
	800	http://ebictools.en.made-in-china.com/product/kqfmZKDGCNVR/China-Rotary-Hammer-RH24HK-.html
	850	http://ykjingchuang.en.made-in-china.com/product/dMAnyKeVrlku/China-Rotary-Hammer-KD2801A-.html
	1050	http://kaibangtools.en.made-in-china.com/product/NMWmYLuPgtDC/China-Rotary-Hammer-30mm-MD6-30-.html
	1120	allenina-powertools.en.made-in-china.com/product/bMqEcIFVkKhi/China-Rotary-Hammer-RH0113-.html
	500	http://kaibangtools.en.made-in-china.com/product/sbWnrRgGJaDC/China-20mm-Rotary-Hammer-MD1-20-.html
	500	http://precisetools.en.made-in-china.com/product/xqlEmPvOEZWF/China-Rotary-Hammer-PT7020-.html
	800	http://panxiaoming.en.made-in-china.com/product/sKxmSOGAgJkc/China-Rotary-Hammer-PT-BR-EHP1005-800W-26MM.html
	850	http://realtime.en.made-in-china.com/product/MqjJYsXHldkG/China-Rotary-Hammer-RH26-850B-.html
	850	http://ykjingchuang.en.made-in-china.com/product/SMaQBuvTZFWz/China-Bosch-Tool-H2602A-.html
Circular Saws		
	1350	http://kaibangtools.en.made-in-china.com/product/UocnYMgEsTiZ/China-185mm-Circular-Saw-ME5-185-.html

Table C.9 ***(continued)***

	Rated Input Power (W)	Source
	1200	http://ykjingchuang.en.made-in-china.com/product/UeoQWygYgMVn/China-Circular-Saw-H5190D-.html
	1050	http://lacelatools.en.made-in-china.com/product/nobEjmWAaZhG/China-185mm-Circular-Saw-261812-1050W.html
	1500	http://jufeng.en.made-in-china.com/product/wBaJneLHHEWF/China-185mm-Electric-Circular-Saw-GT-CS185.html
	1200	http://ykjingchuang.en.made-in-china.com/product/IoqnWKulbMcm/China-Circular-Saw-KD5190DX-.html
	1500	http://kangton.en.made-in-china.com/product/goCEdrmJgMYK/China-185mm-1500W-Circular-Saw-KTP-CS9191-.html
	1400	http://zhoutongwelding.en.made-in-china.com/product/WoeJqNrxfZhM/China-Circular-Saw-BH-8185B-.html
	1300	http://kaibangtools.en.made-in-china.com/product/yeTEGjblAHWC/China-Circular-Saw-ME1-185-.html

Source: Prepared by authors' with assistance from DHInfrastructure based on available information from professional and media sources, as well as product information provided by the manufacturers.

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APPENDIX D

BASELINE QUESTIONNAIRE FOR THE COMMUNITY SURVEY

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FORM NO. | | | |

MILLENNIUM CHALLENGE ACCOUNT –TANZANIA (MCA-T)

Community Survey Questionnaire

CONFIDENTIAL **MPRVID** | | | | |

VILLAGE/MTAA LOCATION	
Region Name:	Region Number:
District Name:	District Number:
Ward Name:	Ward Number:
Village/Mtaa Name:	Village/Mtaa Number:
GPS Coordinates of Village/Mtaa: S: [ ][ ] [ ][ ] [ ][ ][ ] D D° M M. S S S' E: [ ][ ][ ] [ ][ ] [ ][ ][ ] D D D° M M. S S S'	*Name the location where GPS coordinates were taken:*

INTERVIEWER VISITS	
First Visit	
Interviewer name:	*Interviewer ID:*
Date of Visit: / / *DD MM YYYY*	*Result Code:*
If no one is available for the interview, make an appointment to return another day.	
Date of Next Visit: / / *DD MM YYYY*	*Time:* : *HH MM*
Second Visit	
Interviewer Name:	*Interviewer ID:*
Date of Visit: / / *DD MM YYYY*	*Result Code:*
If no one is available for the interview, make an appointment to return another day.	
Date of Next Visit: / / *DD MM YYYY*	*Time:* : *HH MM*
Third Visit	
Interviewer Name:	*Interviewer ID:*
Date of Visit: / / *DD MM YYYY*	*Result Code:*
RESULT CODES	
04. Interview complete *05. Respondent not available, visit rescheduled* *06. Incomplete*	*04. Refused* *05. Village/mtaa not located* *88. Other*

INTRODUCTION

My name is ___________________. I am a representative of NRECA International. This survey is part of a study aimed to gain understanding of the current situation of electrification in Tanzania. We would like to ask you the following questions. Your cooperation is greatly appreciated

☞ ***If the village/mtaa is a INTERVENTION area, read:***

TANESCO will be constructing electricity lines in this community within the coming year. As part of this study, we would like to interview community leaders to collect information about the residents and businesses in this community who will be affected by the electricity project. We would also like to conduct a listing of households and enterprises in this community so that we can come back to conduct surveys with them at a later time.

☞ ***If the village/mtaa is a COMPARISON area, read:***

As part of this study, we would like to interview community leaders to collect information about the residents and businesses in this community.

☞ ***READ FOR ALL COMMUNITIES:***

If you agree to participate in the survey, all the answers that you provide will be kept private – only members of the survey team will have access to this information. You would be free to choose not to answer any question that you would prefer not to answer. You can stop the interview at any time, ask me to clarify any question, or ask me to repeat something if you don't understand. You may also choose to withdraw from the study at any time.

Do you have any questions for me now?

☞ ***Answer questions as completely as possible and proceed.***

Can we begin now?

1 ☐ → *YES* → Very good. *START INTERVIEW.*

0 ☐ → *NO* → Thank you for your time. *Determine if another time would work. Record result code and appointment on cover sheet.*

Enter interview Start Time: ☐☐ : ☐☐
HH **:** *MM*

A. RESPONDENT ROSTER

Record the name and position of all village leaders, sub-village leaders, and other community leaders present who will act as respondents during this interview.

	A1. Name	*A2. Position*	
a)			1=VILLAGE/MTAA CHAIRPERSON
b)			2=VILLAGE/MTAA EXECUTIVE OFFICER
c)			3=VILLAGE/MTAA COUNIL MEMBER
d)			4=VILLAGE/MTAA ELDER
e)			5=OTHER ___________ (SPECIFY)

S. SUB-VILLAGE INFORMATION		
S1	Is [NAME OF VILLAGE/MTAA] classified as a village or a mtaa?	VILLAGE .... 1 MTAA .... 0 → *GO TO B1*
S2	Is [NAME OF VILLAGE/MTAA] divided into sub-villages?	YES .... 1 NO .... 0 → *GO TO B1*

INTERVIEWER: IS THIS COMMUNITY IN THE INTERVENTION GROUP? (MPRVID NUMBERS THAT BEGIN WITH 1 ARE INTERVENTION.) *INTERVENTION COMMUNITY* *1* ☐ *YES* / *0* ☐ *NO*			**QUESTIONS S5 AND S6 ARE TO BE ASKED IN INTERVENTION VILLAGES ONLY:**	
Line No.	S3. Please tell me the names of all sub-villages in [NAME OF VILLAGE].	S4. How many households are there in [SUB-VILLAGE]?	S5. Will new electricity lines be constructed in [SUB-VILLAGE]? 1=YES 0=NO *IF NO, SKIP TO NEXT ROW*	S6. What percent of households in [SUB-VILLAGE] will have access to the new power lines?
01.				
02.				
03.				
04.				
05.				
06.				
07.				
08.				
S7.	INTERVIEWER: FOR INTERVENTION VILLAGES, *Put an 'X' next to the highest number recorded in S6 (the last column above). This is the sub-village to be listed for the household survey. Note the line number (from the first column above) of this sub-village here:* [____] [____] *LINE NUMBER OF SELECTED SUB-VILLAGE*			

B. BACKGROUND		
B1	How many households are currently living in VILLAGE/MTAA? *DO NOT ASK THIS QUESTION IF THERE IS/ARE NUMBER(S) ENTERED IN S4*	_____/____/____/____ HOUSEHOLDS
B2	How many households have come to settle permanently in VILLAGE/MTAA during the past 2 years (since 2009)?	_____/____/____/____ HOUSEHOLDS
B3	How many households have moved out of VILLAGE/MTAA during the past 2 years (since 2009)?	_____/____/____/____ HOUSEHOLDS
B4	What is the main source of income for most households in VILLAGE/MTAA?	FARMING .... 1 LIVESTOCK .... 2 FISHING/HUNTING .... 3 TRADING.. 4 SERVICES...................................... 5 OTHER ________________________ 8 9SPECIFY)
B5	What is the price per acre of residential land in VILLAGE/MTAA?	____________________ SH/ACRE

C. TRANSPORTATION, COMMUNICATION AND WATER SUPPLY		
C1	Is VILLAGE/MTAA accessible by motor vehicle (car or truck)?	NO .... 0 YES, BY UNPAVED/ GRAVEL/DIRT ROAD .... 1 YES, BY PAVED ROAD 2
C2	What is the distance in Kilometers from VILLAGE/MTAA to the regional capital?	_____/______/______ KILOMETERS
C3	What is the distance in Kilometers from VILLAGE/MTAA to the district capital?	_____/______/______ KILOMETERS

C4	Does VILLAGE/MTAA have bus service to other villages/towns?	YES .... 1 NO 0
C5	Is VILLAGE/MTAA connected to land-line telephone lines?	YES .... 1 NO 0
C6	Can a cell/mobile phone get a working signal in VILLAGE/MTAA?	YES .... 1 NO .... 0 → *C8*
C7	How many people in VILLAGE/MTAA have a cell phone? Almost all people, some people, very few people, or none?	NONE .... 0 VERY FEW PEOPLE ....1 SOME PEOPLE...............................2 ALMOST ALL PEOPLE 3
C8	What is the main source of water supply for most households in VILLAGE/MTAA?	WELL... 1 PIPED WATER (FROM TAPS) ...... 2 SPRING WATER............................. 3 WATER FROM RIVERS, LAKES ... 4 RAIN WATER .... 5 BUY WATER FROM VENDORS..... 6 BORE HOLES .... 7 OTHER, SPECIFY .... 8 _________________

D. ACCESS TO ELECTRICITY

D1	Does VILLAGE/MTAA have access to the main electricity grid or main power line?	YES .... 1 NO .... 0 → *GO TO D4*
D2	In what year was VILLAGE/MTAA connected to the main grid or main power line?	______/____/____/____ YEAR
D3	Approximately how many households in VILLAGE/MTAA are connected to the main grid or main power line?	______/____/____/____ HOUSEHOLDS

D4		YES	NO
	Does any household in this Village/MTAA use electricity from …?	1	0
	a) isolated grid power system ………………………	1	0

	b) village/community gen-set ………………………. c) Privately owned gen-set and share with others d) Small individual diesel gen-set ………………….. e)Solar PV home system …………………………… f) Solar lantern ………………………………………. i) Wind mill …………………………………………… j) Other, specify ______________________________ (SPECIFY)	1 1 1 1 1 1	0 0 0 0 0 0

E. CIVIL SERVICES				
		E1. Does VILLAGE/MTAA have a ___________ located within the village/mtaa? 1= YES 0=NO *IF NO, SKIP TO E3*	E2. Does the ________________ use electricity from any source? 1=YES 0=NO	E3. How far is the nearest _________? DISTANCE (in Km)
a)	Pre-primary school			______/______KM
b)	Primary school			______/______KM
c)	Secondary school			______/______KM
d)	Post office			______/______KM
e)	Bank			______/______KM
f)	Police post			______/______KM

F: DEVELOPMENT PROJECTS			
		F1. During the past 2 years, have any ________ projects been implemented in VILLAGE/MTAA? 1=YES 0=NO	F2. Are any ________ projects planned in VILLAGE/MTAA in the next 2 years? 1=YES 0=NO
a)	Road construction		
b)	Markets: construction		
c)	Public water supply: installing pump, public tap, etc.		
d)	Construction of primary school		
e)	Construction of secondary school		
f)	Construction of health center or dispensary		
g)	Construction of power lines.		

G. HEALTH SERVICES					
	G1. Does VILLAGE/MTAA have a __________ located within the village/mtaa? 1= YES 0=NO *IF YES, SKIP TO G3.*	G2. How far is the nearest _________? DISTANCE (in Km)	G3. What time does the __________ open on a typical business day?	G4. What time does the __________ close on a typical business day?	G5. Does the _________ have electricity from any source? 1= YES 0=NO
A) Dispensary		____/____ KM	___:___ Hrs	___:___ Hrs	
B) Health center		____/____ KM	___:___ Hrs	___:___ Hrs	
C) Diagnostic lab		____/____ KM	___:___ Hrs	___:___ Hrs	
D) District or regional hospital		____/____ KM	___:___ Hrs	___:___ Hrs	
	G6. Can you obtain a _________ in VILLAGE/MTAA? *IF YES, GO TO NEXT ROW.*	G7. How far do you have to travel to obtain a _________?			
E) Vaccination		____/____ KM			
F) X-ray		____/____ KM			
G) Lab test for malaria		____/____ KM			
H) Hiv test		____/____ KM			

H. BUSINESS ACTIVITY				
		H1. Is there a ______________ currently operating in VILLAGE/MTAA? 1=YES 0=NO *IF NO GO TO THE NEXT ROW*	H2. How many __________ are currently operating in VILLAGE/MTAA?	H3. Do any of these _________ use electricity? 1=YES 0=NO
a)	Weekly market			
b)	Repair shop for agricultural tools			
c)	Repair shop for car, motorcycle, or bicycle			
d)	Restaurant/tea or coffee shop			
e)	Telephone calling/charging/repair services			
f)	Carpentry shop			
g)	Hotel/guest house			
h)	Barber shop/beauty salon			
i)	Tailor shop			
j)	Newspaper shop			
k)	Internet cafe			
l)	Grain mill			
m)	Saw mill			
n)	Oil mill			
o)	Other (specify)			
p)	Other (specify)			
q)	Other (specify)			

I. ENERGY/FUEL PRICES				
	I1. Is there any place to purchase __________ in VILLAGE/MTAA? 1= YES 0=NO *IF NO, SKIP TO NEXT ROW.*	I2. In what unit is ___________ typically purchased?	I3. How much does one UNIT weight in KG?	I4. How much does __________ cos per UNIT in VILLAGE/MTAA?
A) Kerosene		LITER		______________SH/L
B) Diesel		LITER		______________SH/L
C) Petrol		LITER		______________SH/L
D) Lpg				______________SH
E) Dung				______________SH
F) Firewood				______________SH
G) Charcoal				______________SH
H) D -size dry cell battery				______________SH/ONE BATTERY
I) C -size dry cell battery				______________SH/ONE BATTERY
J) Aa -size dry cell battery				______________SH/ONE BATTERY
k) Car battery				______________ SH/ONE BATTERY

CONCLUSION
That was my last question for you. Before we conclude, do you have any questions for me?
☞ *Answer questions as completely as possible.*
Thank you so much for your help. We look forward to seeing you again in a few months. Your answers are very helpful to us. I thank you so much again.
Enter interview End Time: __ __ : __ __ *HH* : *MM*
Comments: *Please note any unusual circumstances that occurred during interview.*

FOR FIELD SUPERVISOR	
Supervisor Name:	**Supervisor Number:**
Date Completed Questionnaire Checked and Approved by Supervisor:	*DD / MM / YYYY*

FOR DATA ENTRY SUPERVISOR	
Data Entry Supervisor Name:	**Data Entry Supervisor Number:**
Completed Questionnaire checked and approved by office:	/ / *DD / MM / YYYY*
Name of Data Entry Clerk for First Data Entry:	
Date of First Data Entry:	/ / *DD / MM / YYYY*
Name of Data Entry Clerk for Second Data Entry:	
Date of Second Data Entry:	/ / *DD / MM / YYYY*

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APPENDIX E

BASELINE QUESTIONNAIRE FOR THE HOUSEHOLD SURVEY

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FORM NUMBER: | | | | | | MPRVID: | | | | |

MILLENNIUM CHALLENGE ACCOUNT – TANZANIA (MCA-T)

HOUSEHOLD SURVEY QUESTIONNAIRE

CONFIDENTIAL

VILLAGE/MTAA LOCATION	
REGION NAME:	REGION CODE
DISTRICT NAME:	DISTRICT CODE:
WARD NAME:	WARD CODE:
VILLAGE/MTAA NAME:	VILLAGE/MTAA CODE:

HOUSEHOLD LOCATION								
	HH SERIAL NO				HH DWELLING NO.		HH NO. FROM THE LIST	
COMPLETE HOUSEHOLD ID:								
HOUSEHOLD ADDRESS:	NO.	STREET:			BLOCK/NEIGHBORHOOD:			
GPS COORDINATES OF HOUSEHOLD S: D D° M M. S S S' E: D D D° M M. S S S'	IMPORTANT LANDMARK NEAREST TO THE HOUSEHOLD NAME OF HEAD OF HOUSEHOLD:							

INTERVIEWER VISITS	
FIRST VISIT	
INTERVIEWER NAME:	INTERVIEWER ID:
DATE OF VISIT (DD/MM/YYYY): / / / /	RESULT CODE:
SECOND VISIT	
INTERVIEWER NAME:	INTERVIEWER ID:
DATE OF VISIT (DD/MM/YYYY): / /	RESULT CODE:
THIRD VISIT	
INTERVIEWER NAME:	INTERVIEWER ID:
DATE OF VISIT (DD/MM/YYYY): / /	RESULT CODE:

RESULT CODES

1 INTERVIEW COMPLETED
2 RESPONDENT UNAVAILABLE
VISIT RESCHEDULED
3 INTERVIEW INCOMPLETE
4 REFUSED
5 HOUSEHOLD NOT LOCATED
8 OTHER ___________________________
(SPECIFY)

A. INTRODUCTION **(**FEMALE HEAD ALONE OR MALE HEAD IF NO FEMALE HEAD PRESENT**)**

Hello, My name is __________________. I am a representative of the National Rural Electrical Cooperative Association. We are conducting a survey on behalf of the Millennium Challenge Account -- Tanzania. This survey is part of a study aimed to gain understanding of the current situation of electrification in Tanzania. We would like to ask you the following questions. Your cooperation is greatly appreciated.

☞ IF THE VILLAGE/MTAA IS A INTERVENTION AREA, READ:

TANESCO will be constructing electricity lines in this community within the coming year. As part of this study, we would like to interview selected households to collect information about the household activity in this community who will be affected by the electricity project..

☞ IF THE VILLAGE/MTAA IS A COMPARISON AREA, READ:

As part of this study, we would like to interview selected households to collect information about household activities in this community. The purpose of this interview is to study how access to grid electricity improves household welfare such as income, asset, schooling and so on.

☞ READ TO ALL RESPONDENTS:

If you agree to participate in the survey, all the answers that you provide will be kept private – only members of the survey team will have access to this information. You would be free to choose not to answer any question that you would prefer not to answer. You can stop the interview at any time, ask me to clarify any question, or ask me to repeat something if you don't understand. You may also choose to withdraw from the study at any time.

Do you have any questions for me now?

☞ ANSWER QUESTIONS AS COMPLETELY AS POSSIBLE AND PROCEED.

A1.	Can we begin now? ☐ RECORD PID OF RESPONDENT 1 *YES* ⟶ Very good. ⟶ *START INTERVIEW.* 0 *NO* ⟶ Thank you for your time. Determine if another time will work. *RECORD RESULT CODE AND APPOINTMENT ON COVERSHEET.*
A2.	RECORD THE LINE NUMBER (PID) OF THE RESPONDENT ☐☐
A3.	FILL IN TIME WHEN YOU START THE INTERVIEW: ☐☐ : ☐☐ HOUR MINUTES

B. CHARACTERISTICS OF HOUSEHOLD MEMBERS (FEMALE HEAD ALONE OR MALE HEAD IF NO FEMALE HEAD PRESENT)									
	B1	B2.	B3.	B4.	B5.	B6.	B7.		B8.
	NAMES	RELATION SHIP	SEX	AGE	MARITAL STATUS	EDUCATION			EMPLOYMENT
PERSON ID (PID)	Please give me the names of all persons who are currently living in the household, starting with the head of the household. CIRCLE LINE NUMBERS OF ALL MEMBERS WHO ARE AGED BETWEEN 5 AND 24 YEARS.	What is the relationship of [NAME] to household head?	Is [NAME] a male or female? 1 MALE 2 FEMALE	How old is [NAME]? ENTER IN COMPLETED YEARS	What is [NAME]'s marital status? (FOR ALL PERSONS LESS THAN 10 YEARS OLD, RECORD 1 DIRECTLY)	Has [NAME] ever attended school? 1 YES 0 NO →B8	What is the highest level/grade of school that [NAME] has attended?		FOR HOUSEHOLD MEMBERS AGES 15 AND OVER What is [NAME]'s current employment status? READ RESPONSE OPTIONS AND SELECT ONLY ONE.
							Level	**Grade**	
01									
02									
03									
04									
05									
06									
07									
08									
09									
10									

RELATIONSHIP:
01 = HEAD OF HOUSEHOLD
02 = SPOUSE
03 = SON OR DAUGHTER
04 = SON-IN-LAW OR DAUGHTER-IN- LAW
05 = GRANDCHILD HEAD
06 = PARENT
07 = PARENT-IN LAW
08 = BROTHER OR SISTER
09 = CO-WIFE
10 = OTHER RELATIVE
11 = ADOPTED/FOSTER/STEP CHILD
12 = NOT RELATED
88 = OTHER (SPECIFY) ____________________
99 = NOT STATED

MARITAL STATUS:
1 = NEVER MARRIED
2 = MARRIED/ COHABITING
3 = DIVORCED/ SEPARATED
4 = WIDOWED

EDUCATION LEVEL
1 = PRIMARY
2 = SECONDARY
3 = TERTIARY

EMPLOYMENT:
1 = WAGE LABOR/SALARIED EMPLOYEE
2 = SELF-EMPLOYED
3 = FARMING
4 = STUDENT
5 = UNPAID HOUSEHOLD WORK
6 = NOT WORKING

B. CHARACTERISTICS OF HOUSEHOLD MEMBERS (CONTINUED)						
TO BE ASKED FOR MEMBERS AGED BETWEEN 5 AND 24 YEARS						
LINE NUMBER	TRANSFER NAMES OF MEMBERS WHOSE LINE NUMBERS YOU HAVE CIRCLED ON THE PREVIOUS PAGE. WRITE THE NAMES ON THE SAME LINE NUMBERS AS THEY APPEAR ON THE PREVIOUS PAGE.	**B9.** Is [NAME] currently attending school? 1 YES 0 NO→C1	**B10.** Does [NAME] attend a boarding school outside this community? 1 YES→B13 0 NO	**B11.** How many hours per day does [NAME] study at home during daylight hours?	**B12.** How many hours per day does [NAME] study at home after sunset?	**B13.** **Is [NAME]'s school electrified?** 1 YES 0 NO
01				.	.	
02				.	.	
03				.	.	
04				.	.	
05				.	.	
06				.	.	
07				.	.	
08				.	.	
09				.	.	
10				.	.	

C. HEALTH (FEMALE HEAD ALONE OR MALE HEAD IF NO FEMALE HEAD PRESENT)		
Now I would like to ask you about health issues affecting members of your household.		
C1.	Please tell me whether any adults in this household have suffered from any of the following in the past 7 days:	YES NO
	a. Difficulty breathing, wheezing or coughing	1 0
	b. Sneezing, sore throat, nasal discharge or nasal congestion	1 0
	c. Double vision, blurred vision, distorted vision, or other form of worsening of vision	1 0
	d. Headaches	1 0
C2.	INTERVIEWER: REVIEW THE HOUSEHOLD ROSTER. ARE THERE ANY CHILDREN AGE 5 OR YOUNGER IN THE HOUSEHOLD?	YES .... 1 NO .... 0 → C4
C3.	Please tell me whether any children under age 5 in this household have suffered from any of the following in the past 7 days:	YES NO
	a. Difficulty breathing, wheezing or coughing	1 0
	b. Sneezing, sore throat, nasal discharge or nasal congestion	1 0
	c. Double vision, blurred vision, distorted vision, or other form of worsening of vision	1 0
	d. Headaches	1 0
C4	Has any female household member ages 15 and over missed work due to an illness during the last 30 days?	YES .... 1 NO 0
C5	Has any male household member ages 15 and over missed work due to an illness during the last 30 days?	YES .... 1 NO 0
C6.	Now I would like to ask you about all the births (including stillbirths) you have had during the past two years. Have you given birth within the past two years?	YES .... 1 NO .... 0 → C9
C7.	Of the children born to you in the past two years, did any of them die?	YES .... 1 NO .... 0 → C9
C8.	How many children born to you in the past two years have died?	NUMBER [ ][ ]
C9.	During the past 30 days, have you received any information about HIV/AIDS during from TV or radio?	YES .... 1 NO 0
C10.	During the past 30 days, have you received information about any other health issue from TV or radio?	YES .... 1 NO 0

D. HOUSEHOLD ELECTRICAL AND NON-ELECTRICAL ENERGY DEVICES AND APPLIANCES (FEMALE HEAD ALONE OR MALE HEAD IF NO FEMALE HEAD PRESENT)			
		a.	b.
		How many [APPLIANCES] does the household own? *IF 0, SKIP TO NEXT ROW.*	How many hours do you use [APPLIANCE] each day, on average?
D1	Fluorescent light bulb		
D2	Incandescent light bulb		
D3	Energy saving bulbs		
D4	Flashlight		
D5	Candle		
D6	Kerosene lantern		
D7	Pressurized kerosene lantern		
D8	Traditional or charcoal stove		
D9	Kerosene stove		
D10	Electric stove		
D11	Gas Cooker		
D12	Car or motor cycle battery (for household use)		
D13	Generator set		
D14	Solar PV system		
D15	Pico-hydro system		
D16	Television		
D17	Air conditioner		
D18	Electric fan		
D19	VCD/DVD player		
D20	Radio/CD player		
D21	Electric water pump		
D22	Diesel water pump		

D. HOUSEHOLD ELECTRICAL AND NON-ELECTRICAL ENERGY DEVICES AND APPLIANCES (FEMALE HEAD ALONE OR MALE HEAD IF NO FEMALE HEAD PRESENT)			
		a.	b.
		How many [APPLIANCES] does the household own? *IF 0, SKIP TO NEXT ROW.*	How many hours do you use [APPLIANCE] each day, on average?
D23	Manual water pump		
D24	Electric motor		
D25	Diesel/gasoline motor		
D26	Electric tools		
D27	Sewing machine		
D28	Sound equipment		
D29	Iron		
D30	Washing machine		
D31	Vacuum cleaner		
D32	Microwave oven		
D33	Water heater		
D34	Computer		
D35	Bicycle		
D36	Motorcycle		
D37	Motor vehicle (car, van/ minibus, pickup truck, etc.)		
D38	Animal drawn cart		
D39	Boat		
D40	Satellite dish		
D41	Refrigerator/freezer		
D42	Surge protectors,		
D43	Automatic voltage stabilizers/regulators		
D44	Instant power supply (IPS) unit		
D45	Other (SPECIFY) ___________________________		

E. HOUSEHOLD-OWNED BUSINESSES/
INCOME GENERATING ACTIVITIES (IGA)
(FEMALE HEAD ALONE OR MALE HEAD IF NO FEMALE HEAD PRESENT**)**

Now, we would like to ask about any income generating activities operated by this household. Income generating activities include activities OTHER THAN WAGE EMPLOYMENT which are partly or fully owned by the household or a member of the household. Income generating activities would include farming, if the crops are sold for income, running a shop or vending cart, sewing, or providing any other product or service that earns income. If your household operates more than 3 income generating activities, please tell us about the 3 most important activities.

		a. IGA #1	b. IGA #2	c. IGA #3
E1.	Does your household operate any income generating activities – other than the wage labor you have already described -- such as small scale businesses, agricultural or non agricultural activities (IGA)? YES..... 1 NO ……… 0 → F1			
E2.	What type of activity do you operate? FARMING……………………………………………………………………01 SMALL GROCERY SHOP (DUKA) ……………………………………… 02 BAKER.. …………………… 03 BUTCHER .... ………………….. 04 FLOUR MILL (CORN, WHEAT, SORGHUM, MILLET ETC.) 05 COOKING OIL PRODUCTION .... ………………….. 06 TAILORING/CLOTHING REPAIR.................. …………………… 07 CLOTHING PRODUCTION .... ………………….. 08 SHOE REPAIR/MANUFACTURE.................. ………………….. 09 OTHER LEATHER PRODUCTION AND PROCESSING ………. 10 SAWMILL.. ………………….. 11 CARPENTRY/WOOD PRODUCTS/FURNITURE MAKING…….. 12 BLACKSMITH/WELDING/USED METAL PRODUCTION………. 13 CELL PHONE DEALER/REPAIR/CHARGING ………………….. 14 OTHER ELECTRIC/ELECTRONIC REPAIR ... ………………….. 15 TRANSPORT/AUTOMOBILE REPAIR........... ………………….. 16 POTTERY.. ………………….. 17 BAMBOO/CANE WORKS............................ ………………….. 18 AGRICULTURE EQUIPMENT MAKING/REPAIR……………….. 19 OTHER FOOD BUSINESS (RESTAURANT/BAR, SELLS FOOD AT MARKET, TRADES FOOD) .... ………………….. 20 OTHER NON-FOOD BUSINESS (MARKET SELLER, OR TRADER) 21 MEDICAL FACILITY/CLINIC/DISPENSARY ... ………………….. 22 OTHER ________________________________ 88 (SPECIFY)			
E3.	Which household member is primarily responsible for the operation of this activity? ENTER PERSON ID OF THE HOUSEHOLD MEMBER.			
E4.	Where is the activity located? HOUSEHOLD PREMISE .... 1 LOCAL MARKET... 2 SHOP SEPARATED FROM HOME.. 3 ROADSIDE AWAY FROM HOME………………………………….. 4 TRAVELING VENDOR .... 5 OTHER (SPECIFY)... 8			
E5.	In what year did your household begin this activity? YEAR			

	DON'T KNOW: 9898			
E6.	In the past 12 months, how many paid employees did this activity have?			
E7.	In the past 12 months, how many unpaid employees (including family members) did this activity have?			
E8.	In the past 12 months, how many months was the activity in operation?			
E9.	On average, how much revenue does this activity bring in per month? DON'T KNOW: 98989898			
E10.	On average, how much revenue does this activity bring in per year? DON'T KNOW: 98989898			
E11.	Is electricity used in the operation of this activity? Yes 1 No 0 → E15	☐	☐	☐
E12.	What is the source of electricity used for this activity? MAIN GRID/NATIONAL GRID .... 1 ISOLATED GRID (TOWN/VILLAGE) .... 2 GENERATOR SET................................. 3 NEIGHBOR .... 4 SOLAR PV SYSTEM .... 5 OTHER (SPECIFY) .... 8 ____________________________	☐	☐	☐
E13.	What is the primary use of electricity by the activity? LIGHTING .... 1 OPERATE MACHINERY/TOOLS .... 2 REFRIGERATE GOODS FOR SALE .... 3 AIR CONDITIONING... 4 PUMPING WATER... 5 ELECTRIC APPLIANCE .... 6 OTHER USE (SPECIFY) .... 8 ____________________________________	☐☐	☐☐	☐☐
E14.	What is the monthly expenditure for electricity for this activity? (TSH) DON'T KNOW: 98989898			
E15.	Does this IGA require the use of any equipment powered by kerosene, battery, LPG or some other fuel? Yes 1 No 0 → F1	☐	☐	☐
E16.	How much do you spend each month on all types of fuel for this IGA (except electricity)? DON'T KNOW: 98989898			
E17.	What is the primary use of the non-electricity fuel by the activity? LIGHTING .... 1 OPERATE MACHINERY/TOOLS .... 2 REFRIGERATE GOODS FOR SALE .... 3 AIR CONDITIONING... 4 PUMPING WATER... 5 ELECTRIC APPLIANCE .... 6 OTHER USE (SPECIFY) .... 8 ____________________________________	☐☐	☐☐	☐☐

F. HOUSEHOLD CONSUMPTION AND EXPENDITURE (FEMALE HEAD ALONE OR MALE HEAD IF NO FEMALE HEAD PRESENT)		
In the PAST 7 DAYS, how much was spent (in TSH) on each of the following items for your entire household:		**TSH**
F1	Food purchased outside the home	
F2	Food consumed by household members but not purchased (own production, gift, etc.)	
F3	Non-alcoholic beverages	
F4	Cigarettes and alcoholic beverages	
In the PAST 30 DAYS, how much was spent (in TSH) on each of the following items for your entire household:		**TSH**
F5	Water	
F6	Electricity	
F7	Satellite dish and cable TV charges	
F8	Light bulbs,	
F9	Kerosene, candles, biomass, charcoal, etc	
F10	Rent, fee, or lease payment for solar PV or generator system	
F11	Personal hygiene (cosmetic, toiletries, soap, toilet paper, toothpaste, razors, etc.) and household cleaning products	
F12	Wages paid to servants	
F13	Transport	
F14	Laundry	
F15	Entertainment (movies, concert, etc.)	
F16	School fee and supply (books, stationery)	
F17	Other(Specify)	
In the PAST 12 MONTHS, how much was spent (in TSH) on each of the following items for your entire household:		**TSH**
F18	Men’s clothing, shoes, and accessories	
F19	Women’s clothing, shoes, and accessories	
F20	Children’s clothing, shoes and accessories	
F21	Household furnishings and supplies	
F22	Purchase and repair of electric appliances and electronics (refrigerator, A/C, iron, fan, computer, etc.)	

F23	Purchase and repair of solar PV or generator system	
F24	Purchase and repair of other energy appliances (lamps, hurricanes, lanterns, stoves, etc.)	
F25	Purchase and repair of agricultural equipments (power tiller, ploughs, tractors, etc.)	
F26	Purchase and repair transports (motor cycles, cars, carts, etc.)	
F27	Medical expense	
F28	Taxes, insurances and legal fees	
F29	Purchase and maintenance of land or other real estate properties	
F30	Purchase, maintenance and expansion of house	
F31	Cost on marriage, bride price, social and religious	
F32	Funeral expenses	
F33	Losses due to theft, robbery, accidents, natural disaster, etc.	
F34	Other major expenses	

G. USE OF TELEPHONES (FEMALE HEAD ALONE OR MALE HEAD IF NO FEMALE HEAD PRESENT)		
G1.	Does your household have a land line phone connection?	YES.................................... 1 NO..................................... 0 → G6
G2.	How much did you pay to get the land line phone connection?	TSH [ ][ ][ ][ ][ ][ ][ ][ ] DON'T KNOW …………………..98989898
G3.	On an average, how many calls are made per week from the land line phone?	NUMBER [ ][ ][ ][ ]
G4.	On an average, what is the total duration of all calls made per week from your land line phone(s)?	DURATION IN MINUTES [ ][ ][ ]
G5.	On an average, how much is your monthly bill for your land line phone?	TSH [ ][ ][ ][ ][ ][ ][ ][ ]
G6.	Does anyone in your household have any mobile phone?	YES............................ 1 NO.............................. 0 → H1
G7.	How many mobile phones does your household have in total?	NUMBER [ ][ ]
G8.	Do you, personally, have a mobile phone most of the time?	YES...1 NO...0
G9.	On an average, how many times per week is each mobile phone in your household recharged?	NUMBER [ ][ ]
G10	Where do you mostly recharge your mobile phone(s)?	AT HOME .... 1 AT NEIGHBOR'S HOME......................... 2 AT RETAIL PLACES .... 3 OTHER SPECIFY................................... 8 ____________________________
G11.	If you pay for recharging, how much do you pay each time?	TSH [ ][ ][ ][ ] DON'T KNOW …………………..9898
G12.	On an average, how many calls are made per week from each mobile phone in your households?	NUMBER [ ][ ] DON'T KNOW …………………..98
G13.	What is the average duration of each call made?	MINUTES [ ][ ][ ]
G14.	On an average, how much does your household spend EACH MONTH for mobile phone time in your household?	TSH [ ][ ][ ][ ][ ] DON'T KNOW …………………..98989

H. TIME USE OF HOUSEHOLD MEMBERS

(FEMALE HEAD ALONE OR MALE HEAD IF NO FEMALE HEAD PRESENT**)**

H0	Please tell us how many hours you spent doing each of the following activities in the past 24 hours. We'll ask about you first, and then about one school-aged child. ENTER PID OF THE CHILD FROM SECTION B IN COLUMN B.	a. Respondent	b. In-school child ages 5 – 14 ☐☐ PID
ENTER NUMBER OF HOURS OR FRACTION FOR LESS THAN ONE HOUR AND "0" FOR NO TIME ON AN ACTIVITY. TOTAL HOURS FOR ALL ACTIVITIES MUST ADD UP TO 24 HOURS OR MORE.			
H1	Wage labor in agricultural	☐☐	
H2	Wage labor in non-agriculture	☐☐	
H3	Farming, kitchen gardening, poultry and livestock raising, animal grazing, fishing, etc.	☐☐	
H4	Food processing	☐☐	
H5	Other income-generating activities such as tending shop, doing handicrafts, etc.	☐☐	
H6	Water collection	☐☐	☐☐
H7	Fuel collection	☐☐	☐☐
H8	Repairing clothes, basket, machineries, equipment, tools, and etc.	☐☐	
H9	Other household chores such as washing clothes, household cleaning, cleaning dishes, pots, pans, etc.	☐☐	☐☐
H10	Cooking/preparing meal	☐☐	
H11	Taking meals	☐☐	☐☐
H12	Bathing and/or personal hygiene/care	☐☐	☐☐
H13	Caring of children (bathing, feeding, dressing, etc.)	☐☐	
H14	Religious practices such as praying, reading Bible, etc.	☐☐	
H15	Time at school	☐☐	☐☐
H16	Reading/studying	☐☐	☐☐
H17	Listening to radio	☐☐	☐☐
H18	Watching TV	☐☐	☐☐
H19	Resting, day nap	☐☐	☐☐
H20	Visiting neighbors, socializing, entertaining guests	☐☐	
H21	Shopping	☐☐	
H22	Other leisure and entertainment activities	☐☐	☐☐
H23	Night time sleep	☐☐	☐☐
H24	Others (SPECIFY)	☐☐	

I. HOUSEHOLD ASSETS AND NON-WAGE INCOME (FEMALE HEAD ALONE OR FEMALE-MALE TOGETHER IF NECESSARY)		
I1.	MAIN MATERIAL OF THE OUTSIDE WALL OF MAIN DWELLING.	GRASS .... 01 POLES AND MUD .... 02 SUNDRIED BRICKS .... 03 BAKED BRICKS .... 04 TIMBER .... 05 IRON SHEETS .... 06 CEMENT BRICKS .... 07 STONES .... 08 OTHER (SPECIFY) 88
I2.	MAIN MATERIAL OF THE FLOOR OF MAIN DWELLING	EARTH/SAND .... 01 DUNG .... 02 WOOD PLANKS .... 03 PALM/BAMBOO .... 04 PARQUET OR POLISHED WOOD .... 05 VINYL OR ASPHALT STRIPS .... 06 CERAMIC TILES .... 07 CEMENT .... 08 OTHER (SPECIFY) 88
I3.	MAIN MATERIAL OF THE ROOF OF MAIN DWELLING	GRASS/LEAVES/BAMBOO .... 01 MUD AND GRASS .... 02 CONCRETE, CEMENT .... 03 METAL SHEETS (GCI) .... 04 ASBESTOS SHEET .... 05 TILES .... 06 WOOD .... 07 THATCH .... 08 OTHER (SPECIFY) 88
I4.	How long has your family been living in this house?	a. YEARS [ ][ ] b. MONTHS [ ][ ]
I5.	What is the tenure of the house that the household is living in?	OWNED .... 1 RENTED .... 2 → I8 EMPLOYER PROVIDED (PART) .... 3 → I8 EMPLOYER PROVIDED (FREE) .... 4 → I9 FREE .... 5 → I9 NOMADS .... 6 → I9 OTHER (SPECIFY) .... 88 → I9
I6.	What is the current market value of this house and/or the land on which it sits?	TSH [ ][ ][ ][ ][ ][ ][ ][ ] DON'T KNOW 98989898
I7.	Who owns the house and land?	MALE HEAD OF HOUSEHOLD .... 1 FEMALE HEAD OF HOUSEHOLD .... 2 BOTH .... 3 OTHER HOUSEHOLD MEMBERS .... 4 OWNERSHIP NOT SPECIFIED .... 5 → I9
I8.	If renting or subsidized, how much do you pay for rent each month?	TSH [ ][ ][ ][ ][ ][ ]
I9.	How many rooms for sleeping are there in the main dwelling?	ROOMS [ ][ ]
I10.	Does any member of your household own land or buildings used for agriculture or pasture?	YES 1 NO 0 → I13

I11.	What is the current market value of any other land or buildings you or other household members own that is used for agriculture or pasture?	TSH ________ DON'T KNOW …………………..98989898
I12.	Who owns this land?	MALE HEAD OF HOUSEHOLD ………………1 FEMALE HEAD OF HOUSEHOLD………………2 BOTH………………………………………….3 OTHER HOUSEHOLD MEMBERS……………..4 OWNERSHIP NOT SPECIFIED…………………5
I13.	Does any member of your household own land or buildings used for any other purpose, such as business or renting?	YES 1 NO 0 → I16
I14.	What is the current market value of any land or buildings you or other household members own that is used for any other purpose, such as business or renting?	TSH ________ DON'T KNOW …………………..98989898
I15.	Who owns this land?	MALE HEAD OF HOUSEHOLD…………….. 1 FEMALE HEAD OF HOUSEHOLD……………. 2 BOTH……………………………………………. 3 OTHER HOUSEHOLD MEMBERS…………….. 4 OWNERSHIP NOT SPECIFIED …………… 5
I16.	What is the source of household's drinking water in rainy season?	PIPED WATER INSIDE DWELLING…………………………. 01 OUTSIDE DWELLING (PRIVATE)………….. 02 OUTSIDE DWELLING (PUBLIC)……………. 03 NEIGHBOUR'S TAP………………………. 04 WELL/BOREHOLE (WITH PUMP)……………. 05 WELL/BOREHOLE (WITHOUT PUMP)……… 06 WATER VENDOR…………………………….. 07 KIOSK…………………………………………. 08 WATER TRUCK/TANKER SERVICE……….. 09 RIVER/LAKE/SPRING/POND……………….. 10 RAIN WATER……………………………….. 11 OTHER (SPECIFY)…………………………. 88
I17	What is the source of household's drinking water in dry season?	PIPED WATER INSIDE DWELLING…………………………. 01 OUTSIDE DWELLING (PRIVATE)………….. 02 OUTSIDE DWELLING (PUBLIC)……………. 03 NEIGHBOUR'S TAP………………………. 04 WELL/BOREHOLE (WITH PUMP)……………. 05 WELL/BOREHOLE (WITHOUT PUMP)……… 06 WATER VENDOR…………………………….. 07 KIOSK…………………………………………. 08 WATER TRUCK/TANKER SERVICE……….. 09 RIVER/LAKE/SPRING/POND……………….. 10 RAIN WATER……………………………….. 11 OTHER (SPECIFY)…………………………. 88
I18.	What kind of toilet facility does the household have?	FLUSH TOILET .... 1 PIT TOILET/LATRINE TRADITIONAL PIT TOILET .... 2 VENTILATED IMPROVED PIT (VIP) LATRINE .... 3 NO FACILITY/BUSH/FIELD .... 4 OTHER (SPECIFY) 8

I19.	Please tell me about any non-wage income that you, personally, have earned in the past 12 months?. a. Any income from the sale of crops or other agriculture products? b. Any income from land or rooms rented out? Equipment rented out? c. Any income from remittances from friends or relatives? d. Any income from pensions or investments? e. Any other income you have not mentioned yet?	TSHS [ ][ ][ ][ ][ ][ ][ ][ ] TSHS [ ][ ][ ][ ][ ][ ][ ][ ] TSHS [ ][ ][ ][ ][ ][ ][ ][ ] TSHS [ ][ ][ ][ ][ ][ ][ ][ ] TSHS [ ][ ][ ][ ][ ][ ][ ][ ]
I20.	Please tell me about any non-wage income that other members of the household, or the household as a whole, have earned in the past 12 months? a. Any income from the sale of crops or other agriculture products? b. Any income from land or rooms rented out? Equipment rented out? c. Any income from remittances from friends or relatives? d. Any income from pensions or investments? a. Any other income you have not mentioned yet?	TSHS [ ][ ][ ][ ][ ][ ][ ][ ] TSHS [ ][ ][ ][ ][ ][ ][ ][ ] TSHS [ ][ ][ ][ ][ ][ ][ ][ ] TSHS [ ][ ][ ][ ][ ][ ][ ][ ] TSHS [ ][ ][ ][ ][ ][ ][ ][ ]
I21.	What is the total market value of all livestock and poultry owned by members of this household?	TSH [ ][ ][ ][ ][ ][ ][ ][ ] DON'T KNOW ………………….. 98989898
I22.	What is the current value of the savings, deposits, and investments by members of this household?	TSH [ ][ ][ ][ ][ ][ ][ ][ ] DON'T KNOW ………………….. 98989898
I23.	What is the current value of any valuables and cash held by members of this household?	TSH [ ][ ][ ][ ][ ][ ][ ][ ] DON'T KNOW ………………….. 98989898
I24.	What is the current value of any debts, including loans from banks or other individuals, credit cards or store credit, housing loans or mortgages, held by members of this household?	TSH [ ][ ][ ][ ][ ][ ][ ][ ] DON'T KNOW ………………….. 98989898

J. WAGE INCOME (FEMALE HEAD ALONE OR FEMALE-MALE TOGETHER IF NECESSARY)						
J1.	**J2.**	**J3**	**J4**	**J5**	**J6**	**J7**
TRANSFER PERSON ID AND NAMES OF ALL HOUSEHOLD MEMBERS AGED 15 YEARS AND OLDER FROM THE HOUSEHOLD ROSTER.		Did [NAME] work for wages or salary during last 12 months? YES .... 1 NO...... 0 → GO TO NEXT ROW	What was the time unit of [NAME]'s payment? HOURLY ..... 01 DAILY.......... 02 WEEKLY ..... 03 BI-WEEKLY. 04 MONTHLY... 05 ANNUALLY . 06 OTHER........ 88 (SPECIFY) DON'T KNOW..98	How many [UNITS] did [NAME] work during the last 12 months? UNITS DON'T KNOW…98	How much was [NAME]'S payment for each [UNIT]? TSH DON'T KNOW…. 98989898	Which sector does your payment mostly come from? FARM ……….1 NON-FARM..2
LINE NUMBER (PID)	NAMES					

K. HOUSEHOLD'S ENERGY USE

(FEMALE HEAD ALONE OR FEMALE-MALE TOGETHER IF NECESSARY**)**

	K1	K2	K3	K4	K5	K6	K7
	Does your household use any [SOURCE] as a source of fuel for household purposes? YES……..1 NO…….. 0 IF NO, SKIP TO NEXT ROW.	Does your household purchase [SOURCE]? YES … 1 NO …. 0	In what unit do you usually purchase/collect [SOURCE]? BUNCH .... 01 BUNDLE...... 02 HEAP........... 03 LOG............. 04 PIECE.......... 05 SAC............. 06 LITRE …….. 07 KILO ……… 08 AA ………… 09 AAA ……… 10 'D' ………… 11 OTHER........ 88 (SPECIFY)	What is the average weight/volume of each unit in kilograms/liters?	On average, how many [UNITS] of [SOURCE] does your household purchase each month?	What is the cost or current market value of one [UNIT] of [SOURCE]? TSH	Aside from the SOURCE that you purchase, how many UNITS do you collect or produce yourself each month?
a. Fuel wood	☐	☐	☐☐	KG			
b. Crop residue	☐	☐	☐☐	KG			
c. Straw/leaves	☐	☐	☐☐	KG			
d. Animal waste/dung	☐	☐	☐☐	KG			
e. Charcoal	☐	☐	☐☐	KG			
f. Candles	☐	☐	☐☐				
g. Kerosene	☐	☐	☐☐	LT			
h. Diesel/Gasoline	☐	☐	☐☐	LT			
i. LPG	☐	☐	☐☐	KG			
j. Dry Cell Batteries	☐	☐	☐☐				
k. Other (Specify)	☐	☐	☐☐				

K8	Does the household use motorcycle or car batteries to provide power for household appliances or other household use?	YES............................1 NO..............................0 → L1
K9	How many motorcycle or car batteries are in use in this household for household use?	NUMBER ☐☐
K10	What is the average current market value of each battery?	TSH ☐☐☐☐☐☐ DON'T KNOW …………………… 989898
K11	How much does your household pay to re-charge one of these batteries?	THS ☐☐☐☐
K12	How many times per month does your household re-charge any motorcycle or car battery (give the total number of re-charges for all batteries used for household purposes)?	NUMBER ☐☐
K13	How many hours per day, on average, does your household use a car or motorcycle battery for any household purpose?	HOURS ☐☐

L. USE OF ELECTRICITY **(**FEMALE HEAD ALONE OR FEMALE-MALE TOGETHER IF NECESSARY**)**		
L1	Have you spoken with any Ward Development Assistant (WDA), Community Development Officials (CDO), or Gender Focal Points (GFP) about a program to inform women and men about the benefits of electricity and/or associated with the MCA-T financed Energy Sector Project?	YES ....1 NO 0
L2	Does the household use electricity from any source (other than batteries)?	YES ....1 NO ....0 → M
L3	What is the source of your electricity connection?	MAIN/NATIONAL GRID .... 1 ISOLATED GRID (TOWN/VILLAGE) .. 2 GENERATOR SET............................ 3 NEIGHBOR .... 4 SOLAR PV SYSTEM.......................... 5 OTHER (SPECIFY) 8
L4	What are the major drawbacks of getting electricity from the national grid? CIRCLE ALL MENTIONED	HIGH CONNECTION COST………………..….01 HIGH WIRING COST ……………………….02 HIGH MONTHLY CHARGE ………………..03 HAVE TO PAY BRIBE……………………….04 TOO MUCH PAPERWORK…………………05 UNRELIABLE SERVICE (POWER OUTAGE, VOLTAGE FLUCTUATION, ETC.)………..06 NO NATIONAL GRID …………………… 07 DIFFICULTY IN FILLING FORMS …….. 08 OTHER (SPECIFY)_________________ 88
L5	In what month and year was the electrical connection first made to your home?	☐☐ ☐☐☐☐ a. MONTH b. YEAR DON'T KNOW …………………… 989898

L6	How much did your household pay for the connection fee plus wiring (if any)?	TSH ☐☐☐☐☐☐☐☐ DON'T KNOW …………………… 98989898
L7	On average, how much does your household pay per month for electricity?	TSH ☐☐☐☐☐
L8	What is the household's primary use of electricity?	LIGHTING .... 1 FAN .... 2 AIR CONDITIONING............................... 3 HEATING SPACE .... 4 HEATING WATER .... 5 PUMPING WATER................................. 6 ELECTRONIC/ELECTRICAL APPLIANCE.7 OTHER (SPECIFY) 8
L9	What is the household's secondary use of electricity?	LIGHTING .... 1 FAN .... 2 AIR CONDITIONING............................... 3 HEATING SPACE .... 4 HEATING WATER .... 5 PUMPING WATER................................. 6 ELECTRONIC/ELECTRICAL APPLIANCE..7 OTHER (SPECIFY) .... 8 ________________________________

M. HOUSEHOLD RECONTACT INFORMATION **(**FEMALE HEAD ALONE OR FEMALE-MALE TOGETHER IF NECESSARY**)**		
Thank you very much, we are almost finished! We would like to come back and interview you again in about two years. In order to make sure we can get in touch with you at that time, we would like to get some contact information for the members of this household. This information will not be connected with the information you have just provided to me, and it will not be shared with anyone outside the research team, or be used for any purpose other than this study.		
M1. Household's Physical Address:		
HOUSEHOLD HEAD	M2a. NAME:	M2b. PHONE:
REFERENCE PERSON WITHIN THE COMMUNITY	M3 Name:	M4 Occupation:
	M5. Location:	M6. Phone:

N. CONCLUSION
That was my last question for you. Before we conclude, do you have any questions for me? ☞ ANSWER QUESTIONS AS COMPLETELY AS POSSIBLE.
N1. ENTER INTERVIEW END TIME: ☐☐ **:** ☐☐ HH **:** MM

O. MALE HEAD OF HOUSEHOLD/SPOUSE	
O1.	INTERVIEWER: REVIEW HOUSEHOLD ROSTER. IS THERE A MALE SPOUSE OR MALE HEAD OF HOUSEHOLD LIVING IN THIS HOUSEHOLD? ☐ **1** *YES* ⟶ PROCEED TO INTERVIEW MALE HOUSEHOLD HEAD/SPOUSE 0 *NO* ⟶ END VISIT.
MALE/SPOUSE INTERVIEW INFORMATION	
O2.	INTERVIEWER ID: ☐☐
O3.	DATE OF VISIT (DD/MM/YYYY): ___ ___ / ___ ___/ ___ ___ ___ ___
O4.	RESULT CODE: 1 INTERVIEW COMPLETED 2 RESPONDENT UNAVAILABLE, VISIT RESCHEDULED ☐ 3 INTERVIEW INCOMPLETE 4 REFUSED 5 RESPONDENT NOT AVAILABLE

INTRODUCTION

Hello, My name is __________________. I am a representative of the National Rural Electrical Cooperative Association. We are conducting a survey on behalf of the Millennium Challenge Account -- Tanzania. This survey is part of a study aimed to gain understanding of the current situation of electrification in Tanzania. We would like to ask you the following questions. Your cooperation is greatly appreciated.

☞ *IF THE VILLAGE/MTAA IS A INTERVENTION AREA, READ:*

TANESCO will be constructing electricity lines in this community within the coming year. As part of this study, we would like to interview selected households to collect information about the household activity in this community who will be affected by the electricity project..

☞ *IF THE VILLAGE/MTAA IS A COMPARISON AREA, READ:*

As part of this study, we would like to interview selected households to collect information about household activities in this community. The purpose of this interview is to study how access to grid electricity improves household welfare such as income, asset, schooling and so on.

☞ *READ TO ALL RESPONDENTS:*

If you agree to participate in the survey, all the answers that you provide will be kept private – only members of the survey team will have access to this information. You would be free to choose not to answer any question that you would prefer not to answer. You can stop the interview at any time, ask me to clarify any question, or ask me to repeat something if you don't understand. You may also choose to withdraw from the study at any time.

Do you have any questions for me now?

☞ *ANSWER QUESTIONS AS COMPLETELY AS POSSIBLE AND PROCEED.*

O5.	Can we begin now? ☐ 1 *YES* ⟶ Very good. ⟶ *START INTERVIEW.* 0 *NO* Thank you for your time. *DETERMINE IF ANOTHER TIME WOULD WORK. RECORD RESULT CODE AND APPOINTMENT ON COVERSHEET.*
O6.	FILL IN TIME WHEN YOU START THE INTERVIEW: ☐☐ : ☐☐

O7.	What is your full name? CONFIRM RESPONDENT'S NAME ON HOUSEHOLD ROSTER AND ENTER HIS PERSON ID HERE	PID ☐☐

P. WAGE INCOME – MALE/SPOUSE		
I would like to ask you some questions about your income from employment and other sources. This information is for the purposes of research and will not be shared with anyone.		
P1.	Did you work for wages or salary during last 12 months?	YES ....1 NO ....0 → Q1
P2.	What was the time unit of your payment?	HOURLY.. 1 DAILY .... 2 WEEKLY.. 3 BI-WEEKLY .... 4 MONTHLY .... 5 ANNUALLY.. 6 OTHER SPECIFY................................... 8
P3.	How many [UNITS] did you work during the last 12 months?	☐☐
P4.	How much was your payment for each [UNIT]?	TSH ☐☐☐☐☐☐☐
P5.	Which sector does your payment mostly come from?	FARM …………………..1 NON-FARM…………. 2

Q. TIME USE – MALE/SPOUSE		
Please tell us how many hours you spent doing each of the following activities in the past 24 hours. ENTER NUMBER OF HOURS OR FRACTION FOR LESS THAN ONE HOUR AND "0" FOR NO TIME ON AN ACTIVITY. TOTAL HOURS FOR ALL ACTIVITIES MUST ADD UP TO 24 HOURS OR MORE.		
Q1.	Wage labor in agriculture	
Q2.	Wage labor in non-agriculture	
Q3.	Farming, kitchen gardening, poultry and livestock raising, animal grazing, fishing, etc.	
Q4.	Food processing	
Q5.	Other income-generating activities such as tending shop, doing handicrafts, etc.	
Q6.	Water collection	
Q7.	Fuel collection	
Q8.	Repairing clothes, basket, machineries, equipment, tools, and etc.	
Q9.	Other household chores such as washing clothes, household cleaning, cleaning dishes, pots, pans, etc.	
Q10.	Cooking/preparing meal	
Q11.	Taking meals	
Q12.	Bathing and/or personal hygiene/care	
Q13.	Caring of children (bathing, feeding, dressing, etc.)	
Q14.	Religious practices such as praying, reading Bible, etc.	
Q15.	In school	
Q16.	Reading/studying	
Q17.	Listening to radio	
Q18.	Watching TV	
Q19.	Resting, day nap	
Q20.	Visiting neighbors, socializing, entertaining guests	
Q21.	Shopping	
Q22.	Other leisure and entertainment activities	
Q23.	Night time sleep	
Q24.	Others (SPECIFY)	

R. BUSINESSES/INCOME GENERATING ACTIVITIES (IGA) -- MALE/SPOUSE				
Now, we would like to ask about any income generating activities that you own or operate. Income generating activities include activities OTHER THAN WAGE EMPLOYMENT that you own. Income generating activities would include farming, if the crops are sold for income, running a shop or vending cart, driving a taxi, or providing any other product or service that earns income. If you operate more than 3 income generating activities, please tell us about the 3 most important activities.				
R1.	Do you operate any income generating activities – other than the wage labor you have already described -- such as small scale businesses, agricultural or non agricultural activities (IGA)? YES ..... 1 NO.......0 → S	a. IGA #1 ☐	b. IGA #2 ☐	c. IGA #3 ☐
R2.	What type of activity do you operate? FARMING…………………………………………………………… 01 SMALL GROCERY SHOP (DUKA) ………………………………………02 BAKER ………………………… 03 BUTCHER ……………………….. 04 FLOUR MILL (CORN, WHEAT, SORGHUM, MILLET ETC.) 05 COOKING OIL PRODUCTION…………………….. 06 TAILORING/CLOTHING REPAIR …………………… 07 CLOTHING PRODUCTION……………………….. 08 SHOE REPAIR/MANUFACTURE…………………….. 09 OTHER LEATHER PRODUCTION AND PROCESSING ………. 10 SAWMILL ……………………….. 11 CARPENTRY/WOOD PRODUCTS/FURNITURE MAKING…….. 12 BLACKSMITH/WELDING/USED METAL PRODUCTION………. 13 CELL PHONE DEALER/REPAIR/CHARGING………………….. 14 OTHER ELECTRIC/ELECTRONIC REPAIR……………………. 15 TRANSPORT/AUTOMOBILE REPAIR……………………….. 16 POTTERY ………………………….. 17 BAMBOO/CANE WORKS ……………………….. 18 AGRICULTURE EQUIPMENT MAKING/REPAIR……………….. 19 OTHER FOOD BUSINESS (RESTAURANT/BAR, SELLS FOOD AT MARKET, TRADES FOOD)…………………….. 20 OTHER NON-FOOD BUSINESS (MARKET SELLER, OR TRADER) 21 MEDICAL FACILITY/CLINIC/DISPENSARY ……………………. 22 OTHER ________________________________ 88	☐☐	☐☐	☐☐
R3.	Where is the activity located? HOUSEHOLD PREMISE.. 1 LOCAL MARKET .... 2 SHOP SEPARATED FROM HOME .... 3 ROADSIDE AWAY FROM HOME/TRAVELING VENDOR.......... 4 OTHER (SPECIFY) .... 8 ________________________________	☐	☐	☐

R4.	In what year did you begin this activity? YEAR			
R5.	In the past 12 months, how many paid employees did this activity have?			
R6.	In the past 12 months, how many unpaid employees (including family members) did this activity have?			
R7.	In the past 12 months, how many months was the activity in operation?			
R8.	On average, how much revenue does this activity bring in per month?			
R9.	On average, how much revenue does this activity bring in per year?			
R10.	Is electricity used in the operation of this activity? Yes 1 No 0 → GO TO R14	☐	☐	☐
R11.	What is the source of electricity used for this activity? MAIN GRID/NATIONAL GRID.................. 1 ISOLATED GRID (TOWN/VILLAGE) .... 2 GENERATOR SET .... 3 NEIGHBOR... 4 SOLAR PV SYSTEM .... 5 OTHER (SPECIFY) 8	☐	☐	☐
R12.	What is the primary use of electricity by the activity? LIGHTING .... 1 OPERATE MACHINERY/TOOLS .... 2 REFRIGERATE GOODS FOR SALE .... 3 AIR CONDITIONING .... 4 PUMPING WATER .... 5 ELECTRIC APPLIANCE .... 6 OTHER USE (SPECIFY) 8	☐☐	☐☐	☐☐
R13.	What is the monthly expenditure for electricity for this activity? (TSH)			
R14.	Does this IGA require the use of any equipment powered by kerosene, battery, LPG or some other fuel? YES ………. 1 NO ……… 0 → S1	☐	☐	☐
R15.	How much do you spend each month on all types of fuel (except electricity) for this IGA?			
R16.	What is the primary use of the non-electricity fuel by the activity? LIGHTING .... 1 OPERATE MACHINERY/TOOLS .... 2 REFRIGERATE GOODS FOR SALE .... 3 AIR CONDITIONING .... 4 PUMPING WATER .... 5 ELECTRIC APPLIANCE .... 6 OTHER USE (SPECIFY) 8	☐☐	☐☐	☐☐

S. CONCLUSION
That was my last question for you. Before we conclude, do you have any questions for me? ☞ ANSWER QUESTIONS AS COMPLETELY AS POSSIBLE. Thank you so much for your help. We look forward to seeing you again in two years. Your answers are very helpful to us.
S1. ENTER INTERVIEW END TIME: __ __ : __ __ HH : MM

FOR FIELD SUPERVISOR	
Supervisor Name:	Supervisor Number:
Date Completed Questionnaire Checked and Approved by Supervisor:	*DD / MM / YYYY*

FOR DATA ENTRY SUPERVISOR	
Data Entry Supervisor Name:	Data Entry Supervisor Number:
Completed Questionnaire checked and approved by office:	*DD / MM / YYYY*
Name of Data Entry Clerk for First Data Entry:	
Date of First Data Entry:	*DD / MM / YYYY*
Name of Data Entry Clerk for Second Data Entry:	
Date of Second Data Entry:	*DD / MM / YYYY*

APPENDIX F

BASELINE QUESTIONNAIRE FOR THE ENTERPRISE SURVEY

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FORM NUMBER: ☐☐ **MPRVID:** ☐☐☐☐

MILLENNIUM CHALLENGE ACCOUNT –TANZANIA (MCA-T)

CONFIDENTIAL **ENTERPRISE SURVEY QUESTIONNAIRE**

VILLAGE/MTAA LOCATION	
REGION NAME:	REGION CODE ☐☐
DISTRICT NAME:	DISTRICT CODE: ☐
WARD NAME:	WARD CODE: ☐☐☐
VILLAGE/MTAA NAME:	VILLAGE/MTAA CODE: ☐☐☐

ENTERPRISE LOCATION						
ENTERPRISE NAME:						
GPSCOORDINATES OF ENTERPRISE S: ☐☐ ☐☐ ☐☐☐ D D° M M S S S' E: ☐☐☐ ☐☐ ☐☐☐ D D D° M M. S S S'	NAME THE LOCATION WHERE GPS COORDINATES WERE TAKEN:					
COMPLETE ENTERPRISE ID:	ENTERPRISE SERIAL NO.		BUILDING NO.		ENTERPRISE NO. FROM THE LIST	
ENTERPRISE ADDRESS:	NO.	STREET:		BLOCK/NEIGHBORHOOD:		
IMPORTANT LANDMARK NEAREST TO THE ENTERPRISE						
NAME OF OWNER/MANAGER:						
PHONE NUMBERS:	LAND PHONE:			MOBILE PHONE:		

INTERVIEWER VISITS	
FIRST VISIT	
INTERVIEWER NAME:	INTERVIEWER ID:
DATE OF VISIT (DD/MM/YYYY) ___ ___ / ___ ___/ ___ ___ ___ ___	RESULT CODE:
SECOND VISIT	
INTERVIEWER NAME:	INTERVIEWER ID:
DATE OF VISIT (DD/MM/YYYY) ___ ___ / ___ ___/ ___ ___ ___ ___	RESULT CODE:
THIRD VISIT	
INTERVIEWER NAME:	INTERVIEWER ID:
DATE OF VISIT (DD/MM/YYYY) ___ ___ / ___ ___/ ___ ___ ___ ___	RESULT CODE:

RESULT CODE: ___ ___

1 INTERVIEW COMPLETED
2 VISIT RESCHEDULED
3 INTERVIEW INCOMPLETE
4 REFUSED
5 NOT AN ENTERPRISE, PRIVATE HOUSEHOLD OR INELIGIBLE ACTIVITY
6 ENTERPRISE CLOSED
7 COULD NOT LOCATE/WRONG ADDRESS
8 MOVED AWAY AND COULD NOT GET THE NEW LOCATION
88 OTHER (SPECIFY) ________________________________

A. INTRODUCTION

Hello, My name is __________________. I am a representative of the National Rural Electric Cooperative Association, working with the Millennium Challenge Account -- Tanzania (MCA-T). This survey is part of a study aimed to gain understanding of the current situation of electrification in Tanzania. We would like to ask you the following questions. Your cooperation is greatly appreciated.

☞ ***IF THE VILLAGE/MTAA IS A INTERVENTION AREA, READ:***

TANESCO will be constructing electricity lines in this community within the coming year. This enterprise was selected randomly from a list of enterprises in this community that will be affected by the electricity project. As part of this study, we would like to interview selected enterprises to collect information about their activities to assess how electricity impacts enterprises.

☞ ***IF THE VILLAGE/MTAA IS A COMPARISON AREA, READ:***

This enterprise is selected randomly from a list of enterprises in this community for a study to assess how electricity affects enterprises. As part of this study, we would like to interview selected enterprises to collect information about their activities.

☞ ***READ FOR ALL RESPONDENTS:***

If you agree to participate in the survey, all the answers that you provide will be kept private – only members of the research team will have access to this information. You would be free to choose not to answer any question that you would prefer not to answer. You can stop the interview at any time, ask me to clarify any question, or ask me to repeat something if you don't understand. You may also choose to withdraw from the study at any time.

Do you have any questions for me now?

☞ ***ANSWER QUESTIONS AS COMPLETELY AS POSSIBLE AND PROCEED.***

A1.	**Can we begin now?** 1 *YES* ⟶ **Very good.** ⟶ *START INTERVIEW.* 0 *NO* ⟶ **Thank you for your time.** ***Determine if another time would work. Record result code and appointment on cover sheet.*** FILL IN TIME WHEN YOU START THE INTERVIEW ☐ HOUR ☐☐ MINUTES

B. BASIC CHARACTERISTICS OF THE ENTERPRISE

B1.	MARK THE LOCATION OF THE ENTERPRISE.	VILLAGE/MTAA MARKET .... 1 REGIONAL MARKET........................... 2 ROADSIDE NEAR HOME..................... 3 ROADSIDE AWAY FROM HOME......... 4 OTHER FIXED PLACE 5
B2.	Are you the owner or manager of this enterprise? If not, what is your position? IF THE RESPONDENT IS NEITHER AN OWNER OR MANAGER, OR OTHER INDIVIDUAL WITH AUTHORITY, ASK TO SPEAK WITH AN OWNER OR MANAGER, AND BEGIN AGAIN AT B1.	OWNER .... 1 MANAGER.. 2 OTHER ________________________ 8 (SPECIFY)
B3.	Please tell me your full name.	
B4.	SEX OF THE RESPONDENT.	MALE .... 1 FEMALE.. 2
B5.	Is the enterprise registered with local or national government?	YES... 1 NO... 0
B6.	Is this a private for-profit establishment?	YES... 1 NO... 0
B7.	Is this a shareholding company?	YES... 1 NO... 0
B8.	Is this enterprise owned by a single individual, or owned in partnership by multiple owners?	SOLE PROPRIETOR........................... 1 PARTNERSHIP.................................. 2 → B10
B9.	IF THE RESPONDENT IS NOT THE OWNER ASK: Is the owner of this enterprise male or female? IF THE RESPONDENT IS THE OWNER, GO TO B11.	MALE .... 1 FEMALE.. 2 → B11
B10.	Are the owners of this enterprise all male, all female, or both male and female?	ALL MALE... 1 ALL FEMALE .... 2 MALE AND FEMALE 3
B11.	Does the (largest) owner manage the enterprise day-to-day, or is there a hired manager?	OWNER MANAGES .... 1 → B13 HIRED MANAGER............................... 2
B12.	Is the manager male or female?	MALE .... 1 FEMALE.. 2

The next few questions are meant to collect information about the owner of the enterprise, if there is only one owner, or about the "largest" owner, in the case of a partnership. The "largest" owner is the person who owns the largest share of the enterprise, or who has the final say in decisions related to the enterprise. The "largest" owner might also be the person who receives the largest share of the profits.

B13.	What is the age of the (largest) enterprise owner?	YEARS [ ][ ]
B14.	What is the highest level of education completed by the (largest) owner?	NO EDUCATION .... 0 PRE-PRIMARY .... 1 PRIMARY .... 2 SECONDARY .... 3 POST-SECONDARY 4
B15.	In what year was the enterprise established?	[ ][ ][ ][ ]

		YEAR
B16.	What is the main activity of the enterprise?	FARMING…………………………………………01 SMALL GROCERY SHOP (DUKA) ……….. 02 BAKER…………………………………………...03 BUTCHER……………………………………….04 FLOUR MILL (CORN, WHEAT, SORGHUM, MILLET ETC.) ………………………………… 05 COOKING OIL PRODUCTION………………. 06 TAILORING/CLOTHING REPAIR……………. 07 CLOTHING PRODUCTION………………….. 08 SHOE REPAIR/MANUFACTURE… ……… 09 OTHER LEATHER PRODUCTION AND PROCESSING … …………………………….. 10 SAWMILL……………………………………….. 11 CARPENTRY/WOOD PRODUCTS/ FURNITURE MAKING………………………… 12 BLACKSMITH/WELDING/USED METAL PRODUCTION…………………………… 13 CELL PHONE DEALER/REPAIR/CHARGING 14 OTHER ELECTRIC/ELECTRONIC REPAIR…..15 TRANSPORT/AUTOMOBILE REPAIR ………..16 POTTERY…………………………………………17 BAMBOO/CANE WORKS ……………………….18 AGRICULTURE EQUIPMENT MAKING/REPAIR .... 19 HER FOOD ENTERPRISE (RESTAURANT/BAR, SELLS FOOD AT MARKET, TRADES FOOD). .... 2 0 OTHER NON-FOOD ENTERPRISE (MARKET SELLER, OR TRADER)……………..21 MEDICAL FACILITY/ CLINIC/ DISPENSARY….22 OTHER ______________________________ 88 (SPECIFY)
B17.	Have you ever received any kind of education or formal training in [ENTERPRISE ACTIVITY]?	YES .... 1 NO 0

C. OPERATION, NET ASSET AND CAPITAL INVESTMENT OF THE ENTERPRISE		
C1.	On average, how many months does the enterprise operate per year?	MONTHS
C2.	On average, how many days per month does the enterprise operate during those months?	DAYS
C3.	What are the usual hours of operation for the enterprise? ENTER TIMES IN 24 HOUR FORMAT.	a. FROM b. TO
C4.	How many acres/sq. meters of land are used for this enterprise? IF UNDER ONE ACRE, FILL IN FRACTION	ACRES ………. 1 ______________ SQ. METERS… 2 ______________ .
C5.	What is the ownership status of the land?	OWNED .... 1 RENTED .... 2 ON LEASE .... 3 OTHER (SPECIFY) ... 8 → C7 ____________________
C6.	What is the current market value of the land?	TSH
C7.	What is the ownership status of the physical structures?	OWNED…………………1 RENTED…………………2 ON LEASE………………3 OTHER (SPECIFY)……..8 → C9 ________________________
C8.	What is the current market value of the physical structure?	TSH
C9.	What is the current market value of all inventories (for example products that you are planning to sell later)?	TSH
C10.	What is the current market value of any other assets that you do not sell (for example machinery, cars, trucks, computers, etc.)?	TSH
C11.	What is the current total value of all debts owed on the enterprise (including loans from the bank, merchandise received on credit, etc.)	TSH

D. SOURCES OF FINANCE FOR THE ENTERPRISE			
	How much of the investment for this enterprise came from the following sources? READ EACH ITEM AND MARK THE RESPONSE FOR BOTH COLUMNS.	a. Since the enterprise was established	b. In the last year
D1.	Own resources	TSH	TSH
D2.	Loans from commercial banks and other formal sources	TSH	TSH
D3.	Loans from NGOs/microcredit organizations	TSH	TSH
D4.	Loans from friends, relatives and neighbors	TSH	TSH
D5.	Loans from informal money lenders	TSH	TSH
D6.	Other sources (SPECIFY) ____________________________	TSH	TSH

E. NON-ENERGY INPUTS AND ENTERPRISE REVENUE			
How much did you spend last month for…			
E1.	Raw material	(TSH/month)	TSH
E2.	Rent of land/physical structure/machinery	(TSH/month)	TSH
E3.	Transportation	(TSH/month)	TSH
E4.	Hired labor	(TSH/month)	TSH
E5.	Goods for resale	(TSH/month)	TSH
E6.	Marketing	(TSH/month)	TSH
E7.	Tax /VAT	(TSH/month)	TSH
E8.	Insurance	(TSH/month)	TSH
E9.	Payment of loans and interest	(TSH/ month)	TSH
E10.	Repair and maintenance of facilities and equipments	(TSH/month)	TSH
E11.	Other (SPECIFY)________________________	(TSH/month)	TSH
Now I would like to ask about revenues:			
E12.	Last month's revenue from sale		TSH
E13.	Revenue from sale in 2010		TSH

F. USE OF HIRED LABOR IN THE ENTERPRISE			
	F1.	F2.	F3.
	Please tell me how many paid workers and unpaid workers work in this enterprise? (Please include any temporary workers and family members that have worked in the enterprise any time in the past year.)	How many of these workers are permanent employees?	What is the average wage paid to employees per month?
Paid workers			
a. Male			TSH
b. Female			TSH
Unpaid workers			
c. Male			
d. Female			

F4	Have you laid-off any workers in the last month?	YES ………………… 1 NO ………………… 2 → G1
F5	Why?	PROBLEMS WITH ELECTRICITY FROM NATIONAL GRID …………………….. 1 LACK OF CUSTOMERS FOR PRODUCT…. 2 OTHER ______________________ 8 (SPECIFY)

G. ENTERPRISE'S ENERGY USE (NON-ELECTRICITY)

	G1.	G2.	G3.	G4.	G5.	G6.	G7.
	Does your enterprise use any [SOURCE] as a source of fuel for the enterprise purposes? YES........... 1 NO............. 0 IF NO, SKIP TO NEXT ROW.	Does your enterprise purchase/collect any [SOURCE? YES .... 1 NO………. 0	In what unit do you usually purchase/collect [SOURCE]? BUNCH ..... 1 BUNDLE.... 2 HEAP......... 3 LOG........... 4 PIECE........ 5 SAC .... 6 KG………… 7 LITER…….. 8 AA………… 9 AAA……….. 10 D CELL……. 11 OTHER...... 88 (SPECIFY)	What is the average weight/volume of each unit in kilograms/ litres?	How many [UNITS] of [SOURCE] did your enterprise purchased last month?	What is the cost or current market value of one [UNIT] of [SOURCE]? TSH	Aside from the [SOURCE] that you purchase, how many UNITS did you collect or produce yourself last month?
a. Fuel wood				KG			
b. Crop residue				KG			
c. Straw/Leaves				KG			
d. Animal waste/ dung				KG			
e. Charcoal				KG			
f. Candles							
g. Kerosene				LT			
h. Diesel/gasoline				LT			
i. LPG				KG			
j. Dry Cell Batteries							
k. Other (Specify)							

G. ENTERPRISE'S ENERGY USE (NON-ELECTRICITY) (continued)		
G9.	Does the enterprise use motorcycle or car batteries to provide power for appliances or other enterprise use?	YES……………………………..1 NO………………………………0 → H1
G10.	How many motorcycle or car batteries are used by the enterprise?	NUMBER ☐☐
G11.	How much does the enterprise pay to re-charge one of these batteries?	TSH ☐☐☐☐☐☐☐☐
G12.	How many times did the enterprise re-charge any motorcycle or car battery last month (give the total number of re-charges for all batteries used for business purposes)?	TIMES ☐☐
G13.	How many hours per day, on average, did the enterprise use a car or motorcycle battery for any business purpose last month?	HOURS ☐☐

H. ENTERPRISE'S USE OF ELECTRICITY		
H1.	Does the enterprise use electricity from any source (except batteries?	YES.. 1 NO .... 0 → J1
H2.	What is the source of your electricity connection? MARK ALL THAT APPLY	MAIN/NATIONAL GRID……………………..1 ISOLATED GRID (TOWN/VILLAGE)………2 GENERATOR SET…………………………..3 NEIGHBOR……………………………………4 PICO HYDRO…………………………………5 SOLAR PV SYSTEM…………………………6 OTHER ______________________8 (SPECIFY) 2–8 → I1
H3.	In what month and year was the electrical connection first made to the enterprise?	☐☐ MONTH ☐☐☐☐ YEAR
H4.	What were the reasons for connecting to grid electricity? CIRCLE THREE REASONS	BETTER LIGHTING .... 1 IMPROVED PRODUCTIVITY/EFFICIENCY .... 2 ENHANCED INCOME.. 3 MORE COST EFFECTIVE................................... 4 ELECTRICITY IS CHEAPER THAN ALTERNATE FUELS... 5 OTHER (SPECIFY)... 8 ______________________
H5.	How much did the enterprise pay for the connection fee?	TSH ☐☐☐☐☐☐☐☐
H6.	How much did the enterprise pay for wiring (if any)?	TSH ☐☐☐☐☐☐☐☐
H7.	If there was any unofficial cost (for example, bribe), how much was it?	TSH ☐☐☐☐☐☐☐☐
H8.	How much did the enterprise pay last month for electricity (including production of electricity from other source (e.g. diesel))?	TSH ☐☐☐☐☐☐☐☐

H9.	On average, how many hours was electricity available per day in the enterprise last month?	HOURS [ ][ ]
H10.	In the past month, how often did the enterprise face power outages? READ RESPONSE OPTIONS AND MARK ONE.	DAILY........ 1 FEW TIMES A WEEK........ 2 FEW TIMES A MONTH........ 3 RARELY........ 4 NEVER........ 5
H11.	What do you use for energy during a power outage? MARK ALL THAT APPLY.	REMAIN WITHOUT POWER........ 1 USE CANDLE........ 2 USE EMERGENCY/BATTERY OPERATED LIGHT 3 USE KEROSENE LAMPS/LANTERNS........ 4 MOTORCYCLE/CAR BATTERY........ 5 DIESEL GENERATOR........ 6 OTHER ________________ 8 (SPECIFY)

I. ENTERPRISE'S USE OF ELECTRICITY (continued)		
I1	How much did you spend last month on backup sources of energy?	TSH [ ][ ][ ][ ][ ][ ][ ][ ]
I2	On average, how much did you spend per month on backup sources of energy in 2010?	TSH [ ][ ][ ][ ][ ][ ][ ][ ]
I3	In the past month, how often did the enterprise face voltage fluctuations?	DAILY........ 1 FEW TIMES A WEEK........ 2 FEW TIMES A MONTH........ 3 RARELY........ 4 NEVER........ 5
I4	How often per month did the enterprise face voltage fluctuations in 2010?	DAILY …….. 1 FEW TIMES A WEEK …….. 2 FEW TIMES A MONTH …….. 3 RARELY …….. 4 NEVER …….. 5
I5	In an earlier question you told us about backup of energy sources. How much additional monetary loss can be attributed to power outage or voltage fluctuation over the last month (i.e. loss of inventory, reduced production activity, delay, breakdown of machinery, etc.)?	TSH [ ][ ][ ][ ][ ][ ][ ][ ]
I6	How much additional monetary loss can be attributed to power outage or voltage fluctuations per month (i.e. loss of inventory, reduced production activity, delay, breakdown of machinery, etc in 2010?	TSH [ ][ ][ ][ ][ ][ ][ ][ ]

I7	Last month, what was the enterprise's primary use of electricity?	LIGHTING .... 1 FAN.. 2 AIR CONDITIONING... 3 HEATING SPACE .... 4 HEATING WATER .... 5 PUMPING WATER .... 6 ELECTRONIC/ELECTRICAL APPLIANCE/MACHINERY .... 7 OTHER________________________________ 8 (SPECIFY)
I8	What was the enterprise's primary use of electricity in 2010?	LIGHTING………………………………… ..1 FAN…………………………………………. .2 AIR CONDITIONING……………………….. 3 HEATING SPACE…………………………. .4 HEATING WATER…………………………. .5 PUMPING WATER……………………………6 ELECTRONIC/ELECTRICAL APPLIANCE/MACHINERY……………………7 OTHER____ ________________________ 8 (SPECIFY)
I9	Last month, what was the enterprise's secondary use of electricity?	LIGHTING………………………………… ..1 FAN…………………………………………. .2 AIR CONDITIONING……………………….. 3 HEATING SPACE…………………………. .4 HEATING WATER…………………………. .5 PUMPING WATER……………………………6 ELECTRONIC/ELECTRICAL APPLIANCE/MACHINERY……………….…7 OTHER____ ________________________ 8 (SPECIFY)
I10	What are the major drawbacks of getting electricity from the national grid? CIRCLE ALL THAT APPLY	HIGH CONNECTION COST……………………1 HIGH WIRING COST……………………………2 HIGH MONTHLY CHARGE……………………..3 HAVE TO PAY BRIBE……………………………4 → K1 TOO MUCH PAPERWORK……………………..5 UNRELIABLE SERVICE (POWER OUTAGE, VOLTAGE FLUCTUATION, ETC.)………...6 OTHER (SPECIFY)………………………………8 ....

J. FOR ENTERPRISEES THAT ARE NOT CONNECTED TO THE NATIONAL GRID		
J1	What is the primary reason that this enterprise is not connected to grid?	GRID IS NOT AVAILABLE IN THE AREA.1 HIGH CONNECTION COST……………….2 HIGH TARIFF……………………………….3 ELECTRICAL EQUIPMENTS/ MACHINERY ARE EXPENSIVE…………...4 NO PERCEIVED USE OF GRID ELECTRICITY………………………………..5 SATISFIED WITH CURRENT ENERGY SOURCE…………………………………...6 OTHER ___________________________8 (SPECIFY)
J2	Thinking about the operation and growth of your enterprise, would you consider the lack of grid electricity to be a major obstacle, a moderate obstacle, a minor obstacle, or not an obstacle?	MAJOR OBSTACLE .... 1 MODERATE OBSTACLE .... 2 MINOR OBSTACLE.................. 3 NOT AN OBSTACLE 4
J3	Is the enterprise interested in getting connected to the national grid?	YES.................................. 1 NO .... 0 → K1
J4	Has the enterprise submitted an application for an electricity connection through the national grid?	YES.. 1 NO 0
J5	What is the primary reason the enterprise desires to connect to the national grid?	BETTER LIGHTING................................... 1 IMPROVED PRODUCTIVITY/ EFFICIENCY .... 2 ENHANCED INCOME .... 3 MORE COST EFFECTIVE .... 4 ELECTRICITY IS CHEAPER THAN ALTERNATE FUELS .... 5 ENVIRONMENTALLY FRIENDLY 6 OTHER _____________-__________ 8 (SPECIFY)

K. ENTERPRISE ELECTRICAL AND NON-ELECTRICAL ENERGY DEVICES AND APPLIANCES			
		a.	b.
		How many [APPLIANCES] does the enterprise own? IF 0, SKIP TO NEXT ROW.	How many hours did the enterprise use [APPLIANCE] each day, on average, last month?
K1.	Fluorescent light		
K2.	Incandescent light		
K3.	Energy saving light		
K4.	Flashlight		
K5.	Candle		
K6.	Kerosene lantern		
K7.	Pressurized kerosene lantern		

K8.	Traditional /charcoal stove		
K9.	Kerosene stove		
K10.	Electric stove		
K11.	Gas cooker		
K12.	Car or motorcycle battery (for non-transportation use)		
K13.	Generator set		
K14.	Solar PV		
K15.	Television		
K16.	Air conditioner		
K17.	Electric fan		
K18.	VCD/DVD player		
K19.	Radio/CD player		
K20.	Electric water pump		
K21.	Diesel water pump		
K22.	Manual water pump		
K23.	Electric motor		
K24.	Diesel/gasoline motor		
K25.	Electric tools (drill, compressor, etc.)		
K26.	Sewing machine		
K27.	Sound equipment		
K28.	Iron		
K29.	Washing machine		
K30.	Vacuum cleaner		
K31.	Microwave oven		
K32.	Water heater		
K33.	Computer		
K34.	Bicycle		
K35.	Motorcycle		
K36.	Motor vehicle (car, van/minibus, pickup truck, etc.)		
K37.	Animal drawn cart		
K38.	Boat		
K39.	Satellite dish		
K40.	Refrigerator/freezer		
K41.	Chinese lamps		
K42.	Any Other ______________________________ (SPECIFY)		

L: MOBILE PHONES FOR ENTERPRISE PURPOSES		
L1.	Does anyone in your enterprise use a mobile phone for business purposes?	YES.. 1 NO.. ...0 → M
L2.	If yes, how many mobile phones do you and your employees use in all for business purposes?	[ ][ ] PHONES
L3.	Do you and/or your employees always have access to a charged cell phone during business hours?	YES.. 1 NO.. 0
L4.	Where do you and your employees normally recharge your mobile phones?	AT HOME.. .1 AT BUSINESS PLACE ……………………..2 AT ANOTHER RETAIL PLACE............. 3 OTHER________________________ 8 (SPECIFY)
L5.	If you pay for recharging, how much do you pay each time? IF NO FEE FOR CHARGING, ENTER '0' TSH.	TSH [ ][ ][ ][ ]
L6.	On average, how many calls are made per week from all mobile phones in your enterprise?	CALLS [ ][ ][ ][ ]
L7.	On average, how much does your enterprise pay per month for mobile phone time, repairs, charging, and all other related costs?	TSH [ ][ ][ ][ ][ ][ ][ ][ ]

M. ENTERPRISE RE-CONTACT INFORMATION:

Thank you very much, we are almost finished! We would like to come back and interview you again in about two years. In order to make sure we can get in touch with you at that time, we would like to get some contact information for you and other individuals familiar with this enterprise.

This information will not be connected with the information you have just provided to me, and it will not be shared with anyone outside the research team, or be used for any purpose other than this study.

M1.	Enterprise Name:		
M2.	Enterprise's Physical Address:		
M3.	Enterprise Manager (if different from the owner)	M4 Name:	M5 Phone:
M6	Reference person within the community	M7 Name:	M8 Occupation:
		M9 Location:	M10 Phone:

N. CONCLUSION
That was my last question for you. Before we conclude, do you have any questions for me? ☞ ANSWER QUESTIONS AS COMPLETELY AS POSSIBLE. Thank you so much for your help. We look forward to seeing you again in a few months. Your answers are very helpful to us. I thank you so much again.
N1. ENTER INTERVIEW END TIME: [ ][ ] : [ ][ ] HH : MM
N2. COMMENTS: PLEASE NOTE ANY UNUSUAL CIRCUMSTANCES THAT OCCURRED DURING INTERVIEW.

FOR FIELD SUPERVISOR	
SUPERVISOR NAME:	SUPERVISOR NUMBER: [ ][ ]
DATE COMPLETED QUESTIONNAIRE CHECKED AND APPROVED BY SUPERVISOR: *CHECK IF YES:* [ ]	[ ][ ] [ ][ ] [ ][ ][ ][ ] *DD / MM / YYYY*

FOR DATA ENTRY SUPERVISOR	
DATA ENTRY SUPERVISOR NAME:	DATA ENTRY SUPERVISOR NUMBER: [ ][ ][ ]
COMPLETED QUESTIONNAIRE CHECKED AND APPROVED BY OFFICE:	[ ][ ] / [ ][ ] [ ][ ][ ][ ] *DD / MM / YYYY*
NAME OF DATA ENTRY CLERK FOR FIRST DATA ENTRY:	
DATE OF FIRST DATA ENTRY:	[ ][ ] / [ ][ ] [ ][ ][ ][ ] *DD / MM / YYYY*
NAME OF DATA ENTRY CLERK FOR SECOND DATA ENTRY:	
DATE OF SECOND DATA ENTRY:	[ ][ ] / [ ][ ] [ ][ ][ ][ ] *DD / MM / YYYY*

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