



United Republic of Tanzania

Access to Electricity and Modern Cooking Solutions

November 2023





Multi-Tier Framework (MTF)

Impact of Access to Sustainable Energy Survey (IASSES 2021/22)



TALL

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List of Abbreviations

AE	Access to energy
Ah	Ampere-hour
CO	Carbon monoxide
CSPRO	Census and Survey Processing System
EA	Enumeration area
ESMAP	Energy Sector Management Assistance Program
EWURA	Energy and Water Utilities Regulatory Authority
IASES	Impact of Access to Sustainable Energy Survey
ISC	Improved cooking solutions/stoves
ISO	International Organization for Standardization
Kg	Kilogram
kW	Kilowatt
kWh	Kilowatt-hour
PM2.5	Particulate matter that have a diameter of less than 2.5 micrometers
Lmhr	Lumen-hour (The quantity of light equal to a lumen radiated or received in one hour)
LPG	Liquefied petroleum gas
MoE	Ministry of Energy
MTF	Multi-Tier Framework
NSCA	National Sample Census of Agriculture
NBS	National Bureau of Statistics
Norad	Norwegian Agency for Development Cooperation
PPS	Probability proportional to size
REA	Rural Energy Agency
SDG7	Sustainable Development Goal number 7
SE4All	Sustainable Energy for All
SSB	Statistics Norway
TANESCO	Tanzania Electric Supply Company
TZS	Tanzanian Shilling
V	Volt
W	Watt
Wh	Watt-hour

Foreword

The Impact of Access to Sustainable Energy Survey (IASSES) 2021/22 was implemented by the National Bureau of Statistics (NBS) and Statistics Norway (SSB) in collaboration with Ministry of Energy, Tanzania Electric Supply Company (TANESCO), Rural Energy Agency (REA) and Energy and Water Utilities Regulatory Authority (EWURA). The survey was jointly funded by the Government of Tanzania and the Norwegian Agency for Development Cooperation (Norad) through Statistics Norway.

Access to sustainable energy is a critical issue with far-reaching impacts on communities, economies, and the environment. In today's world, energy is the backbone of development. It is essential for meeting the basic needs of people such as cooking, lighting and heating. However, millions of people lack access to reliable and affordable energy, and this hinders their social and economic development.

To address this issue, governments organizations and communities around the world are in the process of expanding access to sustainable energy. The Impact of Access to Sustainable Energy Survey explores the impact of sustainable energy on people's lives, businesses, and the environment. The survey seeks to understand how access to sustainable energy influences economic growth, health, education, gender equality, and mitigates climate change.

The main objective of the Survey was to measure the access to sustainable energy and the impact of such access at the national and regional levels. The survey is an important step in acquiring a comprehensive understanding of the impact of access to sustainable energy. It provides valuable insights for policymakers, businesses, and organizations working to expand access to sustainable energy. It also identifies best practices for sustainable energy implementation and inform future policies and initiatives.

We hope that the findings of this survey will contribute to the global effort towards achieving universal access to sustainable energy. We extend our sincere gratitude to all the participants who have contributed their valuable insights and experiences to this survey.



Honorable Doto Biteko (MP)

Deputy Prime Minister and Minister of Energy

Acknowledgements

I would like to express my deepest gratitude to the Government of Tanzania and all the organizations that contributed to the successful implementation of the Impact of Access to Sustainable Energy Survey for the year 2021/22. Their expertise, guidance, and support were instrumental in ensuring the survey's quality and relevance.

The National Bureau of Statistics (NBS) extend its sincere appreciation to Statistics Norway, Rural Energy Agency (REA), Energy and Water Utilities Regulatory Authority (EWURA), Tanzania Electric Supply Company Limited (TANESCO), and the Ministry of Energy for their valuable support and collaboration in conducting the survey.

NBS would also like to thank all the survey participants who shared their insights and experiences with us during the survey. Their contributions are invaluable and will help inform future policies and initiatives towards expanding access to sustainable energy.

Finally, NBS would like to acknowledge the hard work and dedication of the survey team, including the data collectors, supervisors, and data analysts, who worked tirelessly to ensure the survey's success. Their commitment to the project is greatly appreciated.

I thank you all for your valuable contributions to the Impact of Access to Sustainable Energy Survey.



Dr. Albina Chuwa
Statistician General
National Bureau of Statistics

Preface

The Impact of Access to Sustainable Energy Survey (IASSES) 2021/22 was implemented by the National Bureau of Statistics (NBS) and Statistics Norway (SSB) in collaboration with Ministry of Energy, Tanzania Electric Supply Company (TANESCO), Rural Energy Agency (REA) and Energy and Water Utilities Regulatory Authority (EWURA). Among the key contributors to this report are Bjørn K. G. Wold, Frode Berglund, Titus Mwisomba, Samwel Kawa, Philemon Mwenda, Jillahoma Mussa, Nico Ombeni, Nicolaus Moshi, Emmanuel Fwilo, Astrid Mathiassen, Ole Sandvik, Per Schøning, Kristian Lønø, Anne Abelsæth and Dag Roll-Hansen.

The funding for the IASSES 2021/22 was provided by the Government of Tanzania and the Norwegian Agency for Development Cooperation (Norad).

Additional Information about the IASSES 2021/22 may be obtained from the National Bureau of Statistics, Head Office, Jakaya Kikwete Road; P. O. Box 2683, Dodoma, Tanzania. Telephone: +255 26 - 2963822; Fax: +255 26 - 2963828; E-mail: sg@nbs.go.tz and Website: www.nbs.go.tz.

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Definition of Key Terms

Power plant – A production facility for electric power based upon sustainable production such as hydro-generated electricity, solar panel generated electricity, and wind mill generated electricity; or diesel generated electricity.

Electric grid – Electric lines or wires capable of transmitting of electric charge at various levels from high to consumer voltage.

High voltage power transmission lines – Grid lines from power plants to community transformers from 147,000 to 1000 volts.

Transformer stations and transformers – Facilities reducing voltage step by step from the highest level at 147,000 volts to consumer levels at 220/230 V (consumer households) or 340 V (business consumers).

Connection to electricity – A household (or business) is connected to the electric grid by wires to the location.

Access to electricity – A household with their own connection to electricity, with the possibility to get connected to electricity or by gaining from neighbours connected to electricity, such as by being able to charge the mobile phones.

Electric charge – The potential electric energy measured in volt or kilovolt abbreviated as kV.

Electric current or flow – The amount of electricity flowing in a circuit such as a wire. It is measured in ampere.

Electric power – The electric energy consumed such as for light or running a machine. It is measured in watts or kilowatts. $1W=1V \times 1A$.

Electric power-consumption – The electric power consumed in a given period. It is measured in Wh or kWh.

Power capacity:

- From the grid there is no technical limitation. You pay per kW used in a given time period in kWh.
- From a solar panel, there is electric energy limitation you usually get 95% of the panel capacity such as 19W from a 20W panel. You pay nothing and may consume for 10 hours during daytime in full sunshine.
- From a battery there is power limitation you usually get 75% of the battery capacity. A 12V battery storing 20 Ah may give you $75\% \times 12V \times 20Ah = 180 \text{ Wh}$. With a 20W solar panel you may theoretically recharge the battery in 1 day of full sunshine, but due to technical waste during charging, you may need 1.5 days.

You may then light 2 x 5W LED bulbs for 18 hours or both 2 bulbs and a 20W TV for 6 hours.

Household – All members of a household living in one compound, one building, or one apartment and usually eating from the same pot.

Community – All households living in a village or a quarter where most households know each other and have a common knowledge of their location.

Enumeration Areas (EAs) – These areas are usually demarcated during the Population and Housing Census. They have an average of 100-150 households and are considered as single localities for census enumeration.

Region – The 26 official regions in Mainland Tanzania

Areas – In this report the communities and EAs are grouped in three levels of urban versus rural: Dar es Salaam, Other urban areas, and Rural areas.

Centrality – In this survey the rural communities and EAs are grouped in three levels of centrality: max 10 km to town, 11-25 km to town, more than 25 km to town.

Executive Summary

From 2019 to 2022, the Tanzania's National Bureau of Statistics (NBS) and Statistics Norway (SSB) conducted a survey named Impact of Access to Sustainable Energy Survey (IASSES). The survey, that was conducted in Mainland Tanzania, was jointly funded by the Government of Tanzania and Norwegian Agency for Development Cooperation (Norad). The current report follows the main international goals and indicators for the Sustainable Development Goal number 7 (SDG7.1) which is to offer affordable, reliable, sustainable and modern energy for all by 2030.

Access to Electricity

Mainland Tanzania uses several key indicators to measure access to electricity. The Rural Energy Agency (REA) considers households to have access if there is an electric pole in the village, hamlet, or mtaa (street). The household is connected to electricity if there is an electric bulb in the house. According to this definition, the percentage of households connected to electricity increased from 32.8 percent in 2016/17 to 45.8 percent in 2021/22, consequently more than 2 million households in Mainland Tanzania, have been connected to electricity over the last six years.

The proportion of households connected to electricity is higher in urban than in rural areas and highest in Dar es Salaam region where almost nine out of ten households are connected to electricity whereas seven out of ten are connected in other urban areas, and about four out of ten are connected in rural areas.

The percentage of households living in communities connected to electricity is large. These households are not necessarily connected but only that connection is possible in the community. Even in rural areas 2 of 3 households live in communities with connection to electricity. As many as 95.0 percent of the communities have grid, mini-grid, or other electricity source in the community.

The Sustainable Development Goals (SDGs) also cover energy services. The SDG indicator 7.1.1 considers households as having access if their supply of electricity is able to provide light for at least 4 hours a day and at least 1 hour at night on average. Overall, just above half of the households fulfil this goal. Furthermore, almost 3 of 4 households in Mainland Tanzania live in communities connected to electricity.

About 30 percent of all households in Mainland Tanzania rely on grid as their main source of electricity. In Dar es Salaam this applies to almost 90 percent, while only about 10 percent of the households report grid as the main source of electricity in rural areas. About 30 percent of rural households do not have any form of electricity

¹ SDG TARGET 7.1 By 2030, ensure universal access to affordable, reliable and modern energy services

INDICATOR 7.1.1 Proportion of population with access to electricity. In meta-data: Access rates are only considered if the primary source of lighting is the local electricity provider, solar systems, mini-grids and stand-alone systems. Light on average for at least 4 hours per day and 1 hour at night.

INDICATOR 7.1.2 Proportion of population with primary reliance on clean fuels and technology

Clean is defined by the emission rate targets and specific fuel recommendations and in some circumstances by adopting advanced combustion cook stoves.

The report also gives a detailed picture on households access to electricity regarding capacity, availability, reliability, quality, affordability, and legality of electricity, as well as health and safety. This multi-dimensional approach identifies two main next challenges in Mainland Tanzania. The first challenge is ensuring availability and reliability of access to electricity for households with grid by ensuring the capacity of power delivery and improved maintenance of the grid-net. The second challenge is to identify the barriers for solar power in remote areas.

Cooking solutions

Two out of three households in Mainland Tanzania used firewood as their main source of energy for cooking. The second most common source of energy used for cooking was charcoal, used by one out of four households. Firewood is the dominant fuel in rural areas, while charcoal dominates in urban areas. The percentage of households using modern, clean and efficient sources of energy for cooking such as electricity, biogas and LPG is small. It is two percent in Dar es Salaam, three percent in other urban areas and negligible in rural areas.

In urban areas, hardly any household has a traditional open charcoal burner without any option to stop or regulate the airflow to improve efficiency, and hence reduce the emission of smoke and gases.

A considerable percentage of the households in urban areas use stoves with improved designs or even better, with a chimney. In Dar es Salaam, 9 in 10 households and in other urban areas 2 in 3 households, have stoves with some sort of improved design. In rural areas the situation is very different as only 1 out 10 households have an oven with some improved design. Cook stove efficiency is much higher in urban than in rural areas.

Kitchens in rural areas generally have the best ventilation. This is mainly due to by cooking in open air or having a separate open kitchen house with at least three open sides.

Around half of persons engaged in cooking are exposed to emissions from the stove for about 2 hours per day. Hence, they are exposed to emissions from the main oven for a considerable time.

Two thirds of households in urban areas and 9 in 10 households in rural areas spend less than 5 percent of their income on fuel for cooking. The prices of fuel are generally higher in urban areas, but so is the household income. The best way of reducing the burden of households in the provision of energy for cooking in rural areas, is increasing the efficiency of cook stoves.

The education of the household head influences the choice of cooking solutions substantially, meaning that the more educated the household head, the more efficient is the cooking solution applied. On the other hand, the gender of the household head has less impact on the choice of cooking solutions.

Chapter One

Introduction

The National Bureau of Statistics (NBS) conducted a survey in Mainland Tanzania on the impact of access to sustainable energy for the first time in 2021/22. The survey was jointly funded by the Government of Tanzania and the Norwegian Agency for Development Cooperation (Norad) through Statistics Norway.

All major institutions of the energy sector in Mainland Tanzania were involved in the conduct of Impact of Access to Sustainable Energy Survey (IASSES) 2021/22. The institutions are the Ministry of Energy, Tanzania Electric Supply Company (TANESCO), Rural Energy Agency (REA), and Energy and Water Utilities Regulatory Authority (EWURA).

The results from 2021/22 - IASSES will be used to monitor the SDG 7 (Ensure access to affordable, reliable, sustainable and modern energy for all) and Target 7.1 (By 2030, ensure universal access to affordable, reliable and sustainable energy services). It is also anticipated that, data from the survey will be used in policy design and review, planning, as well as evidence-based decision making.

The survey also captures more details on multi-dimensional access to modern sources of energy, where access is measured by e.g. amount, stability and affordability. This is more advanced compared to the traditional statistical approach which usually only provides the “yes-no” information about “the main source of energy” for lighting and cooking.

This is the first report for the IAES 2021/22. It gives key findings on households' access to sustainable energy, cooking solutions, and the quality of the access. The report includes an in-depth explanation of the methodology used to measure access. This report will be followed by other reports from the same survey material including a full analysis report covering the wide statistical data material collected, as well as a report on barriers and drivers of adapting modern energy and impact of access to energy.

The main objective of this survey was to measure the access to sustainable energy and the impact of such access at the national and regional levels. Further, the IASSES has:

- i. Contributed to the Sustainable Energy for all (SE4All)/World Bank initiative of measuring access to energy for evidence based national and regional planning as well as for international comparisons;
- ii. Developed a new survey module whose objective is to learn and document potential impact on economic activity and human welfare when households and Communities access modern energy sources;
- iii. Documented the access to sustainable energy in urban and rural areas and the impact observed after 5 to 10 years; and
- iv. Developed capacity of the National Bureau of Statistics and Energy Sector institutions to measure the development in access, connectivity/availability and impact in the years to come.

The sample for the IASES in Mainland Tanzania is a two-stage sample, comprising urban and rural areas in each region of Mainland Tanzania. At the first stage the enumeration areas (EAs) are selected within each domain by random systematic probability proportional to size (PPS) sampling based upon the number of households in each EA as registered in the 2012 Population and Housing Census. At the second stage all households in a given EA are listed and a fixed number of households are selected by random systematic sampling. The final sample comprised of 2,580 urban households and 3,984 rural households, making a total of 6,564 households across Mainland Tanzania was selected. Mobile teams travelled to all regions to list all households in the selected areas and interview the sampled households from December 2021 to March 2022. Tablets with electronic questionnaires and maps were used during the data collection. More on sampling and data collection can be found in Appendix A: Technical notes.

Chapter Two

Access and Connection to Electricity – Overall Measures

Access to electricity may be measured in several ways. The current report follows international and national measures and indicators as far as household data allow. The main international goals and indicators are under the overarching Sustainable Development Goal number 7 (SDG72) which aims at affordable, reliable, sustainable, and modern energy for all by 2030. Furthermore, access to energy is detailed by the degree and quality of access to energy. This is described by a multi-dimensional tier-classification.

At the national level in Mainland Tanzania, the main policy focus is extending the benefits of electricity to an increasing share of the population. A household may benefit from electricity by being connected to the grid, by accessing solar based and other sources of electricity, or through neighbors with electricity within and next to the community with electricity. National indicators presented below include households connected to electricity and communities access to electricity.

The sample is designed to give accurate estimates for Mainland Tanzania, Dar es Salaam, other urban areas, and rural areas. The estimates for individual region are less accurate. Nevertheless, regional distributions are still presented to show trends across the country for groups of regions such as between regions close to large urban areas versus remote regions.

2.1 Households connected to electricity

In Mainland Tanzania, the Rural Energy Agency (REA) is responsible for increasing access to electricity by building networks to new communities in the rural areas. Their main goal is to increase the number of households connected to electricity in rural Mainland Tanzania. REA apply the following definition to measure progress towards this goal:

Households Connected to Electricity

REA definition: (If there) is an electric pole in the village, hamlet or mitaa and an electric bulb in the house (the household is connected to electricity). In the Impact of Access to Sustainable Energy Survey 2021/22, households connected to electricity referred to households whose source of electricity was either Tanzania Electric Supply Company Limited (TANESCO) / REA or a local private entity.

Source: [1] Rural Energy Agency (REA): Energy Access and Use Situation Survey I and II Reports

² SDG TARGET 7.1 By 2030, ensure universal access to affordable, reliable and modern energy services

INDICATOR 7.1.1 Proportion of population with access to electricity. In meta-data: Access rates are only considered if the primary source of lighting is the local electricity provider, solar systems, mini-grids and stand-alone systems. Light on average for at least 4 hours per day and 1 hour at night.

INDICATOR 7.1.2 Proportion of population with primary reliance on clean fuels and technology

Clean is defined by the emission rate targets and specific fuel recommendations and in some circumstances by adopting advanced combustion cook stoves.

Table 2.1 Percentage of Households Connected to Electricity, Mainland Tanzania

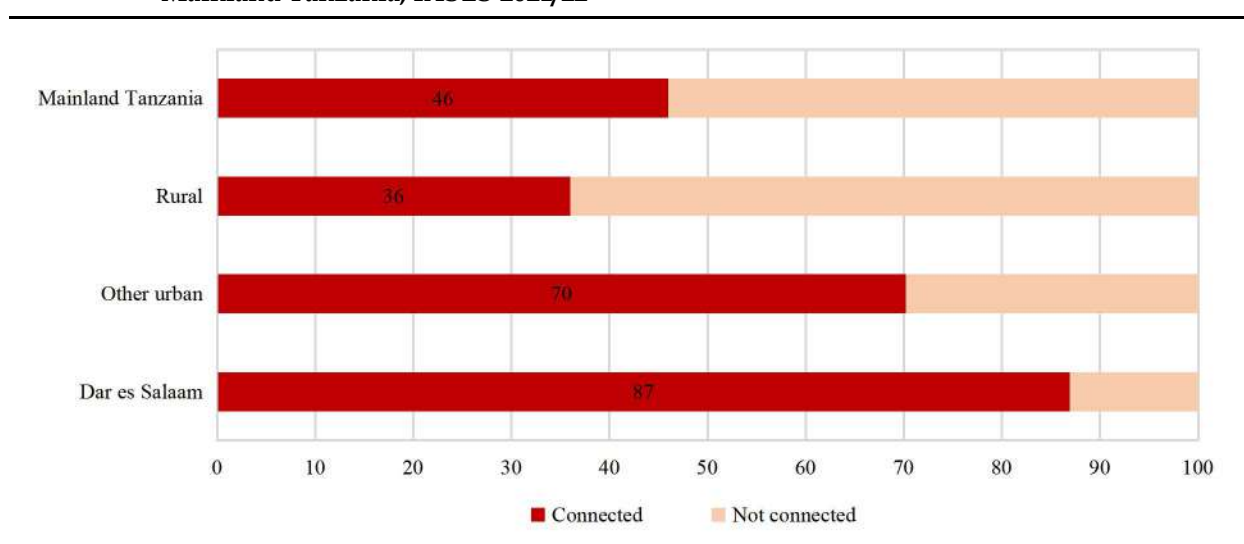
Area	2016/17 (EAUSS I)*	2019/20 (EAUSS II)*	2021/22 (IASES)**
Mainland Tanzania	32.8	39.9	45.8

Source:

*Ministry of Energy through Rural Energy Agency (REA): Energy Access and Use Situation Survey I and II

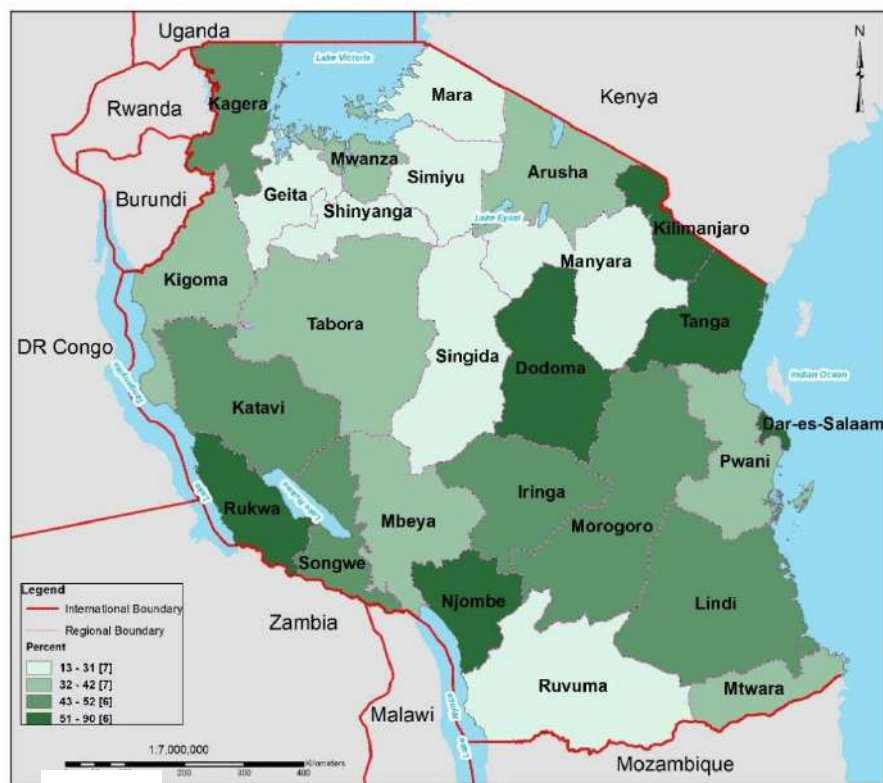
**NBS & SSB: 2021/22 Impact of Access to Sustainable Energy Survey, Mainland Tanzania

Since 2016, there has been an impressive increase in the percentage of households connected with electricity according to the REA definition. The percentage of households connected to electricity increased from 32.8 percent in 2016/17 to 45.8 in 2021/22. Consequently, more than 2 million households, in Mainland Tanzania, have been connected to electricity over the last six years.

Figure 2.1 Percentage of Households Connected to Electricity (REA definition) by Area, Mainland Tanzania, IASES 2021/22

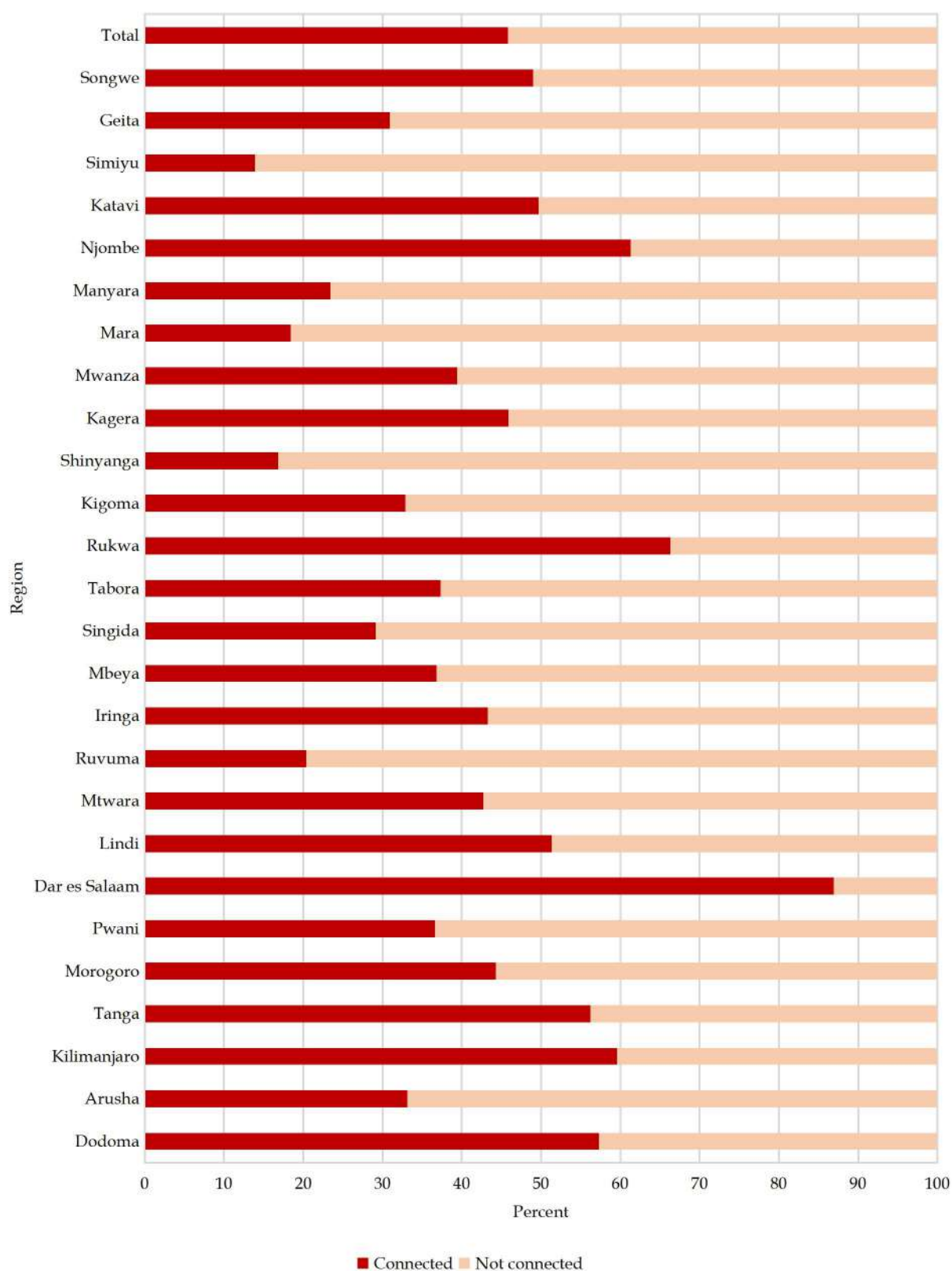
The percentage of households connected to electricity is higher in urban than in rural areas and is highest in Dar es Salaam region where almost nine out of ten households are connected to electricity whereas seven out of ten are connected in other urban areas, and about four in ten are connected in rural areas (Figure 2.1).

Figure 2.2 Percentage of Households Connected to Electricity Grid by Region, Mainland Tanzania, IASES 2021/22



Grid connection is not evenly distributed in Mainland Tanzania. Figure 2.2 shows that the darker the shade the higher the connectivity rate. It also shows that regions in the western and eastern parts of Mainland Tanzania have higher connection rates than those in the northern southern parts.

Figure 2.3 Percentage of Households Connected to Electricity (REA definition) by Region, Mainland Tanzania, IASES 2021/22



Source: 2021/22 Impact of Access to Sustainable Energy Survey, Mainland Tanzania

Figure 2.3 reveals substantial differences in the rates of households connection to the grid in Mainland Tanzania. The rate of connection is 50 percent or above in the eight regions of Katavi, Lindi, Tanga, Dodoma, Kilimanjaro, Njombe, Rukwa and Dar es Salaam. The rate in the three regions of Mara, Shinyanga and Simiyu is less than 50 percent in the remaining 15 regions of the households are connected to electricity.

2.2 Fewer female headed households connected to electricity in Dar es Salaam

In household surveys, findings are often associated with the sex of the household head. In this survey the percentage of female headed households was 25 for Mainland Tanzania, 22 for rural areas, and 30 percent for Dar es Salaam and other urban areas. The percentage of households connected to electricity according to the REA definition is the same for both male and female headed in all areas except Dar es Salaam. In Dar es Salaam, 90 percent of male-headed households have a grid connection compared to 82 percent of female-headed households.

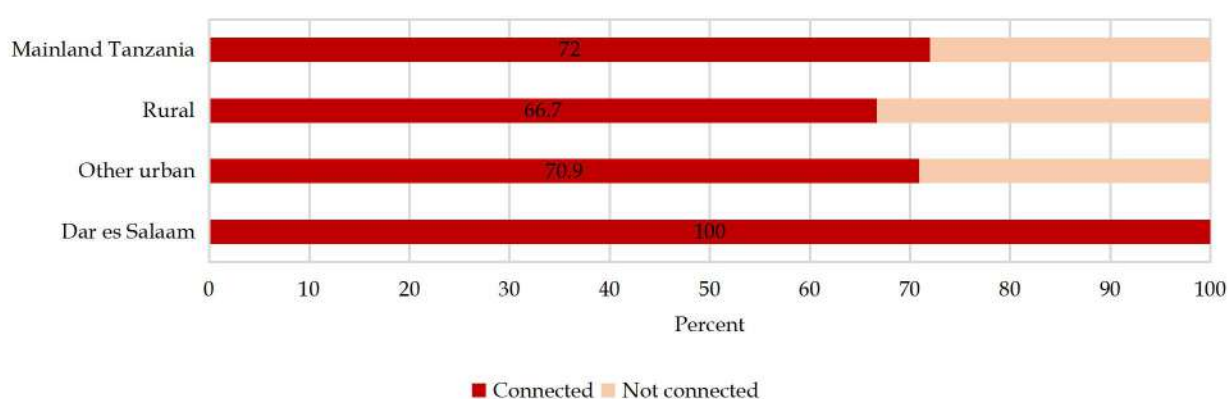
2.3 Community access to an electrical grid/ electricity

One of the main aims of REA is to expand the national grid to more villages and hamlets by establishing low voltage (340V or 430V) transformers. Progress is measured by the number of communities where some households have access to energy.

Communities connected to electricity are calculated as households living in villages or hamlets connected to electricity.

The percentage of households living in communities connected to electricity is large (Figure 2.4). It is large even in rural areas where two thirds of households live in communities with electricity. In Dar es Salaam, all households live in communities (mitaa) that have grid connection.

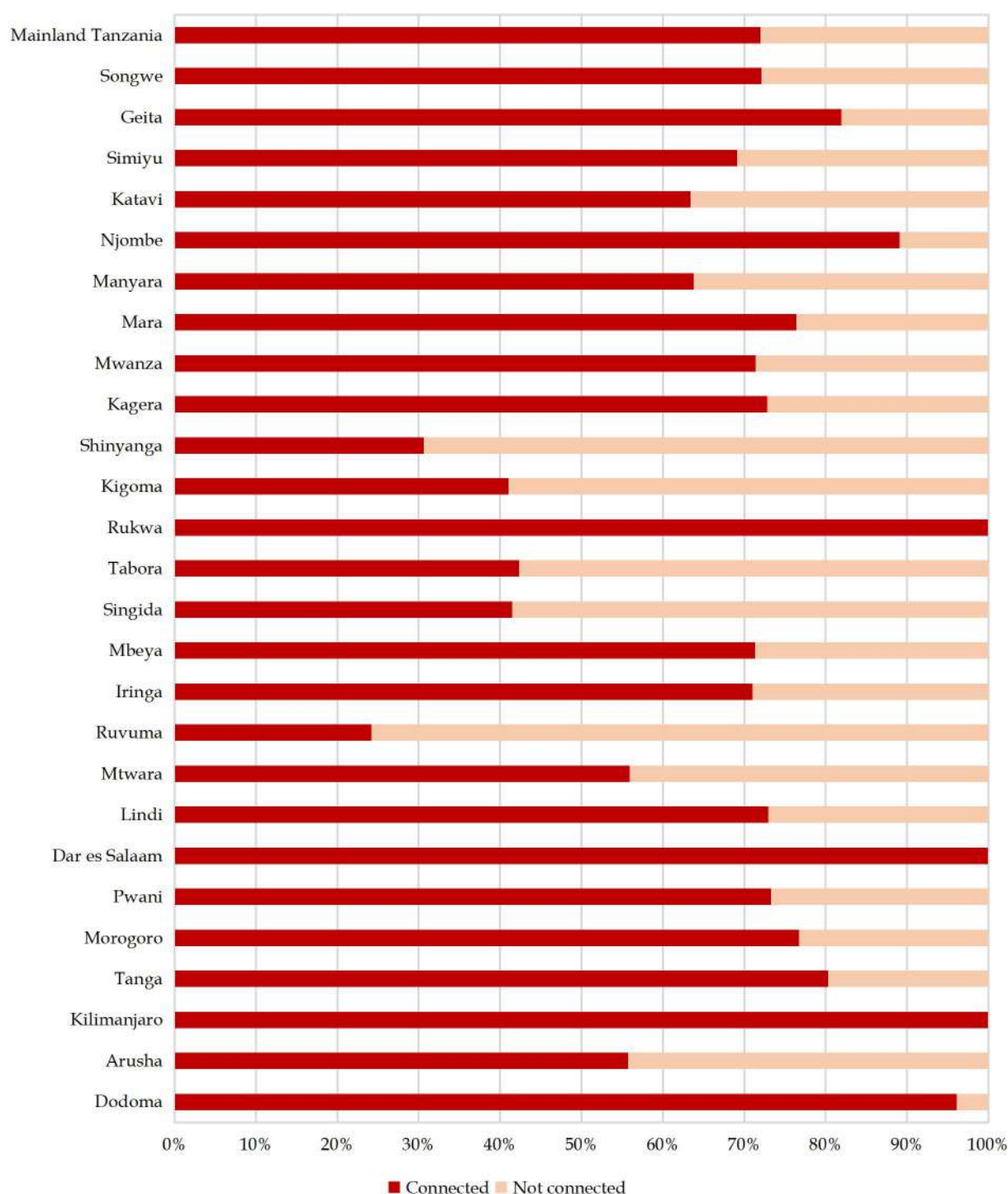
Figure 2.4 Percentage of Households Living in Communities with Access to Electricity by Area, Mainland Tanzania, IASES 2021/22



Source: NBS & SSB: 2021/22 Impact of Access to Sustainable Energy Survey, Mainland Tanzania

Connectivity is high in regions. In most regions, more than half of the households live in communities (villages, hamlets, and mitaa) connected to electricity. In the five regions of Ruvuma, Singida, Tabora, Kigoma and Shinyanga less than half of the households live in communities with some access to electricity.

Figure 2.5 Percentage of Households Living in Communities with Access to Electricity by Region, Mainland Tanzania, IASES 2021/22



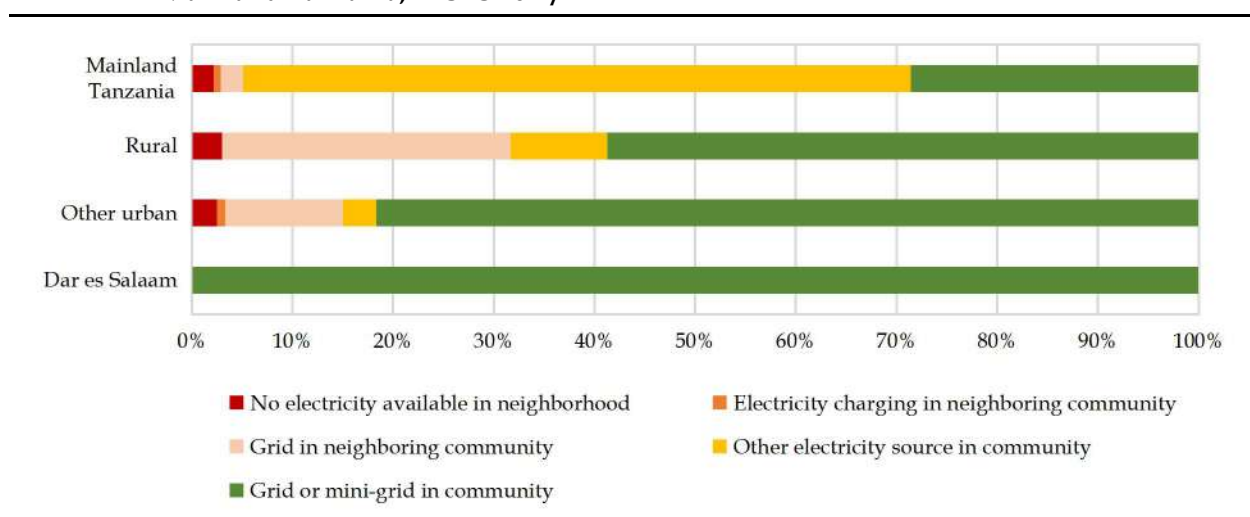
2.4 Access to electricity in neighbour community

The two REA definitions presented above focuses on grid connection. Today it is possible to access to electricity from various sources. This section shows the percentage of households with electricity within walking distance. The purpose of adopting this definition is to show that households can benefit from electricity in the community by for example being able to charge their mobile phones even if they do not have electricity in their homes.

Potential sources of electricity in the neighbourhood community are included:

- Grid or mini-grid in community
- Any other electricity source in community such as pico-generator, generator or community solar systems
- Grid in neighbouring community
- Other electricity source for charging in neighbouring community

Figure 2.6 Percentage of Communities with Access to Electricity by Area and Type of Access, Mainland Tanzania, IASES 2021/22



As many as 95 percent of the communities have either grid, mini-grid or other electricity source in the community. This shows that the widespread access to electricity in Mainland Tanzania comes from a range of options. In the following paragraphs we look into access across sources and quality of this access.

2.5 Sustainable Development Goal 7 (SDG7)

Sustainable Development Goal 7 (SDG7) aims to increase access to affordable, reliable, and modern energy services³. The SDG 7 addresses three dimensions of energy services: affordable, reliable, and modern energy services. These dimensions are covered in

³ SDG TARGET 7.1

By 2030, ensure universal access to affordable, reliable and modern energy services INDICATOR 7.1.1

Proportion of population with access to electricity. In meta-data: Access rates are only considered if the primary source of lighting is the local electricity provider, solar systems, mini-grids and stand-alone systems. Light on average for at least 4 hours per day and 1 hour at night

detail in the paragraphs on tier access to electricity. Here the SDG 7.1.1 indicator is presented as an introduction, requiring access to a minimum supply of electricity sufficient to provide light for at least 4 hours during the day and 1 hour at night on average.

Figure 2.7 Percentage of Households with Access to Electricity as Defined by SDG7 by Area, Mainland Tanzania, IASES 2021/22

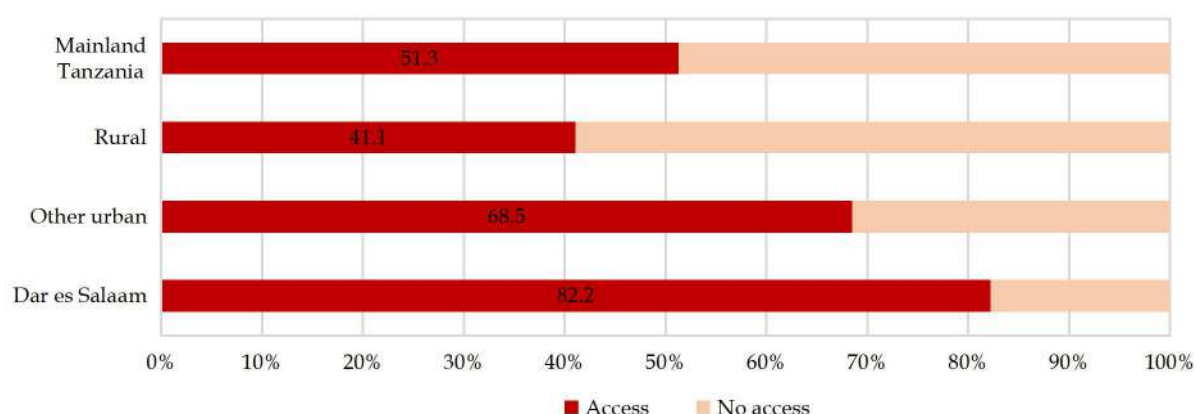
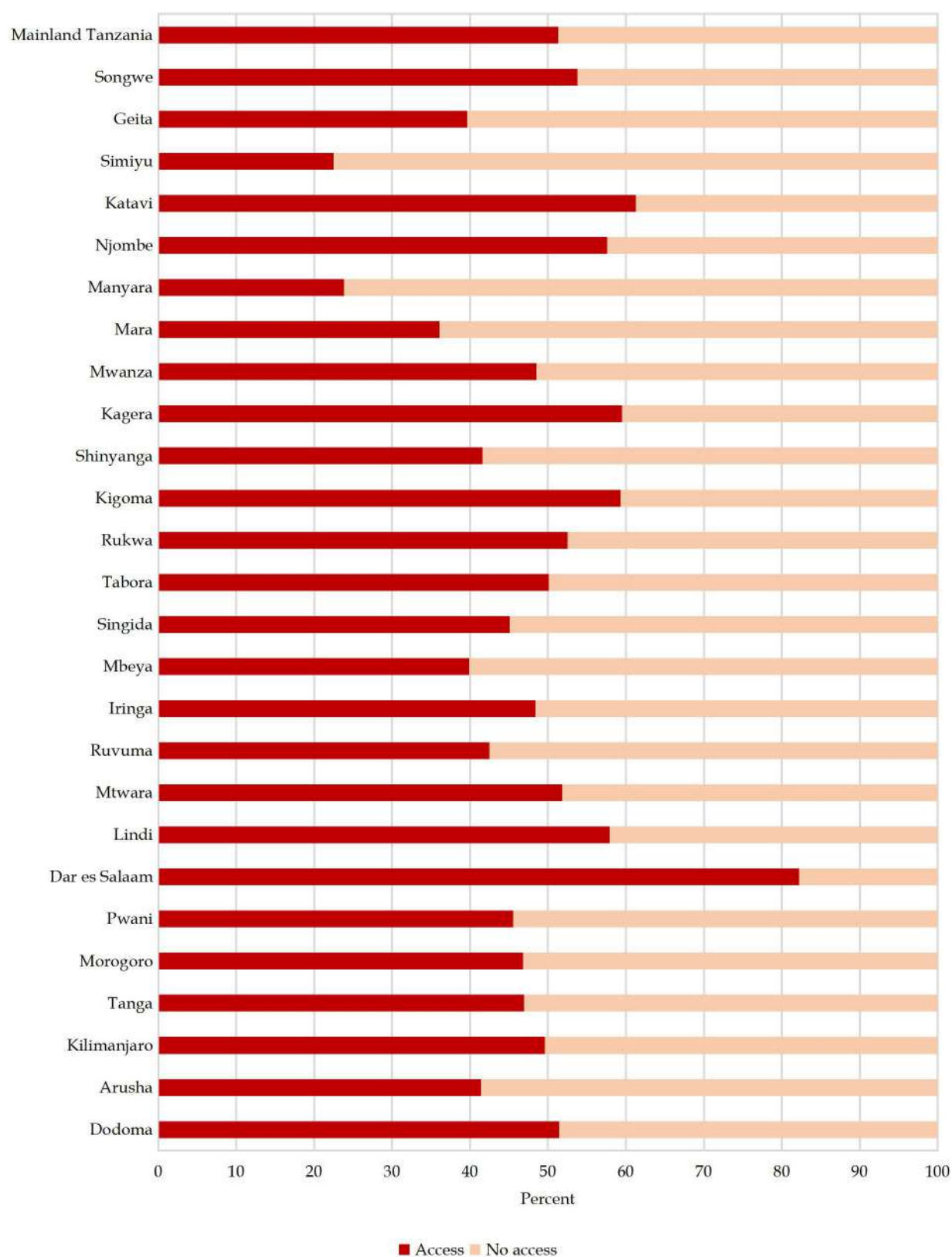


Figure 2.7 shows that, a little more than half of households in Mainland Tanzania access electricity in various forms. The share is particularly high in Dar es Salaam and other urban areas. In rural areas, however, only 41 percent of households have access to power.

In Mainland Tanzania, there is a significant variation in accessing electricity at regional level. While more than 80 percent of households in Dar es Salaam have access to electricity as per SDG7 definition, the percentage is between 40 and 60 for most of the other regions. Simiyu and Manyara regions have the lowest access rates with less than a quarter of households accessing electricity (Figure 2.8).

Figure 2.8 Percentage of Households with Access to Electricity as Defined by SDG7 by Region, Mainland Tanzania, IASES 2021/22

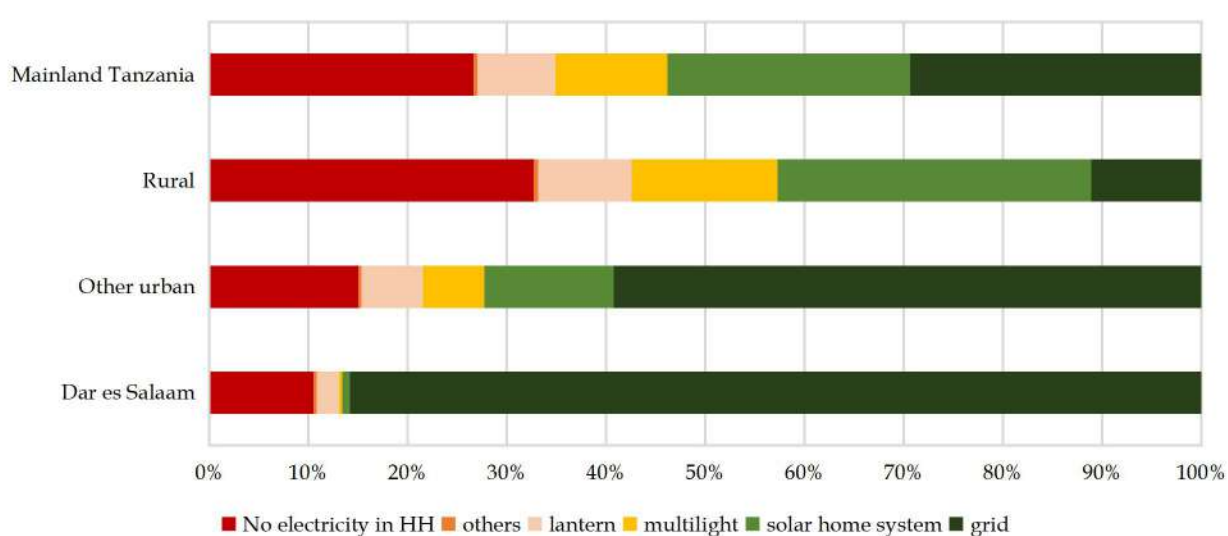


2.6 Main source of electricity

The main source of electricity in households is interesting by itself and also important when discussing the dimensions of access to electricity.

Figure 2.9 shows that about 30 percent of all households in Mainland Tanzania consider grid as their main source of electricity. In Dar es Salaam it is the main source for about 85 percent of the households. In rural areas, about 10 percent of households report grid as the main source while solar based sources (home systems, multi light and solar lantern) are the main source for about 55 percent of the households. Around one third (33 percent) of rural households do not have electricity.

Figure 2.9 Percentage of Households by Area and Main Source of Electricity, Mainland Tanzania, IASES 2021/22



Chapter Three

Tier Access to Electricity in Households

As a response to the first major global energy crisis at the end of the 1970s, the global Energy Sector Management Assistance Program (ESMAP) was established to provide global knowledge and technical assistance. ESMAP, administered by the World Bank, developed a partnership program with 18 partners to assist low and middle-income countries to reduce poverty and boost growth through environmentally sustainable energy solutions. The approach was laid out and documented in the Beyond Connections report from ESMAP in 2015[2]. This approach has identified 7 dimensions of access to electricity and identified the level of access for each dimension in 5 Tiers. The 7 dimensions are as presented in the table below.

Table 3.1 Multi-Tier Framework for Measuring Access to Electricity*

ATTRIBUTE		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Capacity	Power capacity ratings (W or daily Wh)	Less than 3 W	At least 3 W	At least 50 W	At least 200 W	At least 800 W	At least 2 kW
		Less than 12Wh	At least 12 Wh	At least 200 Wh	At least 1 kWh	At least 3.4 kWh	At least 8.2 kWh
	Services		Lighting of 1,000 lmhr per day	Electrical lighting, air circulation, television, and phone charging are possible			
Availability	Daily Availability	Less than 4 hours	At least 4 hours		At least 8 hours	At least 16 hours	At least 23 hours
	Evening Availability	Less than 1 hour	At least 1 hour	At least 2 hours	At least 3 hours	At least 4 hours	
Reliability		Not applicable	Not applicable	More than 14 disruptions per week		At most 14 disruptions per week or At most 3 disruptions per week with total duration of more than 2 hours”	At most 3 disruptions per week with total duration of less than 2 hours
Quality		Not applicable	Not applicable	Household experiences voltage problems that damage appliances		Voltage problems do not affect the use of desired appliances	
Affordability		Not applicable for overall Tiers, but as a separate measure	Not applicable for overall Tiers, but as a separate measure	Cost of a standard consumption package of 365 kWh per year is more than 5 of household income	Cost of a standard consumption package of 365 kWh per year is less than 5 of household income		
Legality		Not applicable	Not applicable	No bill payments made for the use of electricity		Bill is paid to the utility, prepaid card seller, or authorized representative	
Health & Safety		Not applicable	Not applicable	Serious or fatal accidents due to electricity connection		Absence of past accidents	

* In this and all other Tier charts, the Tiers are listed in 6 groups from Tier 0 to Tier 5.

Access to electricity which is measured by the tier dimensions includes: capacity, availability (duration), reliability, quality, affordability, legality, health and safety. Households have been classified into tiers for each dimension, and overall tier is calculated based on the lowest of all the tiers.

3.1 Tier dimensions of access to electricity

The tier approach of access to energy is based on seven dimensions: Capacity, availability, reliability, quality, affordability, legality, and health and safety. The empirical numbers for these seven dimensions in Mainland Tanzania are shown below.

3.1.1 Capacity

Capacity may be measured directly, as the amount of watts accessible. This is the standard option if the household is connected to the grid. The alternative option is to measure the amount of power which may be used per day. This is the standard option if the source is a generator. A solar cell system is measured either as the capacity of the solar panels or by the amount available from the battery. The highest level of these indicators determines the overall capacity tier. If none of this information on capacity is available, a summary of available appliance service (the service capacity) may serve as a proxy indicator. In the following paragraphs capacity for each of the main sources of electricity is presented.

3.1.1.1 Grid capacity

The capacity of the grid is regulated by the main fuse or electricity meter. It is at least 2000W (2 kW) which is above the requirement for tier 5.

Thus, the 30 percent of all households that have access to power from the grid, are placed in the highest tier (tier 5) for this dimension.

Table 3.2 Percentage of Households by Access to Energy (AE) Tier Grid Capacity, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Tier in Grid Connection: percent of N=3.813 mill. households	0	0	0	0	0	100

3.1.1.2 Solar cell and solar battery capacity

If the main source of electricity is a solar home system, the calculation of both production capacity from the solar cell and storage capacity in batteries needs caution. The capacity is set by the minimum of the solar panel and the battery.

For example, a typical new solar panel has the effect of 60W for around 5 hours on a sunny day or $60W \times 5h = 300Wh = 0.3 kWh$ or in a week around 2kWh. This may be stored in a 12V battery as $2100Wh / 12V = 175 Ah$. We may expect a loss of up to 30

percent in charging a battery fully. In 10 sunny days, a 170Ah battery (common capacity) may be fully charged.

Only households that have solar home systems as their main source of electricity are relevant in this analysis. They comprise about 29 percent of the households in Mainland Tanzania. Table 3.3 shows the distribution of households in tiers based on solar panel capacity. Around 74 percent of households access power from solar panels of 3W, around 23 percent from solar panels of at least 50W, and 3 percent from solar panels of more than 200W. They fall in tiers 1, 2 and 3 respectively.

Table 3.3 Percentage of Households by Access to Energy (AE) Tier Solar Cell Capacity, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Tier in Solar Cell Capacity: percent of N=3.129 mill. households	0	74	23	3	0	0

Table 3.4 shows the distribution of households by tier based on battery capacity. Around 80 percent of households have a battery of at least 12Wh in a solar home system and around 17 percent have a battery of at least 200Wh. Around 3 percent of the households have a battery with a capacity of more than 1 kWh. This places them to tiers 1, 2, and 3 respectively.

Table 3.4 Percentage of Households by AE Tier Solar Battery Capacity, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Tier in Battery Capacity: percent of N=3.129 mill. households	0	80	17	3	0	0

The overall solar capacity is given by the minimum capacity of the solar panel and solar battery. On average, the battery has the lowest capacity in tiers. No household remains in tier 3 for both solar cell and battery capacity. Out of 12,845 households in Mainland Tanzania 2,397 have access to electricity by solar panel and/or battery. Of the households getting electricity through solar panel/battery, 92 percent are in tier 1, 8 percent in tier 2 and less than 1 percent are in tier 3 (Table 3.5).

Table 3.5 Percentage of Households by AE Tier Solar Cell and Battery Capacity, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Tier in Solar Cell & Battery Capacity: percent of N=3.129 mill. households	0	92	8	0	0	0

3.1.1.3 Generator capacity

A generator is an expensive means of generating electricity, unless a household is connected to a business where a running generator is needed. Only 4 thousand households out of 12.845 million in Mainland Tanzania, have access to electricity through a generator. Since the capacity of electrical generators is high, they all fall in tier 5. In the survey, all reported generators are in Dar es Salaam.

Table 3.6 Percentage of Households by Tier Aggregate Capacity in W, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Tier in Aggregate Capacity: percent of N=4.000 mill. households	0	0	0	0	0	100

3.1.1.4 Rechargeable battery capacity

Batteries are usually charged by a solar panel but may also be charged at a neighbour's household or a business with access to the grid or to a generator. The former is covered by the analysis in item 3.1.1.1, and the latter is covered here.

A rechargeable battery not charged by solar energy is the main source for only a few households. The batteries have limited capacity ranging within 150 to 950 Wh or less than 80 Ah. Of the households with this as the main source, 82 percent are in tier 1 and 18 in tier 2 (Table 3.7).

Table 3.7 Percentage of Households by Area and AE Tier Battery Capacity in Wh, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Tier in Battery Capacity: percent of Mainland Tanzania N=49,000 households	0	82	18	0	0	0
Dar es Salaam	0	0	0			
Other urban	0	88	12			
Rural	0	81	19			

Table 3.8 Percentage of Households by AE Tier Solar Lantern Capacity in Wh, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Tier in Solar Lantern Capacity: percent of N=841,000 households	0	100	0	0	0	0

3.1.1.5 Access to service capacity

There are number of households that did not provide technical information on power capacity although they reported access to electricity and ownership of electrical

appliances. A proxy measure of accessed electricity capacity is calculated by summing the power requirement across appliances owned by the household. Power demanding appliances will push the capacity upwards.

Out of 12.845 million households in Mainland Tanzania, 354 thousand (about 3 percent) did not provide information of main source of electricity but did have some electrical appliances. The electrical capacity for these households has been estimated through a proxy indicator. Of these households, 76 percent are in tier 1, 22 in tier 2, and tiers 3 and 4 have 1 percent each (Table 3.9).

Table 3.9 Percentage of Households by AE Tier Service Capacity if no other capacity in Wh, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	0	1	2	3	4	5
Tier in Proxy service capacity if not other capacity: percent of N=354,000 households	0	76	22	1	1	0

3.1.1.6 Peak capacity across the means of access to electricity

The overall distribution of households in the capacity Tiers are found by summing up the households in each Tier based on the various approaches to calculate capacity levels as explained above. Households with no electricity, and therefore zero power capacity, will be placed in Tier 0.

About 30 percent of households are found in Tier 5, this is mainly due to grid electricity, about 40 percent are in Tier level 0, 24 percent in Tier 1 and the remaining 5 are distributed across Tiers 2, 3 and 4.

Table 3.10 Percentage of Households by AE Tier Peak Capacity in Wh, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Tier in Access to electricity – capacity from any source: percent N=12.845 mill. households	42	26	3	0	0	30

Capacity is the base dimension of access to electricity, but the Beyond Connection approach includes 6 other dimensions which will be discussed in the following paragraphs.

3.1.2 Availability

Availability, or the duration of the period where electricity is available, is measured in hours for the main source of electricity and recorded both for 24 hours (we will in the following refer to this as “day”) as well as for night (after dark).

As illustrated in the matrix figure below, there are different requirements to reach a given Tier during day and during night. The final Tier is given by the lowest Tier of the two.

Of the households with only a solar lantern or a multilight system, about 25 percent do not have enough electricity available to reach above Tier 0. 25 percent have enough to reach Tier 5. In Dar es Salaam, almost 60 percent have enough to reach Tier 5.

Table 3.11 Percentage of Households by Area and Access to Electricity in Tiers - Availability, Mainland Tanzania, IASES 2021/22

ATTRIBUTE		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Availability	Daily Availability	Less than 4 hours	At least 4 hours		At least 8 hours	At least 16 hours	At least 23 hours
	Evening Availability	Less than 1 hour	At least 1 hour	At least 2 hours	At least 3 hours	At least 4 hours	
Tiers in percent of 7.543 mill. households with Access: Mainland Tanzania		35	2	10	39	11	3
Dar es Salaam		55	4	5	14	14	9
Other urban		43	2	13	29	12	1
Rural		25	2	11	52	10	0

For some households the main shortage is the lack of available electricity throughout the day and night, while for other the main shortage is by night. Hence the summarized availability is lower than each of the sub-dimensions.

There is also a clear tendency to more extreme Tier values during the night. Both the bottom Tier 0 and the top Tier 5 are largest during night. During the full day, the households are more widely spread across the Tiers. For the remaining 5 dimensions, Tier 0 and Tier 1 is not applicable for these dimensions.

3.1.3 Reliability

Tiers on reliability, quality, legality and health & safety are only applicable for households with access to grid. If no access to grid the overall Tier level is determined by the accessible power capacity and availability.

Reliability of electricity from grid is clearly a problem. A substantial share of households has disruption of the energy supply like every second day or at least 2 hours per week. Accordingly, they are placed in Tier 3.

Table 3.12 Percentage of Households by Area and Access to Electricity in Tiers – Reliability, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Reliability	Not applicable		More than 14 disruptions per week		At most 14 disruptions per week or at most 3 disruptions per week with total duration of more than 2 hours"	At most 3 disruptions per week with total duration of less than 2 hours
Tiers in percent of 3,813 mill. households connected to Grid: Mainland Tanzania	0		26		64	10
Dar es Salaam	0		26		62	12
Other urban	0		26		66	8
Rural	0		24		64	12

3.1.4 Quality

This dimension measures the quality of the power being delivered from grid. The quality is indicated by whether large voltage fluctuations may harm any appliances. Most of the households for which this dimension is relevant do not experience this problem. Still 17 percent have experienced that appliances have been damaged due to voltage fluctuation problems.

Table 3.13 Percent of Households by AE Tier Reliability if Access to Grid by Area, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Quality	Not applicable		Household experiences voltage problems that damage appliances		Voltage problems do not affect the use of desired appliances	
Tiers in percent of 3.813 mill. households connected to Grid: Mainland Tanzania	0		17		83	
Dar es Salaam	0		15		85	
Other urban	0		17		83	
Rural	0		20		80	

3.1.5 Affordability

Affordability is assessed for all households, irrespective of whether they are currently having access to electricity. This dimension records whether a household may afford to buy power like 1 kWh per day every day. This is close to the limit for cheap tariff in Tanzania. As long a household consumes less than 75 kWh in a three months period the

tariff will be modest. If the consumption increases above this amount, the tariff will triple.

Seventy-five (75) kWh in a 3 months period will be 0,833 kWh per day. Rather than using the minimum tariff, the price used for calculation will be the average amount paid by households in the survey sample. The average cost is calculated using all who remember, or noted, the last payment for the prepaid meter and amount of power purchased. The mean cost paid by households was TZS 343 per kWh. This average is about 50 percent higher than the minimum tariff.

Using the mean cost, the amount each household would pay for 365 kWh in a year was calculated. This is considered affordable if it is 5 percent or less of the household income.

As it is considered too difficult to register the income, the value of total household consumption is used as a proxy for the income.

Table 3.14 Percentage of Households by Area and Access to Electricity in Tiers - Affordability, all Households, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Affordability	Cost of 365 kWh per year is > 5% of household income			Cost of a standard consumption package of 365 kWh per year is less than 5% of household income		
Percent of 12.835 mill. Households: Mainland Tanzania	42			58		
Dar es Salaam	19			81		
Other urban	32			68		
Rural	49			51		

Table 3.15 Percentage of Households by Area and Access to Electricity in Tiers - Affordability by Area, Households Connected to Grid, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Quality	Not applicable		Household experiences voltage problems that damage appliances		Voltage problems do not affect the use of desired appliances	
Tiers in Percent of 3.813 mill. households connected to Grid: Mainland Tanzania	0		17		83	
Dar es Salaam	0		15		85	
Other urban	0		17		83	
Rural	0		20		80	

Table 3.14 shows that, more than half (58 percent) of the households in Mainland Tanzania may afford to pay for 1 kWh per day throughout the year. On the other hand, 42 percent would not be able to pay.

In order to summarize all dimensions of access to electricity, it is essential to know whether all households with access to the electricity at tier 2 or above may afford to pay for 1 kWh per day. The electricity bill turns out to be a burden by being above 5 percent of the household income for 23 percent of the households with access to electricity.

3.1.6 Legality

The indicator for legality is relevant only for households connected to the grid. Households can either be legally connected or illegally connected to the grid. It is measured indirectly and considered to be legal if the household is paying for the electricity or can explain why they get it without payment.

Table 3.16 shows that about one tenth households with a grid access cannot document legal or free payment for the electricity supply and are therefore placed in tier 3 or 2.

Table 3.16 Percentage of Households with Access to Grid by Access to Electricity in Tiers - Legality, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Legality	Not applicable		No bill payments made for the use of electricity		Bill is paid to the utility, prepaid card seller, or authorized representative	
Percent of 3.813 mill. households connected to Grid	0		8		92	

3.1.7 Health and safety

Health and safety are relevant to grid connection only. Electricity is a safe source of energy at household level when installed by authorized staff. But mistakes during instalment or repair may lead to an injury. Such injuries are not common, but 0.5 percent of the households reported some serious accidents. These households are placed in tier 3.

Table 3.17 Percentage of Households by Access to Electricity in Tiers - Health, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Health & Safety	Not applicable		Serious or fatal accidents due to electricity connection		Absence of past accidents	
Percent of 3.813 mill. households connected to grid	0		1		99	

3.2 Summarizing the 7 dimensions of access to electricity

Table 3.18 Percentage of Households by Access to Electricity in Tiers – 7 Dimensions, Mainland Tanzania, IASES 2021/22

ATTRIBUTE		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5	Total
Capacity	Power capacity ratings (W or daily Wh) including service used	42	24	3	0	0	30	100
Availability	Availability during day and night	35	2	10	39	11	3	100
Reliability	Disruptions			26		64	10	100
Quality	Voltage problems			17		83		100
Affordability	< or > 5 of income (total consumption as proxy)			23	77			100
Legality	Payment registered			9		92		100
Health & Safety	Accidents			1		100		100

The lowest tier level across the 7 dimensions should give the overall tier level. For some dimensions information is missing for some households. Households without any connection to electricity are not asked for reliability, quality, legality and health and safety by the electricity. For these households, the other tiers will determine the overall tier level.

The following figures show the resulting distribution of households and persons in the overall tiers. At the national level 69 percent of the households are in Tier 1 or below and 31 percent are in Tiers 2-5. Seven (7) percent are in Tier 4 or higher.

Table 3.19 Percentage of 12.796 million Households Overall Access to Electricity in Tiers split in 7 Dimensions, Mainland Tanzania, IASES 2021/22

DIMENSION		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5	
Capacity	Power capacity ratings (W or daily Wh) including service used	42	26	3	0	0	30	100
Availability	Availability during day and night	35	2	10	39	11	3	100
Reliability	Disruptions	78				19	3	100
Quality	Voltage problems	75				25		100
Affordability	< or > 5 of income (total consumption as proxy)	42			58			100
Legality	Payment registered	73				27		100
Health & Safety	Accidents	70				30		100
Overall Access to electricity	N=12.796 mill.	48	21	11	12	6	1	Household weight

Figure 3.1 Percentage of Households by Area and Overall Access to Electricity in Tiers, Mainland Tanzania, IASES 2021/22

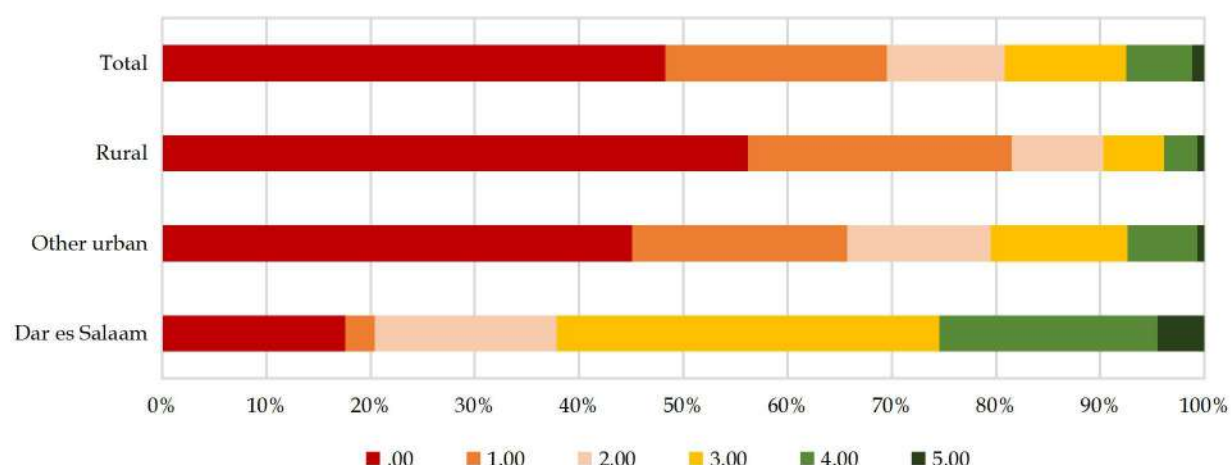


Figure 3.2 Percentage of Persons by Area and Overall Access to Electricity in Tiers, Mainland Tanzania, IASES 2021/22

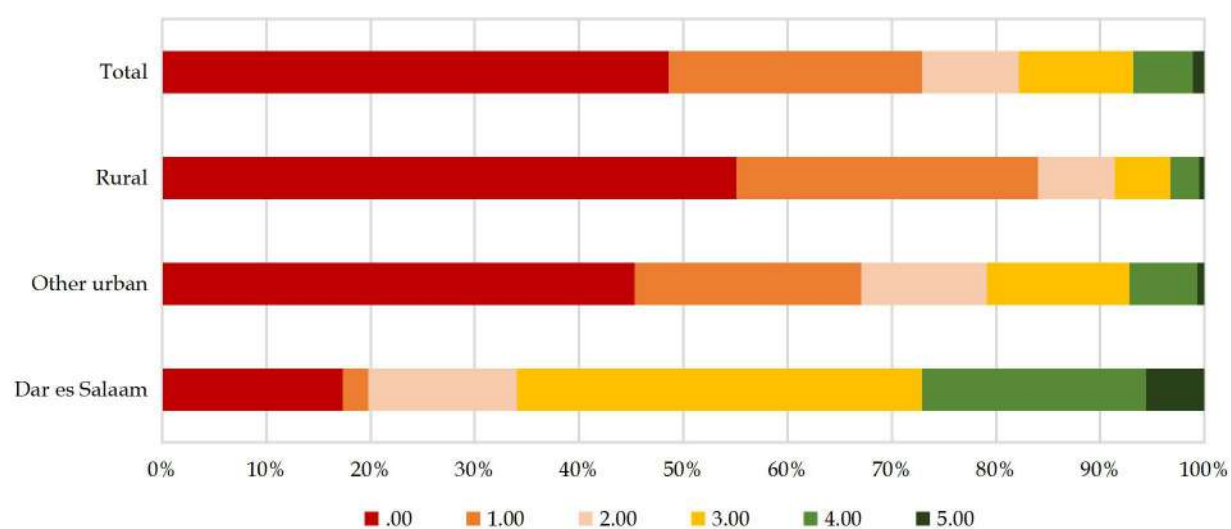


Figure 3.3 Percentage of Households by Region and Overall Access to Electricity in Tiers, Mainland Tanzania, IASES 2021/22

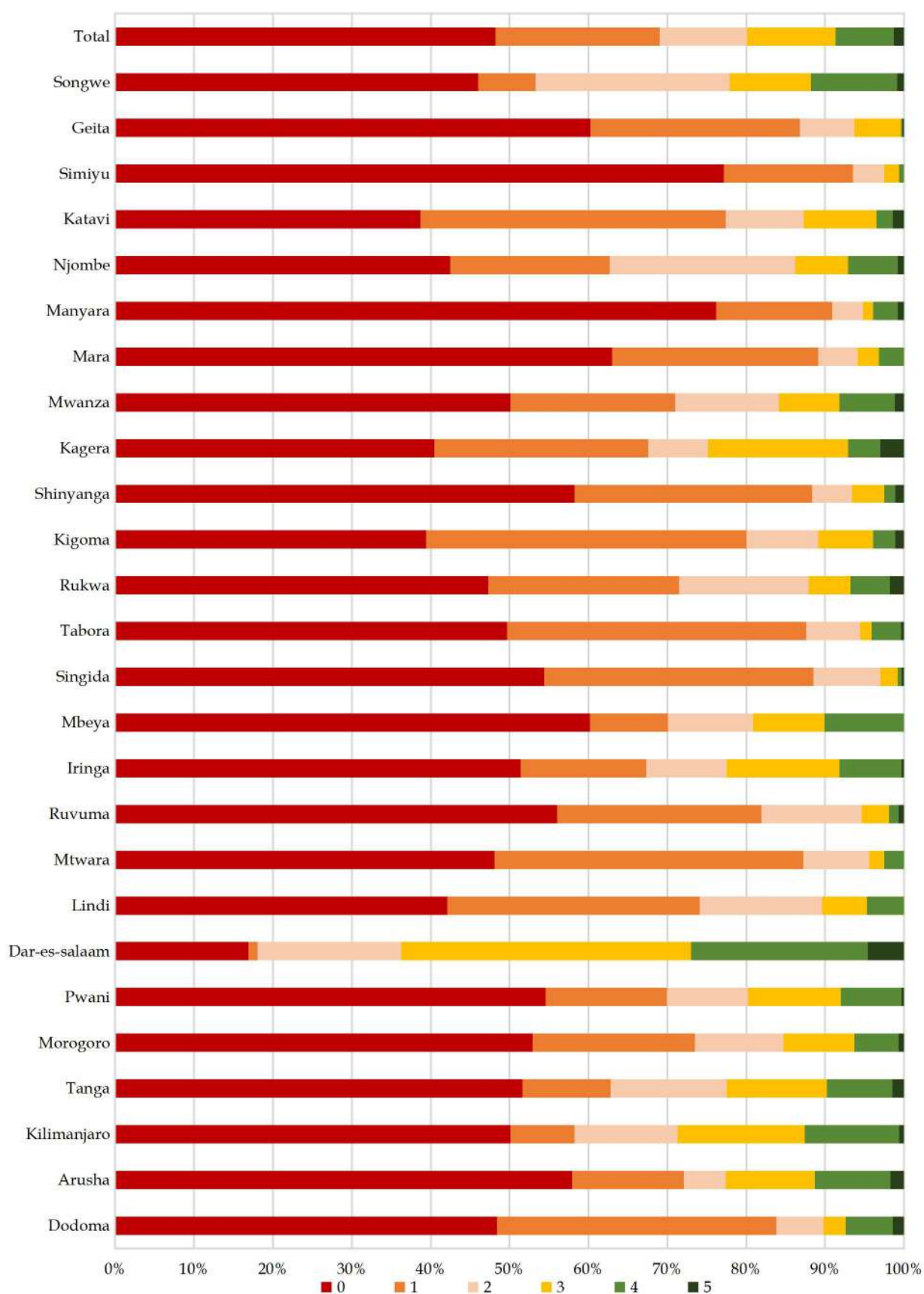
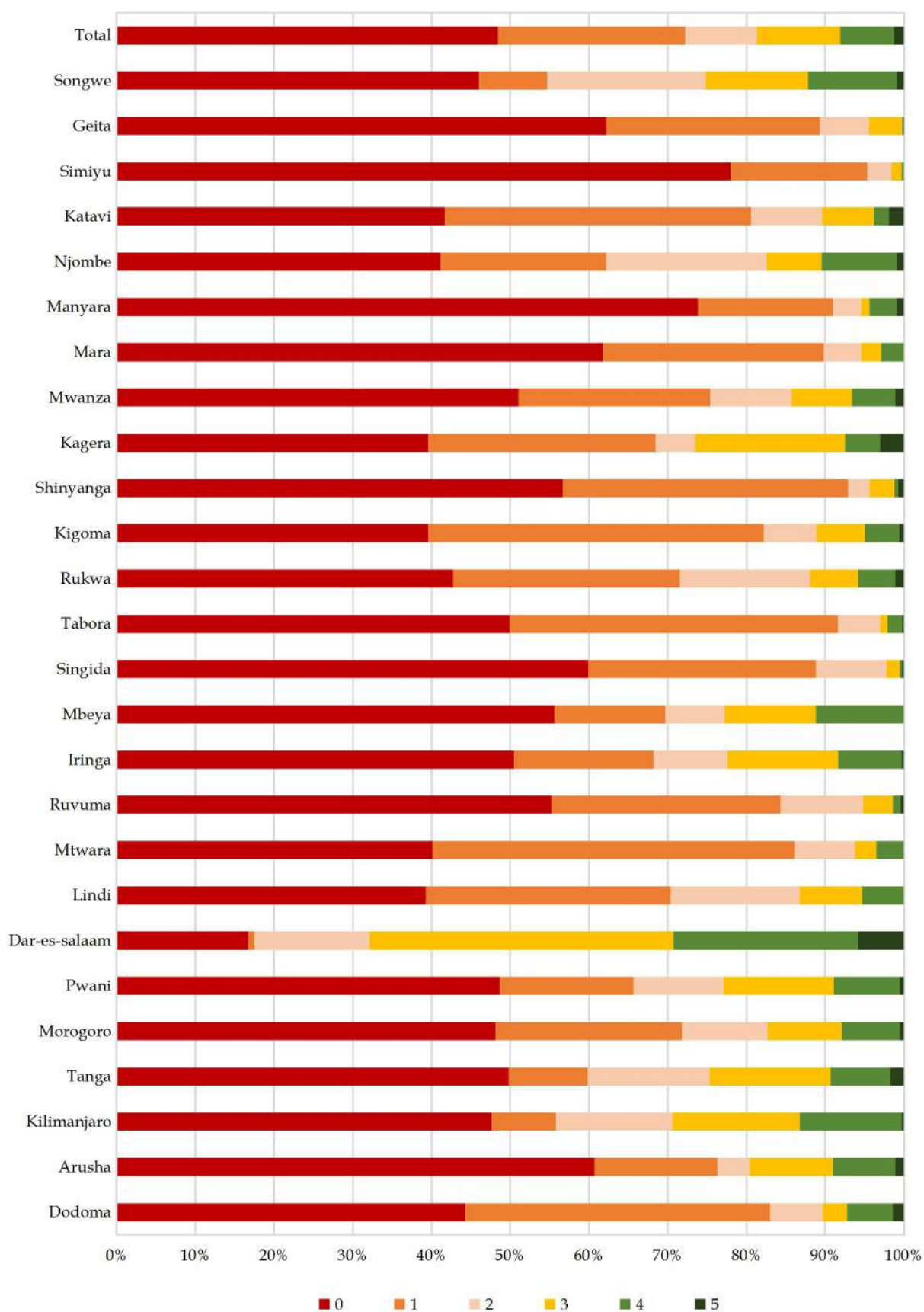
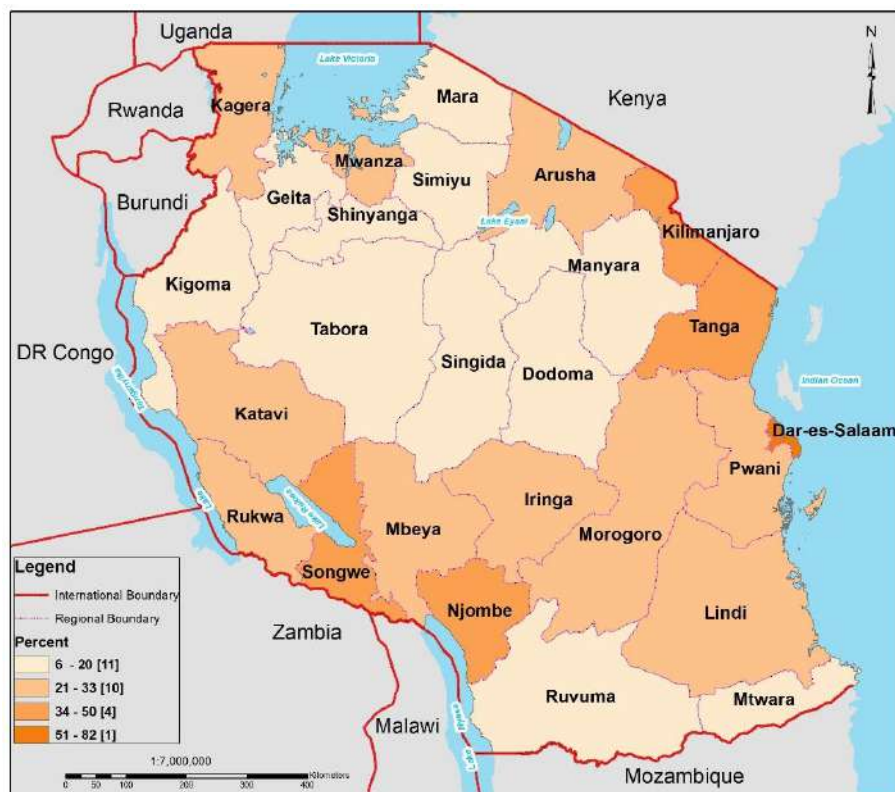


Figure 3.4 Percentage of Persons by Region and Overall Access to Electricity in Tiers, Mainland Tanzania, IASES 2021/22



In order to show the tier distribution by a readable map, we have collapsed Tier 2 to 5 in one group and presented the share of households in each region in a map, shown in Figure 3.5.

Figure 3.5 Percentage of Households with Overall Access to Electricity in Tiers 2-5 by Region, Mainland Tanzania, IASES 2021/22



3.3 Degree of access to electricity by the sex of household head

When summarizing the 7 dimensions of access to electricity, the percentage of households ending in the different tiers varies a lot from region to region in Mainland Tanzania. In the previous chapter we found out that households connected to the grid were much the same for male and female-headed households in all areas except for Dar es Salaam. In Dar es Salaam, 90 percent of the male-headed households were connected to the grid compared to 82 percent of the female-headed households. A similar situation was expected at tier level, but at tier level it extended to Rural Areas. In Dar es Salaam 67 percent of male-headed households are in tiers 3 to 5 compared to only 57 percent of female-headed households. In Rural Areas 65 percent of the female-headed households are in tier 0, but only 56 percent of male-headed households. In the Other Urban Areas, there are only small differences between female and male-headed households.

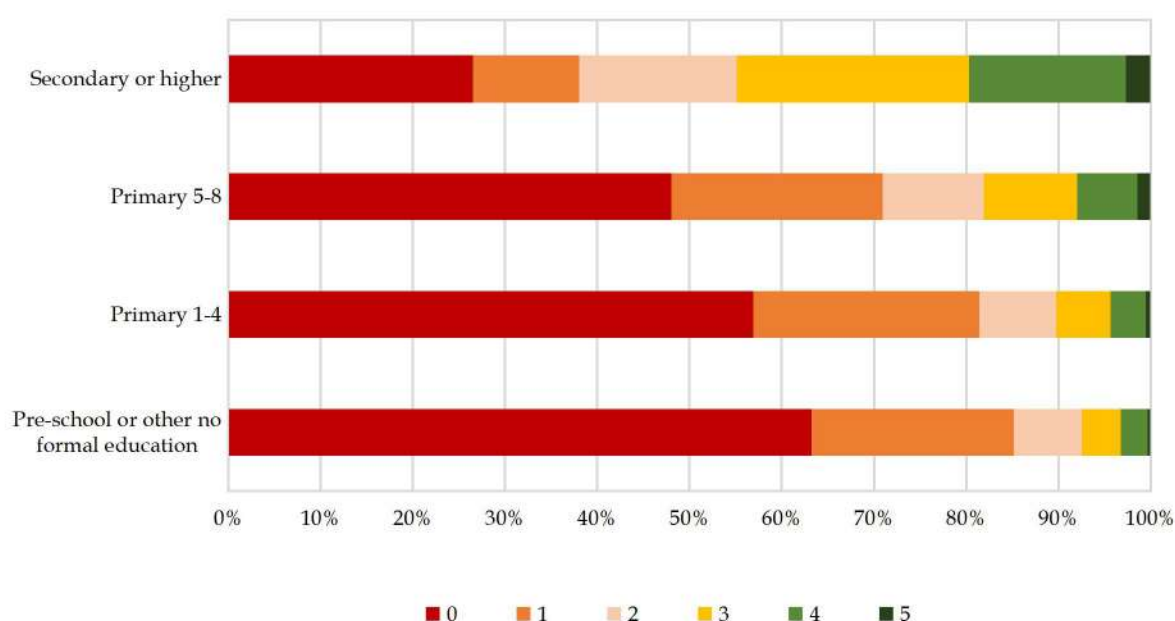
Table 3.20 Percentage of Households by Area, Sex of Household Head and Access to Electricity Tiers 0-5, Mainland Tanzania, IASES 2021/22

Area	Sex of household head	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Dar es Salaam	Male	14	1	18	40	23	4
	Female	22	1	20	32	20	5
	Total	16	1	18	37	22	4
Other urban	Male	29	13	19	23	15	2
	Female	33	8	22	19	15	3
	Total	30	11	20	22	15	2
Rural	Male	56	29	8	4	3	1
	Female	65	22	7	3	2	0
	Total	58	28	8	4	2	1

3.4 Degree of access to electricity by education of household head and by household income

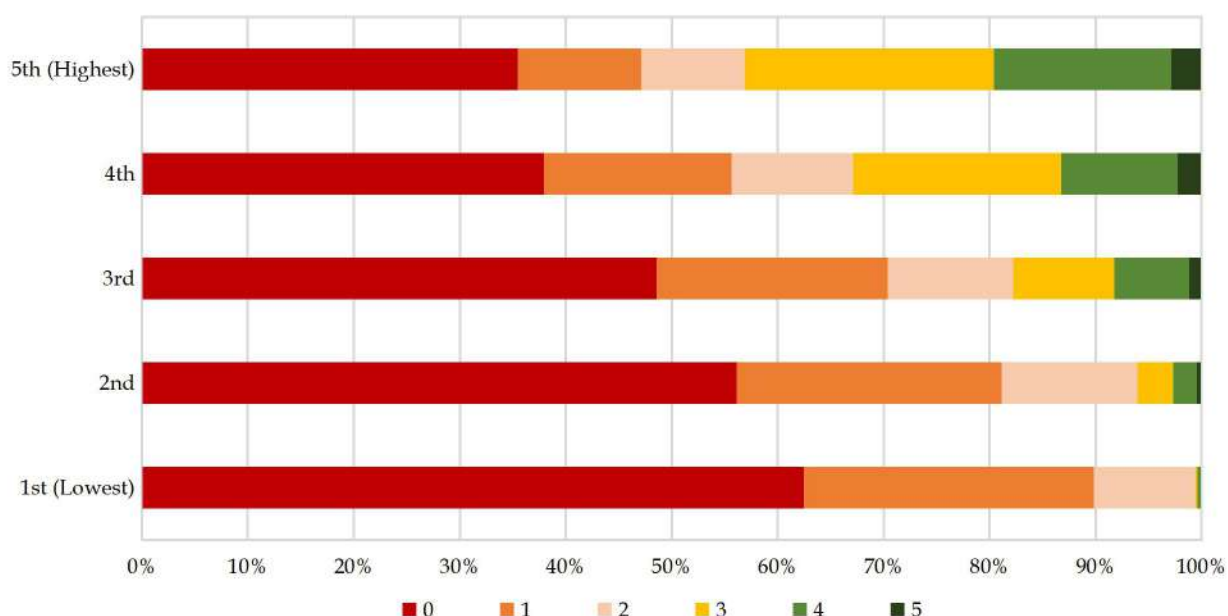
We have already noted how households end up in different tiers due to location and gender. Figure 3.6 shows that the educational background of the household head has even more effect than gender. Forty-five (45) percent of households whose heads have secondary education or higher are in tiers 3 to 5 compared to only 7 percent of households whose heads have no formal education.

Figure 3.6 Percentage of Households by Educational Level of Household Head and Access to Electricity in Tiers 0-5, Mainland Tanzania, IASES 2021/22



In this survey household income is measured by household's total annual expenditure. The household's total annual expenditure is divided into quintiles from the first (lowest) to the fifth (highest). The findings for income are similar to those on education. Forty-four (44) percent of the households in the highest wealth quintile are in tiers 3 to 5, while almost all households in the lowest quintile are in tiers 0 to 2.

Figure 3.7 Percentage of Households by Household Income and Access to Electricity Tiers 0-5, Mainland Tanzania, IASES 2021/22



3.5 Main lessons on Tier access to electricity

The following are the five main lessons learnt from combining the seven dimensions of access to electricity:

- **A great achievement.** The electrical power capacity has continued to increase since the two previous statistical surveys of 2016 and 2019/20 and has reached a new level. The IASES 2021/22 shows that 72 percent or almost three quarters of the households in Mainland Tanzania live in communities which fulfill the SDG 7 goal: “By 2030, ensure universal access to affordable, reliable and modern energy services”. However, not all households who live in communities with access to electricity are directly connected to it. Still 51 percent or more than half of the households fulfill the SDG7 by being connected to an electric source which give them electricity for at least 4 hours during the day and 1 hour at night on average. This has been achieved by fast development in both connection to the grid and solar energy alike.
- **An achievement both for grid connection and solar power.** The REA program has continued to provide grid connection to quite a number of rural communities. At the same time, the range of solar power devices have increased and now

available at both small cheap solar lanterns with limited energy supply and larger devices based upon separate or combined solar panels and batteries. Today solar power is an important source of electricity even for an average income household, particularly in rural areas. Due to relatively low capacity for many devices, households with solar power do not reach high tiers.

- **The main challenge.** The multi-dimensional approach has now identified two main challenges that need to be addressed in Mainland Tanzania. The first challenge is ensuring availability and reliability of the access to electricity for households with grid by ensuring the capacity of power delivery and improved maintenance of the grid-net. Only around 20 percent of the households have access to reliable electricity at tier 4 or 5 level. The second challenge is to identify the barriers for solar power in remote areas. Is this only a question of market price for panels and batteries or is there a need for structural improvements such as promoting battery subscription with annual recycling of batteries.
- **Only minor problems with other dimensions.** The multi-dimensional approach reveals that quality, legality and health and safety are not major problems.
- **Affordable access.** The system of TANESCO with a low tariff for households using less than 75 kWh per month clearly contributes to reduced mean price paid per kWh. The price triples for households using more kWh per months, but as long as a large percentage only use less than 75 kWh per month and stay at the low rate, the mean price is still less than double the low tariff. Hence, the majority of households with access to electricity may be able to pay the mean cost of 1 kWh per day within 5 percent of their total income.

Chapter Four

Access to Modern Cooking Solutions

The Sustainable Development Goal (SDG) number 7 is to assure “affordable, reliable, sustainable and modern energy for all within 2030”. Access to electricity is one, but only one sub-dimension of the goal.

The goal addresses access to energy. Energy is needed in the form of electricity for a number of technical issues, but usually energy for transport, heating and cooking is provided in other ways. At household level, the main non-electrical energy consumption is for cooking and in some countries also for heating. The energy carriers for cooking are usually solid fuel, gas (liquid gas and biogas), or liquid fuel but may also be covered by solar energy or electricity.

In order to develop and present a national energy strategy, it is essential to document the access to electricity and cooking solutions in a joined manner. Traditional energy solutions based upon solid fuel, either firewood or charcoal provides energy for both light and cooking. Access to electricity allows for a wider approach for cooking by closed and more efficient ovens.



Traditional three stone fireplace



LPG- stove

The main international goal and indicators are the overarching SDG 7 of affordable, reliable, sustainable and modern energy for all within 2030. All these dimensions relate to multiple sub-dimensions within the household and in the wider society context.

In this survey the main focus is on access to household cooking solutions as presented in the reference report “*Beyond Connections: Energy Access Redefined*” [2].

The cooking solutions in Tanzania are presented in three steps:

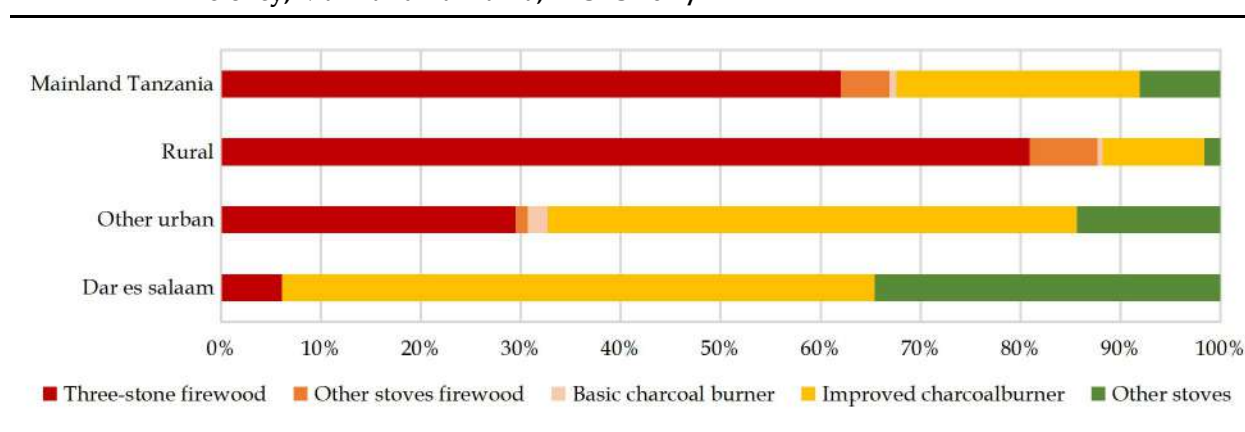
- First, an overview of fuel and main types of cooking ovens.
- Second, a comprehensive list of the main cooking ovens used.
- Third, a more detailed presentation on emissions and efficiency of the main cooking ovens used by a range of households.

4.1 An overview of fuel and main types of cooking ovens

4.1.1 Fuel and stove types used for cooking

Two thirds (67 percent) of all households in Mainland Tanzania use firewood as their main source of energy for cooking according to IASES 2021/22, compared to 61 percent in HBS 2017/18 and 81 percent in the National Sample Census of Agriculture (NSCA) 2019/20. The NSCA focused on agricultural areas where firewood is more commonly used. Charcoal is the second most common source of energy used for cooking and is used by 25 percent of the households, compared to 15 percent in the NSCA 2019/20. Type of fuel used for cooking varies much over the regions. In rural areas around 88 percent of the households use firewood, but only 6 percent do in Dar es Salaam (Figure 4.1). In Dar es Salaam as in other urban areas, charcoal is the most common fuel used for cooking. “Other stoves” are usually gas ovens using LPG. In Dar es Salaam, 34 percent of households use gas while electricity is used by less than one percent. In other urban areas, 2 percent of households use electricity for cooking, while almost 14 percent use gas. In rural areas, less than 2 percent use gas, and none use electricity for cooking.

Figure 4.1 Percentage of Households by Area and Main Cooking Stove by Type of Fuel and Efficiency, Mainland Tanzania, IASES 2021/22



4.1.2 Stoves used for cooking by female and male headed households

When we compare findings from the same areas in Mainland Tanzania, between male and female-headed households, we find small differences in Dar es Salaam and rural areas but about the same in other urban areas. In Dar es Salaam the percentage of female-headed households using improved charcoal burners is 50 percent and for male-headed households is 56 percent. On the other hand, the percentage of female-headed households using other types of improved stoves is larger than that of male-headed households. In rural areas, the use of three-stone firewood stoves is more common for female-headed (84 percent) than male-headed households (80 percent).

Table 4.1 Percentage of Households by Area, Sex of Household Head and Main Cooking Stove by Type of Fuel, Mainland Tanzania, IASES 2021/22

Area	Sex of household head	Three-stone firewood	Other stove firewood	Basic charcoal burner	Improved charcoal burner	Other stoves	Total
Dar es Salaam	Male	6	0	0	56	38	100
	Female	7	0	0	50	44	100
	Total	6	0	0	54	39	100
Other urban	Male	29	1	2	53	15	100
	Female	30	1	3	52	14	100
	Total	30	1	2	53	15	100
Rural	Male	80	7	0	11	2	100
	Female	84	5	1	8	2	100
	Total	81	7	1	10	2	100

4.2 Typology of the main cooking ovens used

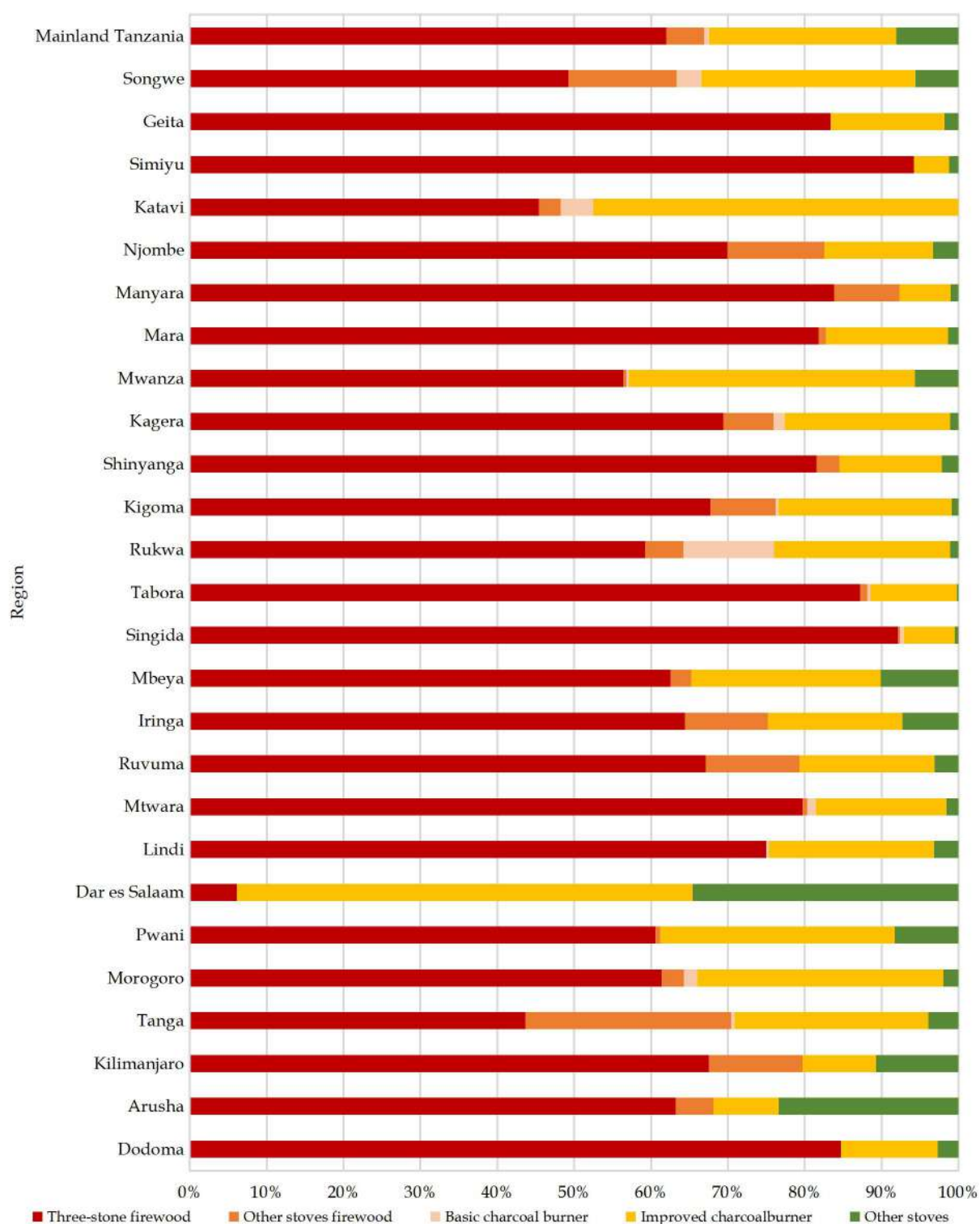
In each country, based upon emission and efficiency level standards, the main types of cooking stoves are identified, classified, and documented by photos using groups of stove design, fuel, and ventilation. This survey builds upon the typology from Rwanda and Ethiopia, such as documented in the Rwanda report: Rwanda, Beyond Connections, Energy Access Diagnostic Report Based on the Multi-Tier Framework (2018), Table 2 page 8, shown below.

Table 4.2 Detailed Description of Draft Cooking Stove Typology

Type of fuel	Description of level	Tier
Firewood, dung, twigs and leaves	Three-stone, tripod, flat mud ring	0
	Conventional improved cooking solutions (ICS)* (closed oven with separate openings for firewood etc. and pots)	1
	ICS with Chimney (as conventional ICS plus chimney), rocket stove with conventional material for insulation	2
	Rocket stove with high insulation, rocket stove with chimney (not well sealed)	3
	Rocket stove with chimney (well-sealed), rocket stove gasifier (rocket stove with two chambers, one for firewood and one for the burning gas), batch feed gasifier (burning solid fuel which is added to the burning chamber in batches)	4
Charcoal	Traditional charcoal stoves	0
	Old generation ICS (with open chamber for charcoal)	1
	Conventional ICS (closed oven with separate chambers and openings for charcoal and pots)	2
	Advanced insulation charcoal stoves, kerosene oven	3
	Advances secondary air charcoal stoves (tightly closed burning chamber with controlled entry of air)	4
Rice husks, pellets and briquettes	Natural draft gasifier (only pellets and briquettes)	3
	Forced air	4
LPG and biogas, electricity (grid or solar), solar oven (non-electric)		5

*ICS: Improved Cooking Stove may be improved in several steps, separate intake of air and fuel, regulate the air flow, insulate the burning chamber, forced flow of burning gases and smoke.

Figure 4.2 Percentage of Households by Region and Main Cooking Stove by Type of Fuel and Improved Efficiency, Mainland Tanzania, IASES 2021/22



As expected, and documented in this survey, firewood is the dominant fuel in rural areas, while charcoal dominates in urban areas. In the case of fuel, there is a major difference in the cook stoves efficiency in rural and urban areas. In urban areas, hardly household has a traditional open charcoal burner without an option to stop or regulate

the airflow to improve the efficiency and if needed, reduce the emission of smoke and gases. Less than one percent of households using traditional charcoal burner have no improved airflow regulation.

In rural areas, only 1 in 14 households using firewood have a cooking stove with improved efficiency. The variation is however large across the regions. In Tanga 1 in 4 households has an improved cooking stove for firewood, while there is hardly any in Simiyu, Geita and Lindi. In order to develop a strategy for moving to more efficient and low emission cooking stoves for firewood, it will be important to look into further details. This will be done in the paragraph on cooking stove tiers.

In the review of tier level, the range of improved cooking stoves for firewood will also be considered. Installing more efficient cooking stoves for firewood can bring the households to another tier level and the households can save money or time from buying or collecting firewood as the need of firewood will be less with an improved oven. The ovens that are in use in Tanzania will be presented in section 5.3.1 below we give only a short description.

The list of ovens presented in section 5.3.1 builds upon reports by specialists in Mainland Tanzania, and observations during a pretest of the survey. The list presented is limited to cooking ovens registered by households as their main oven. The original list includes solar cooker, but this was not registered by any household in the survey.

The approach for collecting information on the available ovens starts with the fuel types. For each type of fuel, the pictures of ovens with the explanatory text are used to identify the type of oven and which is the main oven for the household.

Note that since most of the detailed information provided pertains to the main oven, detailed tabulated information on cooking ovens is for main ovens.

The list of cooking ovens is presented in photos and classified by fuel, efficiency, and tier.

Chapter Five

Multi-Tier Framework for Cooking Solutions

The reference report of “Beyond Connections: Energy Access Redefined”[2] presents six dimensions on how cooking ovens contribute to a sustainable and clean access to energy. As for the case of access to electricity, each of these dimensions is measured and classified in Tiers from 0 to 5, where 5 is the highest degree of access.

An adapted table for the reference report presents the conceptual dimensions.

Table 5.1 Multi-Tier Framework for Cooking Solutions

DIMENSION	TIER0	TIER1	TIER 2	TIER 3	TIER 4	TIER 5
Indoor air quality			Concentration of PM2.5 and CO; Tiers aligned with WHO guidelines			
Efficiency			Draft tier benchmarks have been developed. But the process to reach ISO standards is still pending.			
Convenience			Stove preparation time and fuel collection and preparation			
Safety			Absence of accidents and alignment with the ISO process			
Affordability			Levelized cost of cooking solution < 5 percent of household income			
Quality and availability of fuel			Cooking not affected by seasonal variations in fuel quality and availability			

The module on access to Household Cooking Solutions is designed to measure the 6 cooking related dimensions ranging from health impact to economic impact such as efficiency and convenience.

The global set of measurement dimensions is designed to serve any country based upon a multi-tier approach, each ranging from tier 0 to 5. Initially fuel quality was also included, but it is not efficient to include it in a household survey since the measurement requires a technical survey at the local level. The final tier of access is determined by the lowest tier for any of the 6 dimensions. Emissions, indoor emissions, and efficiency all ideally require professional measurement and analysis. The approach would then be to measure all types of ovens in a lab for emissions, indoor emissions, and efficiency, store this information in a database⁴ and then record which of these ovens is used by each household. With such information plus information on time use, cooking area and accidents, the tier may be estimated for each household.

This ideal approach is designed for research on emission etc. for each type of oven and is far too demanding for a survey. Hence for the current project a proxy system has been designed. This system is comparable with the global system as defined in “Beyond Connections: Energy Access Redefined”. This proxy system can also be used in other national projects to serve national users.

⁴ <http://catalog.cleancookstoves.org/>

5.1 Requirements for all tiers and dimensions for cooking solutions

The global database contains a large number of cooking ovens that have been tested by the producing companies and the technical team of the global database. There is a need, however, to supplement the database with cooking ovens which are common in each country. The surveys on multi-tier access supported by the World Bank developed a simplified Adapted Multi-Tier Framework for measuring access to modern energy cooking solutions for countries like Cambodia, Rwanda, and Ethiopia, using broader groups of stove design, fuel, and ventilation.

This adapted version is used as matrix also for this survey.

Table 5.2 Adapted Multi-Tier Framework for Measuring Access to Modern Energy Cooking Solutions

ATTRIBUTES		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Cooking Exposure	Emission: Fuel	Firewood, dung, twigs, leaves, rice husks, processed biomass pellets or briquette, charcoal, kerosene				Biogas, ethanol, high quality processed biomass pellets or briquettes	Electricity, solar, LPG
	Emission: Stove Design	Three-stone fire, tripod, flat mud ring, traditional charcoal stove	Conventional or old generation Improved cooking solutions (ICS)	ICS+ chimney, rocket stove or ICS + insulation	Rocket stove with high insulation or with chimney, advanced insulation charcoal stoves	Rocket stove with chimney (well-sealed), Rocket Stove gasifier, Advanced secondary air charcoal stove, forced air	
	Ventilation: Volume of Kitchen	Less than 5 m ³	More than 5 m ³	More than 10 m ³	More than 20 m ³	More than 40 m ³	Open air
	Ventilation: Structure	No opening except for the door	1 window	More than 1 window	Significant openings (large openings below/ above door-height)	Veranda or a hood is used to extract the smoke	Open air
	Alternative proxy: Ventilation level	Bad			Average	Good	
	Contact Time	More than 7.5 hours	Less than 7.5 hours	Less than 6 hours	Less than 4.5 hours	Less than 3 hours	Less than 1.5 hours
Cookstove Efficiency	ISO's Vol. Performance Targets (TBC)	Less than 10	More than 10	More than 20	More than 30	More than 40	More than 50
Convenience	Fuel acquisition (collection or purchase) and preparation time (h/w)	More than 7 hours		Less than 7 hours	Less than 3 hours	Less than 1.5 hours	Less than 0.5 hour
	Stove preparation time (minutes per meal)	More than 15 minutes		Less than 15 minutes	Less than 10 minutes	Less than 5 minutes	Less than 2 minutes
Safety of Primary Cookstove		Serious accidents over the past 12 months				No serious accidents over the past 12 months	
Afford-ability		Levelized cost of cooking solution (fuel) more than 5 % of household income				Levelized cost of cooking solution (fuel) less than 5 of household income	
Fuel Availability		Primary fuel available less than 80 days of the year				Primary fuel is readily available 80 days of the year	Primary fuel readily available throughout the year

5.2 Cooking solution dimensions

In addition to the type of cooking stoves, information for emissions and efficiency for several attributes contained in the Multi-Tier Framework as presented is also needed.

The following dimensions are important and will be covered one by one and at the end determine the Tier level for the overall cooking solutions:

- Cooking Exposure
- Cooking Efficiency
- Cooking Convenience
- Cooking Safety
- Cooking Affordability
- Cooking Availability
- Cooking Solution

5.2.1 Cooking exposure

The cooking exposure depends on both the emission from the oven and the ventilation of the kitchen or cooking area.

To estimate cooking exposure, the first step is to determine the tier for *emissions* in a household based on its main stove. Each stove used by a household is classified by a combination of the stove design and the primary fuel used with that stove.

The second step is to determine the *ventilation* for the cooking area, categorized by the location of the cooking activity. A household that prepares its meals indoors in an area with fewer than two openings (windows and doors) to the outside is classified as having poor ventilation. A household that prepares its meals indoors in an area with two or more openings is classified as having average ventilation. And a household that cooks its meals outdoors or at an open veranda is classified as having good ventilation.

Ventilation mitigates the indoor air pollution that a household is exposed to by diluting the concentration of emissions from polluting fuels and expelling the pollutants from the cooking area.

The third step is to determine the *contact time*. As described in Table 3, the shorter the contact time, the higher the tier rate. If the contact is less than 1.5 hours per day, the households are located in tier 5. Every increase of 1.5 hours makes a decrease of 1 tier unit.

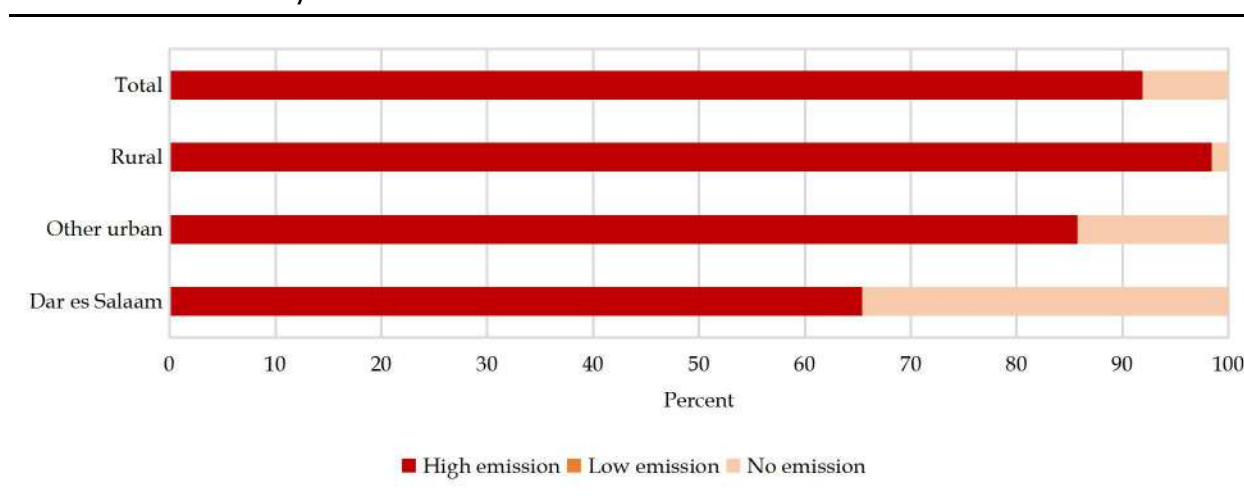
Households in tier 0 for emissions remain in tier 0 for cooking exposure if the oven has poor or average ventilation but move to tier 1 with good ventilation. Households in tiers 1 to 3 for emissions (using a traditional cookstove or ICS) move down one tier for exposure if the oven is poorly ventilated, remain in the same tier if the oven has average ventilation, and move up one tier if the oven has good ventilation. Households in tier 4 for emissions remain in tier 4 for cooking exposure if they have poor or average ventilation and move to tier 5 if they have good ventilation. Households in tier 5 for emissions remain in tier 5 regardless of ventilation.

Cooking exposure is composed of several sub-attributes related to emission, ventilation and contact time.

5.2.1.1 Emissions due to fuel

Emission from burning fuel depends on the main fuel used, not considering the possibilities to switch between fuels.

Figure 5.1 Percentage of Households by Area and Level of Fuel Emission, Mainland Tanzania, IASES 2021/22



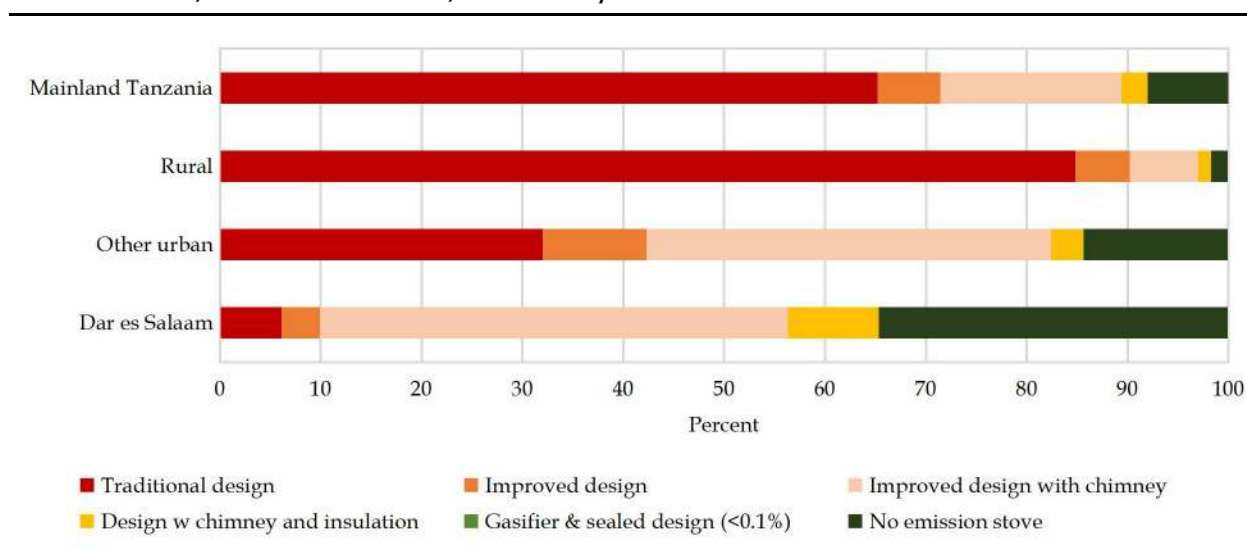
The emissions are high when cooking with solid fuels, like firewood, charcoal, dung or other solid biomass. Almost all households in rural areas use solid fuels, thus, potentially exposing people to unhealthy fumes. The question is then whether the emission can be reduced by using a stove with an improved design.

5.2.1.2 Emission due to the stove design

Ovens fueled by electricity, solar cooker or LPG are classified as tier 5. For ovens using other fuels, the stove design decides tier allocation.

Three-stone, tripod, flat mud ring, and traditional charcoal stoves are allocated to tier 0. Conventional or old ICS with no chimney are classified to tier 1. ICS with chimney, rocket stove with conventional material for insulation are allocated to tier 2. Rocket stove with high insulation, rocket stove with chimney (not well sealed) are in tier 3, while rocket stove with chimney (well-sealed), rocket stove gasifier, and batch feed gasifier are allocated to tier 4.

Figure 5.2 Percent of Households by Area and Cooking Exposure - Emission: Stove Design Tiers 0-5, Mainland Tanzania, IASES 2021/22



A considerable share of the households in urban areas use stoves with an improved design or even better, with a chimney. In Dar es Salaam, more than 9 in 10 households and in other urban areas more than 2 in 3 households, have stoves with some sort of improved design. In rural areas, the situation is very different as only 1 in 10 households have ovens with some improved design.

5.2.1.3 Overall emission

The overall emission is given by the highest level of emission due to type of fuel and oven. Even if solid fuel is at tier 3 level, stove design may bring the households to lower tiers.

Figure 5.3 Percentage of Households by Area and Cooking Exposure - Overall Emission Tiers 0-5 Mainland Tanzania, IASES 2021/22

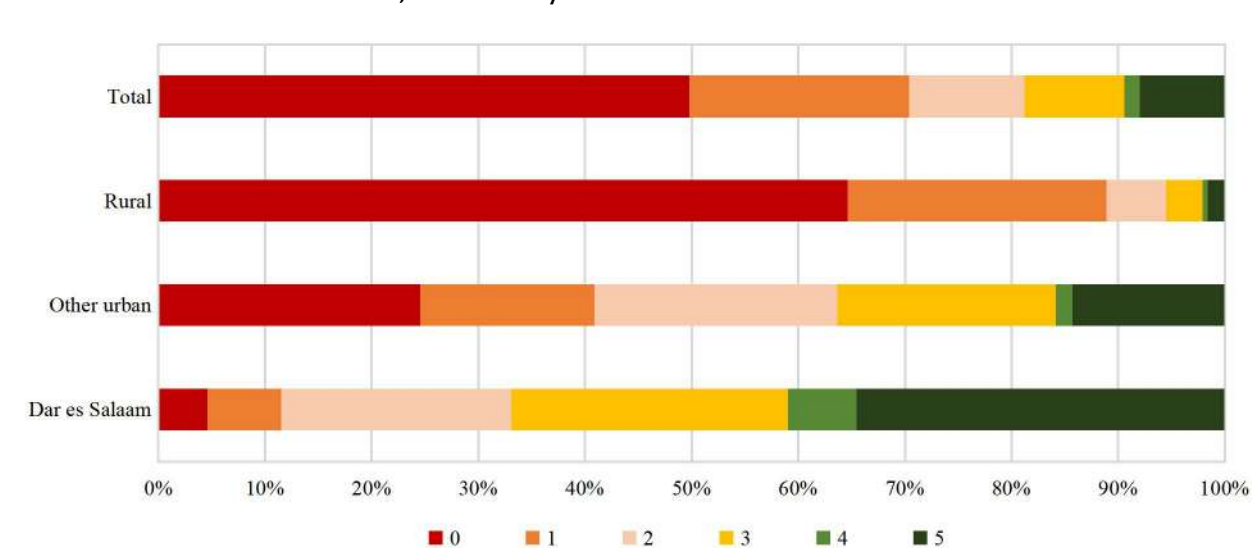


Table 5.3 Percentage of Households by Cooking Exposure - Overall emission Tiers 0-5, Mainland Tanzania, IASES 2021/22

ATTRIBUTES	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Emission: Fuel	Firewood, dung, twigs, leaves, rice husks, processed biomass pellets or briquette, charcoal, kerosene				Biogas, ethanol, high quality processed biomass pellets or briquettes	Electricity, solar, LPG
Emission: Stove Design	Three-stone fire, tripod, flat mud ring, traditional charcoal stove	Conventional or old generation ICS	ICS+ chimney, rocket stove or ICS + insulation	Rocket stove with high insulation or with chimney, advanced insulation charcoal stoves	Rocket stove with chimney (well-sealed), Rocket Stove gasifier, Advanced secondary air charcoal stove, forced air	
Overall Percent	65	6	18	3	0	8

Even if, solid fuel has a proper level of emission at tier 3 level, it is the stove design that determines the levels at tier 3 or below.

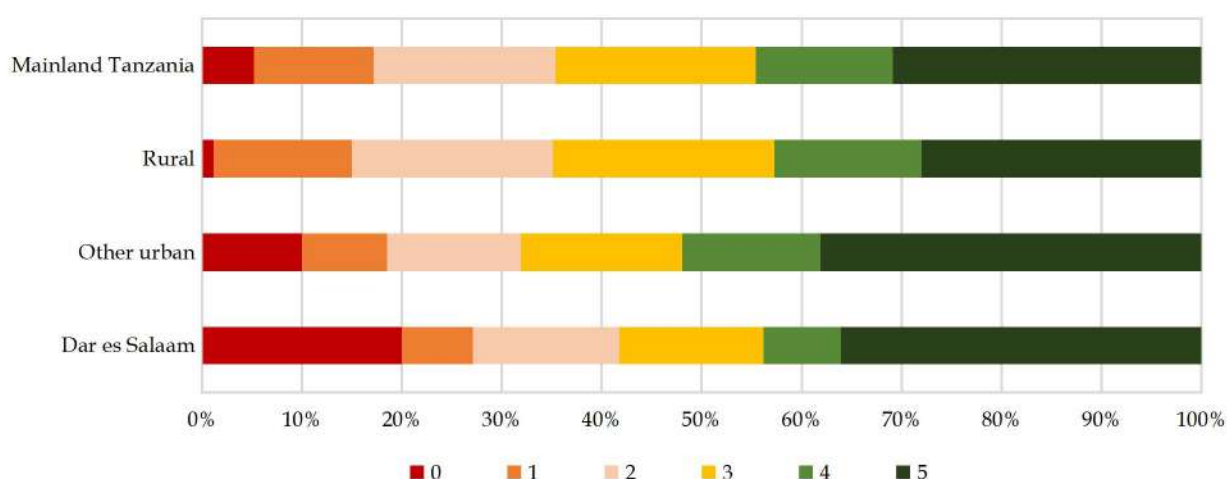
For households in low altitudes in the tropical zone there is a little need for heating the house. Hence stove design with considerable emission, may be compensated, by proper ventilation of the kitchen. In order to document the situation, the level of ventilation has been calculated in several steps.

5.2.1.4 Cooking exposure due to volume of the kitchen and ventilation structure and level

5.2.1.4a Ventilation: Volume of kitchen

The Volume of the kitchen and the ventilation structure are captured in two sets of questions. Ventilation is expected to be lower in cooking areas during the rainy season because households cook indoors. During the dry season, some households use an open or partially open kitchen. Then both volume and ventilation are captured. The first sub-dimension calculates the volume of the cooking area.

Figure 5.4 Percentage of Households by Area and Cooking Exposure - Ventilation: Volume of Kitchen Tiers 0-5, Mainland Tanzania, IASES 2021/22

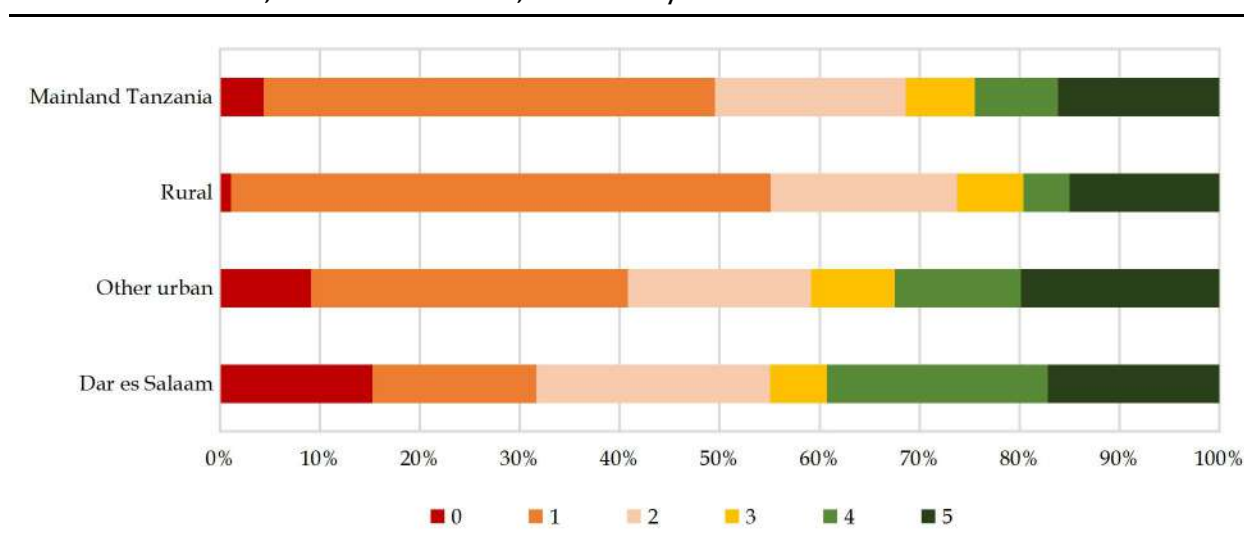


The volume of the kitchen is large across the country and follows an opposite pattern of the stove design and high emission from solid fuel. In rural areas separate kitchen huts are common.

5.2.1.4b Ventilation: Structure

This second sub-dimension calculates the ventilation structure of the cooking area based upon the numbers of windows, doors and an open structure in the cooking area.

Figure 5.5 Percentage of Households by Area and Cooking Exposure – Ventilation: Structure Tiers 0-5, Mainland Tanzania, IASES 2021/22



In Dar es Salaam and other urban areas, there are households that lack proper ventilation through doors and windows, but in general the quality and ventilation levels are quite high.

5.2.1.5 Cooking exposure – overall ventilation level

This sub-dimension summarizes the ventilation across kitchen volume, ventilation structure, and the ventilation level.

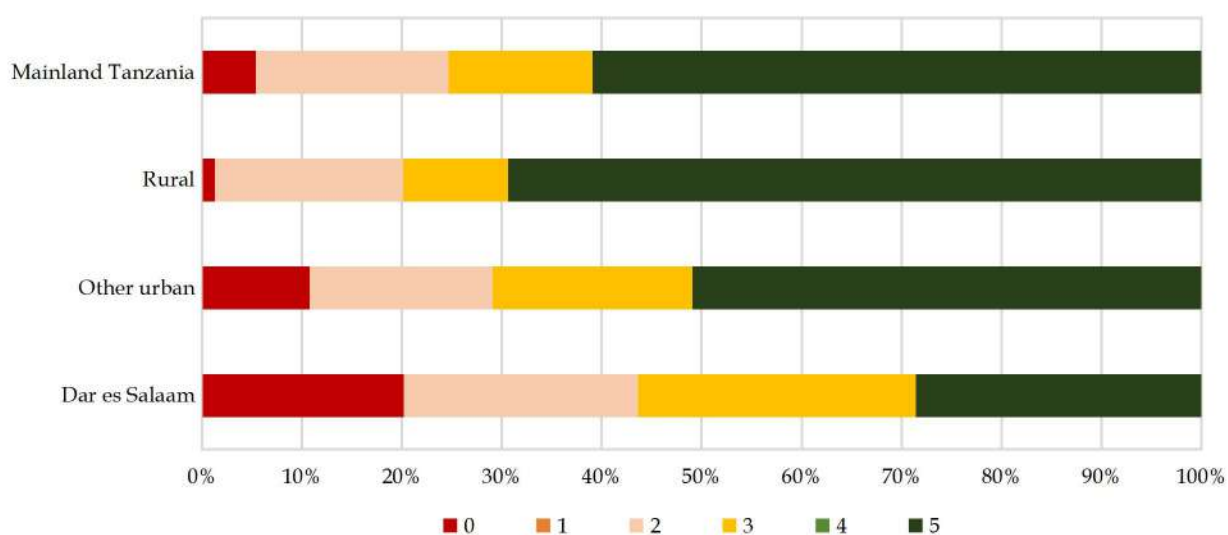
Reaching a high tier of overall ventilation level, requires having an acceptable level of each dimension. However, with the highest level in even one dimension it is possible to reach a high combined overall ventilation level.

Table 5.4 Percentage of Households by Cooking Exposure, Ventilation Attributes and Ventilation Level Tiers 0-5; Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Ventilation: Volume of kitchen	Less than 5 m ³	More than 5 m ³	More than 10 m ³	More than 20 m ³	More than 40 m ³	Open air
Percent	5	12	18	20	14	31
Ventilation: Structure	No opening except the door	1 window	More than 1 window	Significant openings (large openings below/ above door-height)	Veranda or a hood is used to extract the smoke	Open air
Percent	4	45	19	7	8	16
Overall ventilation level*	5	19			14	61

*When the volume of the kitchen and the ventilation structure are combined, the number of Tiers are collapsed as recommended in the Beyond Connection report[2].

Figure 5.6 Percentage of Households by Area and Cooking Exposure - Overall Ventilation Level Tiers 0-5, Mainland Tanzania, IASES 2021/22



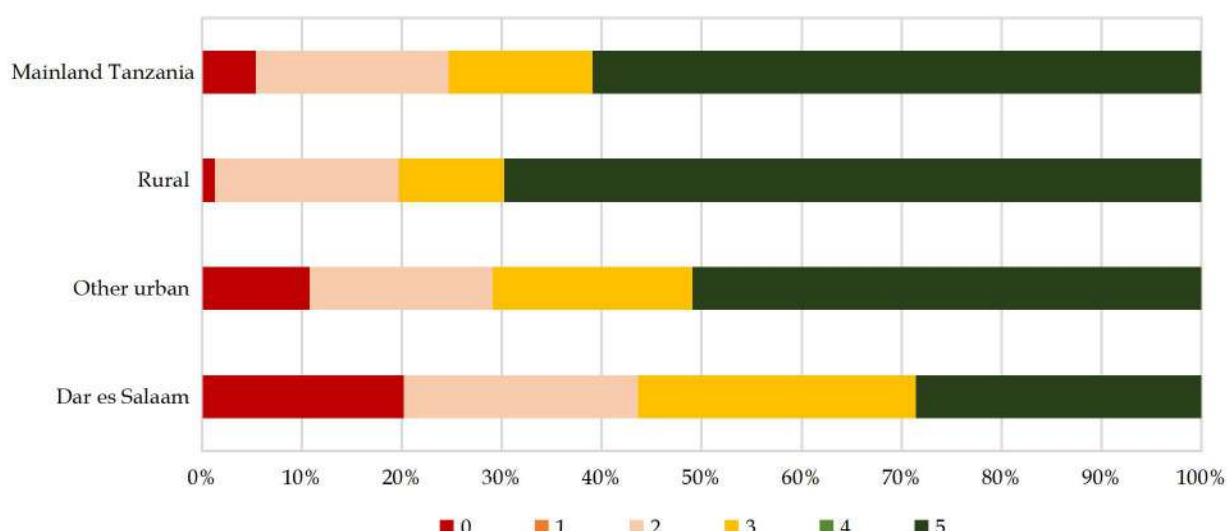
As the table above shows, the ventilation level is quite high. This is mainly due to cooking in open air or having a separate open kitchen houses with at least three open sides.

5.2.1.6 Cooking exposure – direct proxy calculation of ventilation level

This third sub-dimension of cooking exposure calculates the ventilation level as an alternative to the ventilation structure for the cooking area. No ventilation gives tier 0 to 2, large opening and/or fan is defined as tier 3, while veranda, open air, hood or chimney are classified as tier 4 and 5.

This information is just a proxy to be used in the following calculation of the overall ventilation level if either the kitchen volume or kitchen ventilation structure is missing.

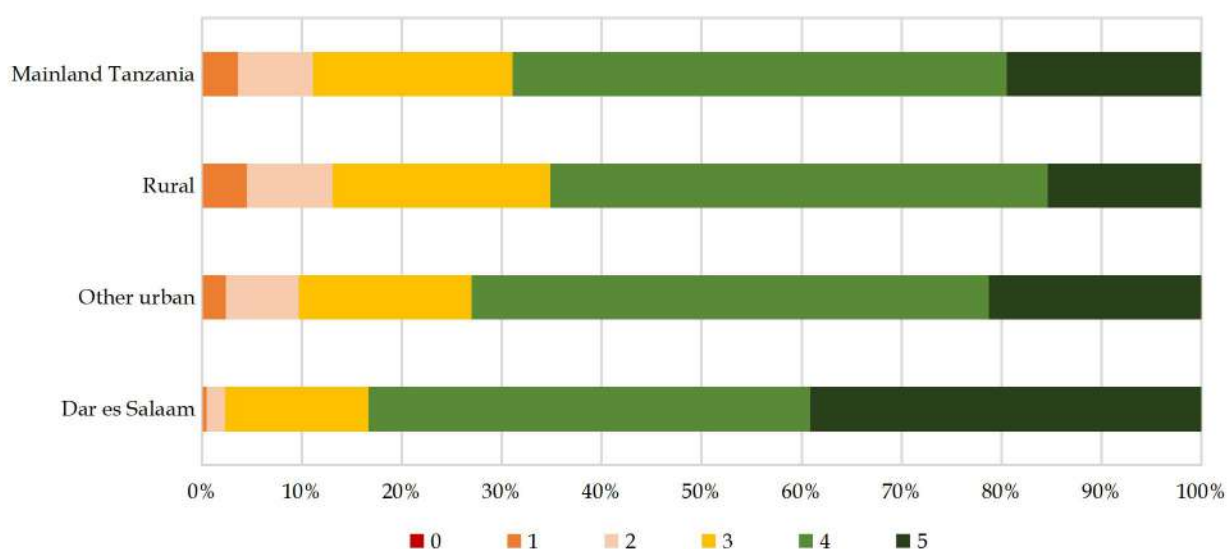
Figure 5.7 Percentage of Households by Area and Cooking Exposure Tiers 0-5 - Ventilation Level, Mainland Tanzania, IASES 2021/22



5.2.1.7 Cooking Exposure - Contact Time

The overall effect of the emission on the household members is also affected by the contact time. The contact time is the period that the main oven is used.

Figure 5.8 Percentage of Households by Area and Cooking Exposure Tiers 0-5 - Contact Time, Mainland Tanzania, IASES 2021/22



Around half of the households across the country, or rather engaged in cooking, are exposed to emissions from the stove for around 2 hours per day (less than 3 hours, but above 1.5). Hence, they may well be exposed to emissions from the main oven for a considerable time.

5.2.1.8 Cooking Emission and Exposure

The measure for potential harmful exposure to emissions from cooking is determined by a combination of type of emission and how long a person is exposed to fumes. High emission from traditional firewood and charcoal cooking may be compensated by open air cooking. Even a proper oven may be harmful in a small and poorly ventilated kitchen or cooking area while, a high emission oven in an open kitchen may not cause any harm.

In order to find the appropriate tier, the emission and exposure are weighed as in the former surveys of Rwanda and Ethiopia.

The surveys from Rwanda and Ethiopia, however, missed detailed information on kitchen and ventilation structure, for many households. Hence a simplified approach was applied to determine the overall ventilation and cooking exposure.

The survey from Mainland Tanzania provides proper information on ventilation and exposure. This information may serve as the base for the matrix to weigh emission and exposure to a joint dimension.

Figure 5.9 Percentage of Households by Area and Cooking Exposure and Emission Tiers 0-5, Mainland Tanzania, IASES 2021/22

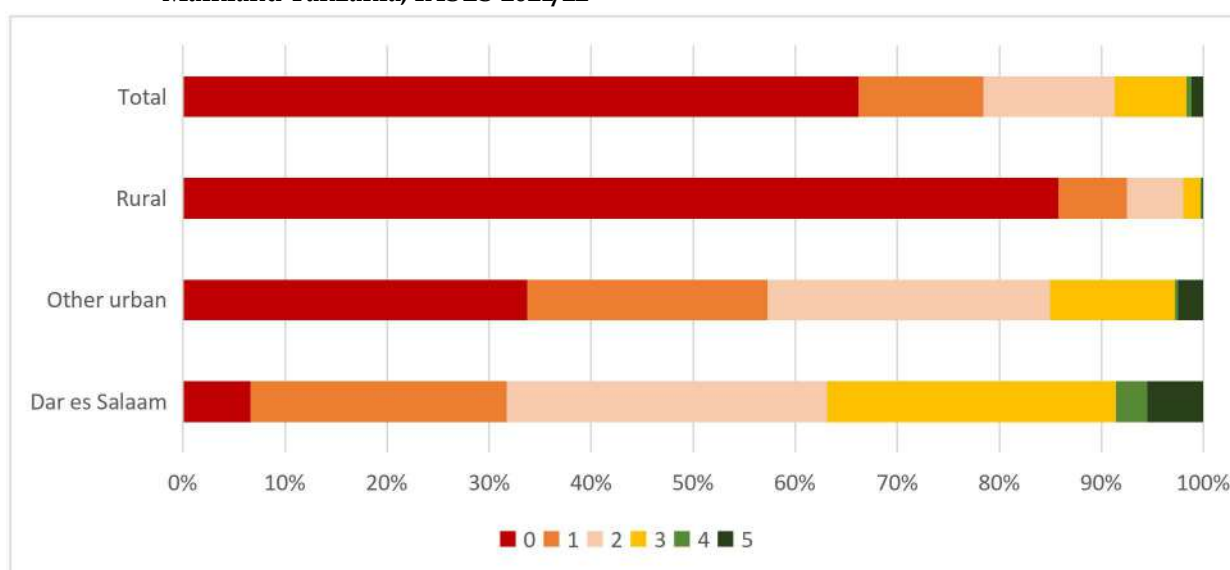


Table 5.5 Percent of Households by Adapted Multi-Tier Framework for Stove Emission and Cooking Exposure, Mainland Tanzania, IASES 2021/22

ATTRIBUTE		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Fuel and stove emission	Emission: Fuel	Solid fuel				Biogas, pellets	Electricity, LPG
	Percent	92				0	8
	Emission: Stove Design	Three-stone, trad charcoal	Old type ICS	ICS+	Insulated stove	Gasifier stove	
	Percent	65	6	18	2	0	8
	Overall emission						
	Percent	65	6	18	3	0	8
Cooking exposure	Ventilation: Volume Kitchen	< 5 m ³	5 m ³ <	10 m ³ <	20 m ³ <	40 m ³ <	Open air
	Percent	5	12	18	20	14	31
	Ventilation: Structure	No	1 window	1 window <	Significant openings	Veranda	Open air
	Percent	4	45	19	7	8	16
	Overall ventilation in percent	5	19		14	61	
	Contact Time	7.5 hours <	< 7.5 hours	< 6 hours	< 4.5 hours	< 3 hours	< 1.5 hours
	Percent	0	4	7	19	48	22
Overall emission and exposure	Percent	50	21	11	9	1	8

5.3 Cooking and cookstove attributes

The IASE survey has collected information on the following additional dimensions from the Beyond Connection report mentioned in the introduction to this chapter:

- Cookstove efficiency
- Convenience
- Safety of Primary cookstove
- Affordability
- Fuel availability

Table 5.6 Adapted Multi-Tier Framework for Stove Attributes, Mainland Tanzania, IASES 2021/22

ATTRIBUTE		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Cookstove Efficiency	ISO's Vol. Performance Targets (TBC) in percent	Less than 10	More than 10	More than 20	More than 30	More than 40	More than 50
Convenience	Fuel acquisition (collection or purchase) and preparation time (h/ w)	More than 7 hours		Less than 7 hours	Less than 3 hours	Less than 1.5 hours	Less than 0.5 hour
	Stove preparation time (minutes per meal)	More than 15 minutes		Less than 15 minutes	Less than 10 minutes	Less than 5 minutes	Less than 2 minutes
Safety of Primary Cookstove		Serious accidents over the past 12 months				No serious accidents over the past year	
Afford-ability		Levelized cost of cooking solution (fuel) more than 5 percent of household income				Levelized cost of cooking solution (fuel) less than 5 of household income	
Fuel Availability		Primary fuel available less than 80% of the year				Primary fuel is readily available 80% of the year	Primary fuel readily available throughout the year

5.3.1 Cookstove efficiency

Cookstove efficiency includes combustion and heat-transfer levels. Direct measurement is difficult, thus rough and conservative estimates are adopted based on *primary* cookstove type ([2] p122). The general approach is, for each country, to identify common cookstoves being built on-site or available at the local market and identify similar cookstoves already measured by the lab and listed in the Clean Cooking Catalogue, developed by the Clean Cooking Alliance⁵.

For Rwanda and Ethiopia, the aim was to measure the efficiency combining fuel and stove type as follows in percentage:

- Tier 0 – Less than 10%
- Tier 1 – More than 10%
- Tier 2 – More than 20%
- Tier 3 – More than 30%
- Tier 4 – More than 40%
- Tier 5 – More than 50%

⁵ <http://catalog.cleancookstoves.org/>

In Norway a scientific measurement of solid fuel efficiency in percentage gives large ranges as follows⁶:

- Open fire – 10% – 15%
- Ovens with separate fuel input, cooking ring, and chimney – 30% – 70%
- Gasifying ovens – 70% – 80%

The IASES is based on these two sets of efficiency measurements implemented as a proxy fuel/stove type list presented below with the following colour codes for the different types of fuel.

Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
--------	--------	--------	--------	--------	--------

Cooking stoves using firewood, dung, twigs and leaves

				
101 Three-stone stove	111 ICS w/ ceramic fire chamber	121 Rocket stove	131 Lorena 1 Rocket stove w high insulation	141 Lorena 2 Rocket stove with well-sealed chimney
Tier 0 Three-stone, tripod	Tier 1 Conventional ICS (closed oven with separate openings for firewood etc and pots)	Tier 2 ICS with Chimney (as conventional ICS plus chimney), rocket stove with conventional material for insulation	Tier 3 Rocket stove with high insulation, rocket stove with chimney (not well sealed)	Tier 4 Rocket stove with chimney (well sealed)

Cooking stoves using charcoal

				
201 Trad. charcoal stove-Open air	211 Charcoal stove, Old ICS Opening for air may be closed	221 Ceramic lined charcoal ICS	231 Ceramic lined and insulated charcoal ICS	241 Efficient charcoal stove with controlled airflow
Tier 0 Traditional charcoal stoves	Tier 1 Old generation ICS (with open chamber for charcoal)	Tier 2 Conventional ICS (closed oven with separate chambers)	Tier 3 Advanced insulation charcoal stoves	Tier 4 Advanced secondary air charcoal stoves (tightly closed burning chamber with controlled entry of air)

⁶ <https://www.tu.no/artikler/hvor-effektivt-er-egentlig-vedfyring/414718>

Cooking ovens using kerosene or rice husks, pellets and briquettes

		
233 Kerosene cooking stove (Mchina)	331 Gasifier stove	341 Jiko Safi Gasifier stove w/forced air & chimney
Tier 3 Kerosene oven	Tier 3 Natural draft gasifier (only pellets and briquettes)	Tier 4 Forced air

Cooking ovens using LPG and biogas, electricity (grid or solar), solar oven (non-electric)

		
451 Biogas stove	452 Multiple LPG stove	461 Electrical stove
Tier 5 Biogas	Tier 5 LPG	Tier 5 Electricity

This classification and information of the type of oven used as the main stove for cooking allows for a calculation of cooking efficiency as shown in the table above with images of each type of oven.

Figure 5.10 Percentage of Households by Area and Cookstove Efficiency Tiers 0-5 , Mainland Tanzania, IASES 2021/22

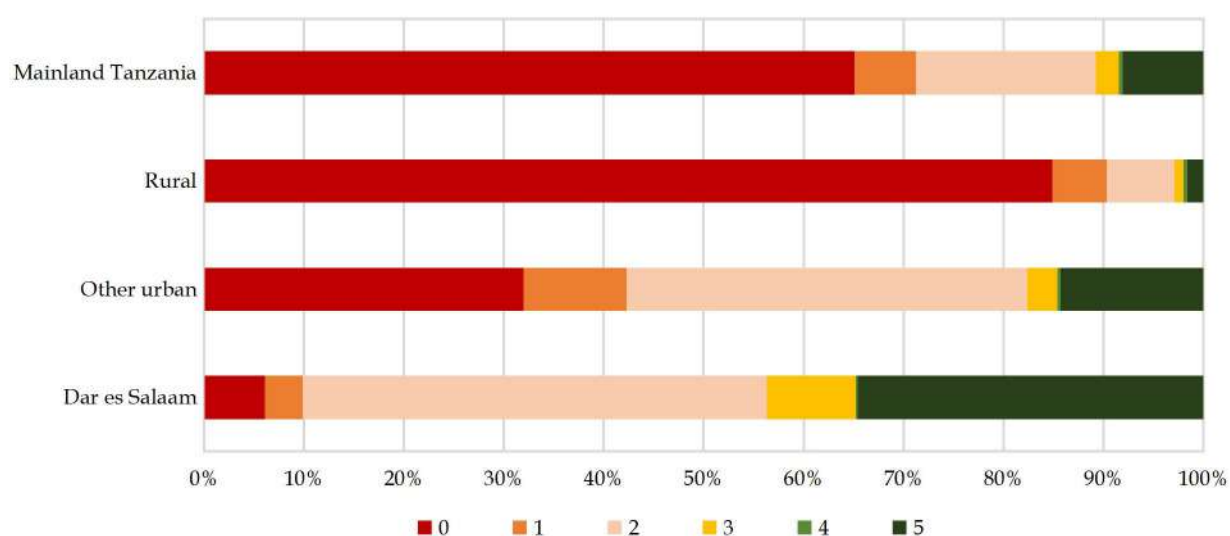
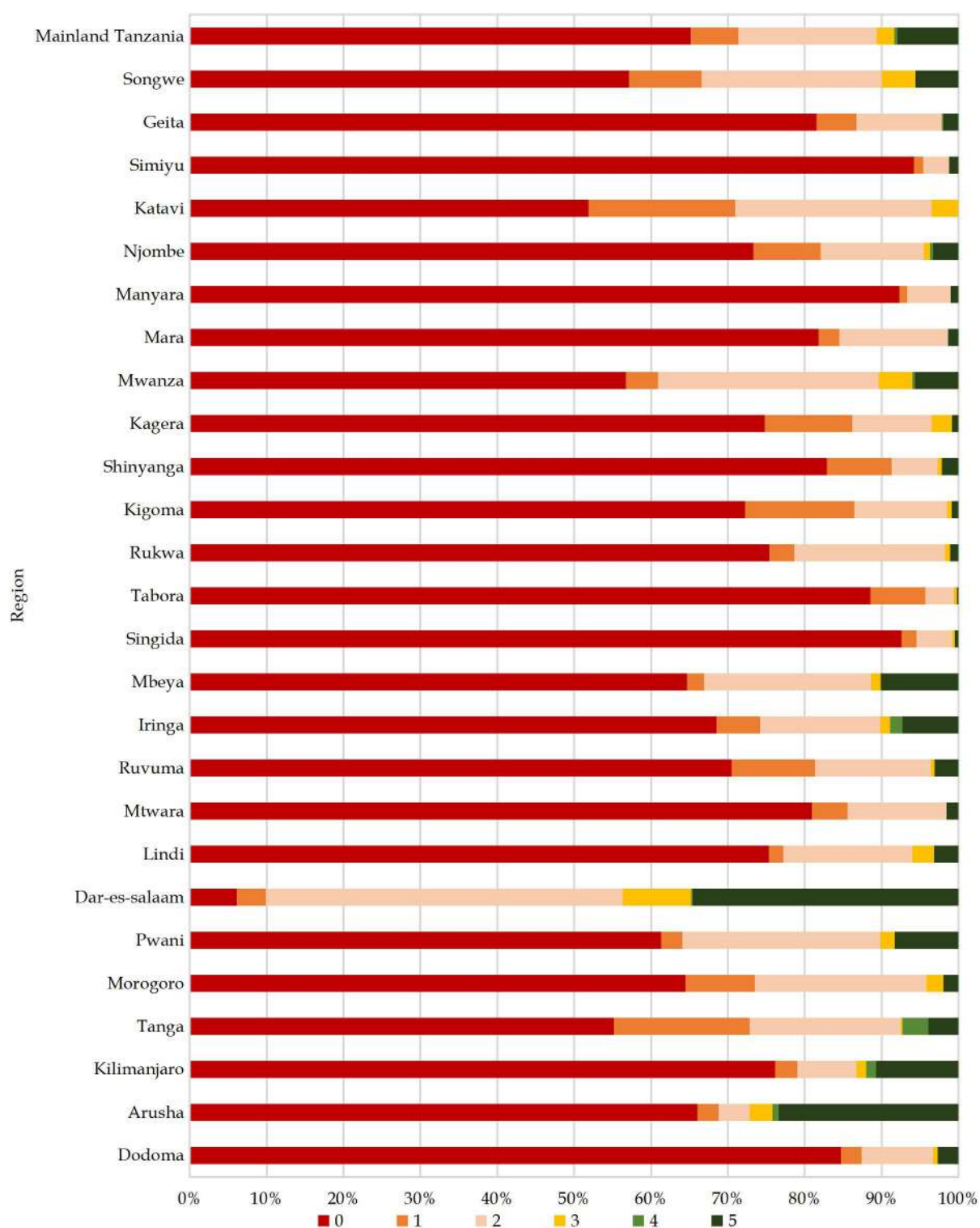


Figure 5.11 Percentage of Households by Region and Cookstove Efficiency Tier 0-5, Mainland Tanzania, IASES 2021/22



As the figures tell, the cookstove efficiency in urban and rural areas are very different stories.

In rural areas the cookstove efficiency is extremely low. About 85 percent or 5 out of 6 households use a cookstove with efficiency of below 10 percent. If the households had the capacity to build an improved firewood cookstove they would improve the efficiency up to 30-40 percent and hence reduce the resources for collecting or buying firewood to one third. The question of who bears the burden of the firewood collection will come later, but it is often women and children. The low efficiency may also contribute to deforestation as the need of firewood is high with cook stoves with low efficiency. Lighting a fire might however not only serve the purpose of cooking, but also keeping warm. This purpose is not part of Tiers-calculation, but can be said to add to the efficiency of using firewood for cooking.

In urban areas the ovens used for cooking are, on average, at tier 2 level based on second generation improved cookstoves usually charcoal ovens with well-regulated airflow or improved and insulated firewood ovens. These ovens have a reasonable efficiency, but a chimney or an oven with high insulation in the fire chamber would improve the efficiency a lot. These improvements do not cost much and have fast returns since less time is needed to collect firewood or money is saved as less charcoal is needed.

There are quite large differences across the regions. In some regions such as Dar es Salaam, Tanga, Mwanza, Katavi and Songwe, only half or less than half of the households use an oven with extremely low efficiency. In Arusha, Kilimanjaro, Pwani, Dar es Salaam, Iringa, Mbeya, Mwanza and Songwe at least 1 in 10 households are using an oven at tier 3 level or above.

Table 5.7 Percentage of Households by Cookstove Efficiency Tiers 0-5, Mainland Tanzania, IASES 2021/22

ATTRIBUTES		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Cookstove Efficiency	ISO's Vol. Performance Targets (TBC) in percent	Less than 10	More than 10	More than 20	More than 30	More than 40	More than 50
	Percent	65	6	18	2	0	8

5.3.2 Cooking convenience - Total convenience combining fuel acquisition and stove preparation

The classification of convenience is based on time used to collect or purchase fuel and prepare the cookstove for each meal.

Fuel acquisition and preparation time is based on the time the household typically take to gather, collect or purchase fuel for one week (the last seven days in the questionnaire).

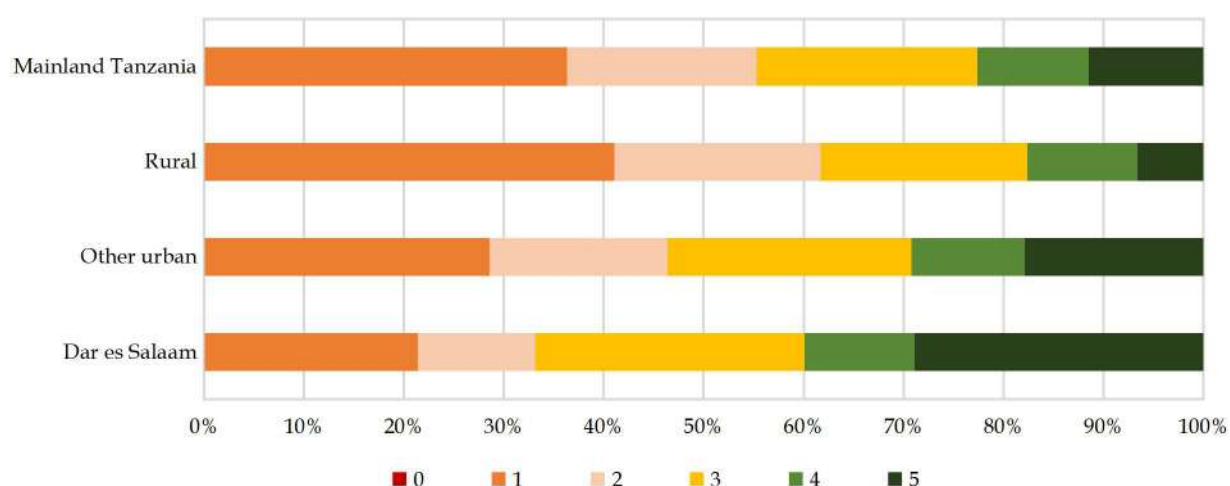
5.3.2.1 Convenience - Stove-preparation time

Stove preparation time is the average time household members spend preparing the stove and fuel for each meal.

Table 5.8 Percentage of Households by Convenience – Fuel and Stove-Preparation Time Tiers 0-5, Mainland Tanzania, IASES 2021/22

ATTRIBUTE		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Convenience	Fuel acquisition (collection or purchase) and preparation time (h/w)	7 hours <		< 7 hours	< 3 hours	< 1.5 hours	< 0.5 hour
	Stove preparation time (minutes per meal)	15 min <		< 15 min	< 10 min	< 5 min	< 2 min
	Fuel and stove convenience, Percent	36		19	22	11	12

Figure 5.12 Percentage of Households by Area and Convenience – Fuel and Stove-preparation time Tiers 0-5, Mainland Tanzania, IASES 2021/22



5.3.3 Safety of Primary Cookstove

The safety dimension relates only to the main cookstove. The households report whether anybody in the household faced any harm/injury from the stove.

Table 5.9 Percentage of Households by Safety of Primary Cookstove Tiers 0-5, Mainland Tanzania, IASES 2021/22

ATTRIBUTES	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Safety of Primary Cookstove	Serious accidents over the past 12 months				No serious accidents over the past 12 months	
Percent	4				96	

As very few households report any serious accidents over the past 12 months, almost all households end up in tier 4 or 5 on the safety dimension.

5.3.4 Affordability

According to ESMAP[2], p 121, the multi-tier framework considers cooking affordable if the levelized cost of a cooking solution is less than 5 percent of household's total income. Since fuel is needed throughout the year, it is reasonable to assume that the costs should

be levelled across all households with the same type of oven. But at the same time, we know that both quantity and price vary across households.

For all types of fuel, poor people may reduce costs by reducing the use of fuel. Hence for all poor people, and especially poor rural people the actual cost may be lower than the levelized costs. Households using firewood as main fuel are asked whether collected or purchased firewood is their main fuel. The time spent on collecting and purchasing fuel is recorded and used for comparing overall costs. For all fuels, the fuel costs are cash expenses excluding the value of time spent on collecting or purchasing the fuel. If the household collected their own fuel, the cash expenses are set to zero.

Based upon the ESMAP[2] outline, the levelized costs are assumed to be average fuel costs for all households with the fuel. This will be based upon actual fuel costs in the household. For firewood, the levelled cost is calculated for firewood used for cooking.

A cost variable is estimated based upon charcoal use in urban areas. The NBS 2011-12 HBS estimates the use of charcoal at 94 to 180 kg per person per year for charcoal users. Assuming 5 persons in a household, that will be around 500 kg per year. The highest price was found in Dar es Salaam where prices ranged from TZS 45,000 to 70,000 for a wholesale bag of 100 kg, indication a retail price of 500 TZS per kg. Hence the annual cost would be around 0.5 million TZS or \$ 200. Household income per year is calculated using the consumption module in the survey.

Table 5. 10 The levelized Costs are Estimated based on the Type of Oven and the Average Price of Fuel for all Households in the group

Oven	Type of fuel	Median price in TZS per year
101 - 141	Firewood	138,257
201 - 231, 241	Charcoal	182,500
233	Kerosene, ethanol	182,500
331 - 341	Coal, briquettes	*
451	Biogas	*
452	LPG, gas	175,200
461	Electric	*
471	Solar	0

*Too few prices for calculation

The first step in the calculation of levelized fuel costs was to calculate actual fuel costs for all households in each fuel group. The second step was to check for potential outliers and recalculate levelized fuel costs based upon remaining households. The third step was to calculate levelized costs for each household based on median costs in each fuel-group.

The median cost for all other fuel types is set equal to purchased firewood as TZS 138,257 per year.

This cost is considered affordable if within 5 percent of the households total income. The proxy indicator of total consumption expenses is used to estimate income.

Table 5.11 Percentage of Households by Area and Fuel Affordability at Fixed Cost Level Tiers 0-5, Mainland Tanzania, IASES 2021/22

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Affordability	Levelized cost of cooking solution (fuel) more than 5 percent of household income				Levelized cost of cooking solution (fuel) less than 5 percent of household income	
Mainland Tanzania	18				83	
Dar es Salaam	32				68	
Other urban	35				65	
Rural	10				90	

Table 5.11 shows affordability of fuel for cooking in Mainland Tanzania. It shows that most of the Tanzanians use less than 5 percent of their income to purchase fuel for cooking.

It turns out that fuel costs are affordable for 2 out of 3 households in urban areas and 9 out of 10 households in rural areas. The price may be higher in urban areas, but so is the income. Also, most households in rural areas collect the firewood themselves, hence it does not take much of their income. High price relative to income may be a barrier for households to use modern cooking solutions, especially in rural areas.

5.3.5 Fuel Availability

It is, of course, not enough that fuel is affordable. It must also be available throughout the season.

Here the focus is on main fuel. If a household uses secondary fuel because primary is not available, it is concluded that the primary fuel is inadequate.

It should be acknowledged that we may miss fuel information for households using two ovens with different fuel.

Table 5.12 Percentage of Households by Fuel Availability Tiers 0-5, Mainland Tanzania, IASES 2021/22*7

ATTRIBUTE	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Fuel Availability	Primary fuel available less than 80 days of the year				Primary fuel is readily available 80 days of the year	Primary fuel readily available throughout year
Percent	54				1	45

Across the country the problem is that the main fuel is not available throughout the year. In rural areas, the fuel used by 6 out of 7 households is out of supply in 20 percent

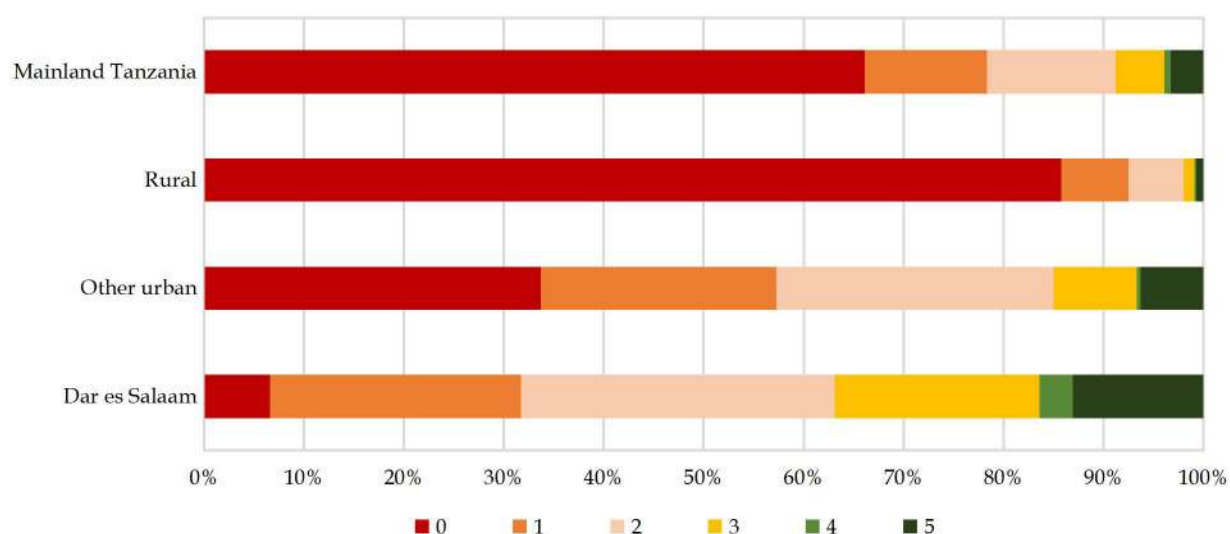
⁷ Due to an error in the questionnaire, only those households reporting both most, and second most used fuel got the question on availability. The values for availability are "always", "10 to 11 months", and "less than 10". However, those who reported on most used fuel, were asked about how many months they had used the fuel. We recoded these values in accordance with the question for availability.

or more of the year. Even in Dar es Salaam, the fuel used by the majority of the households are not available for 2 months or more of the year.

5.4 Overall access to household cooking solutions

The tiers for overall cooking solution is summarized across the 6 cooking solution dimensions. The lowest tier level determines the overall level.

Figure 5.13 Percentage of Households by Area and Cooking Solution Tiers 0-5, Mainland Tanzania, IASES 2021/22



When the 6 dimensions are combined, the tier level for the cookstove efficiency guides the overall cooking solution tiers in rural areas.

However, in Dar es Salaam and other urban areas, however, a significant share of the households move down one or more tiers because of relatively poor cookstove efficiency.

Figure 5.14 Percentage of Households by Region Cooking Solution Tier 0-5 , Mainland Tanzania, IASES 2021/22

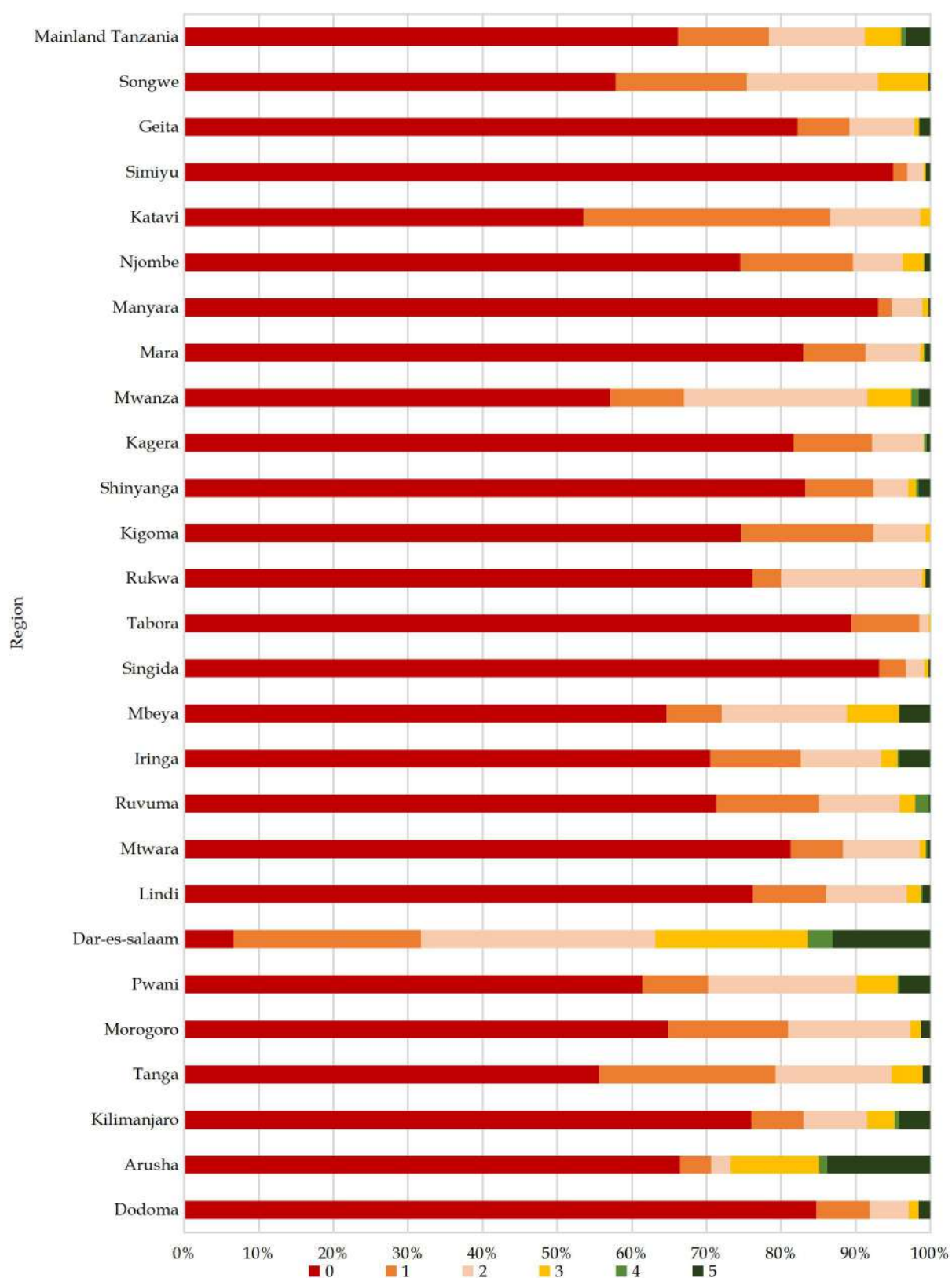


Figure 5.15 Percentage of Persons by Area and Cooking Solution Tiers 0-5 , Mainland Tanzania, IASES 2021/22

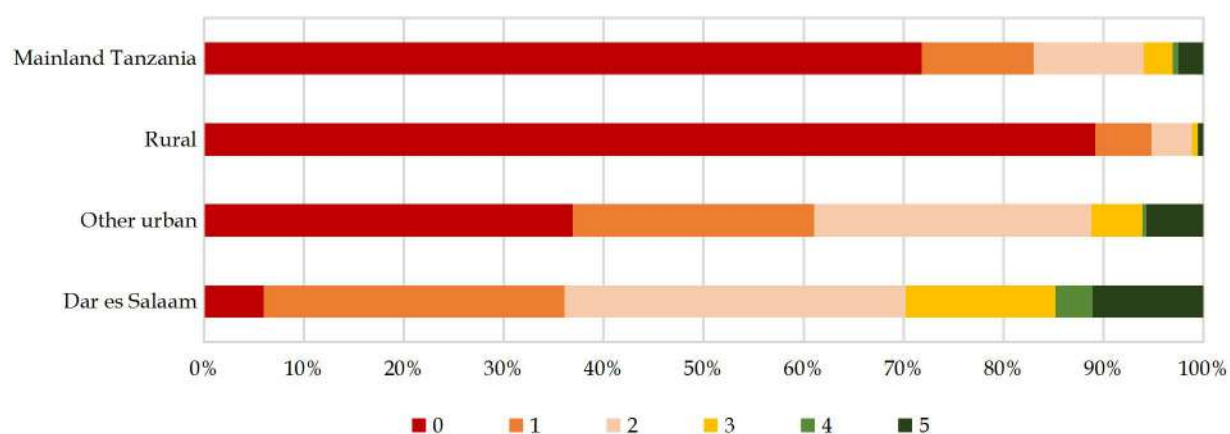
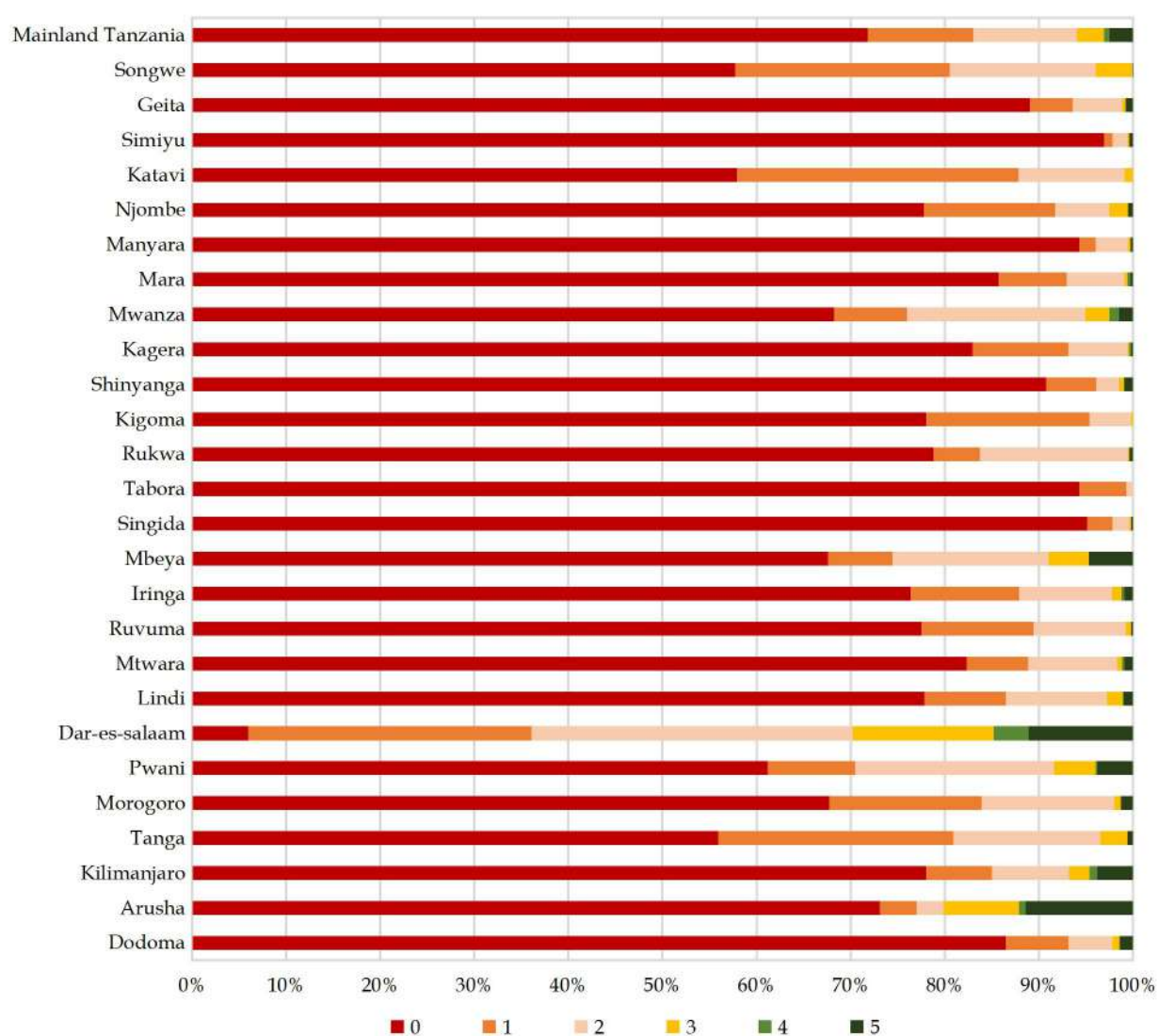


Figure 5.16 Percentage of Persons by Region and Cooking Solution Tier 0-5, Mainland Tanzania, IASES 2021/22

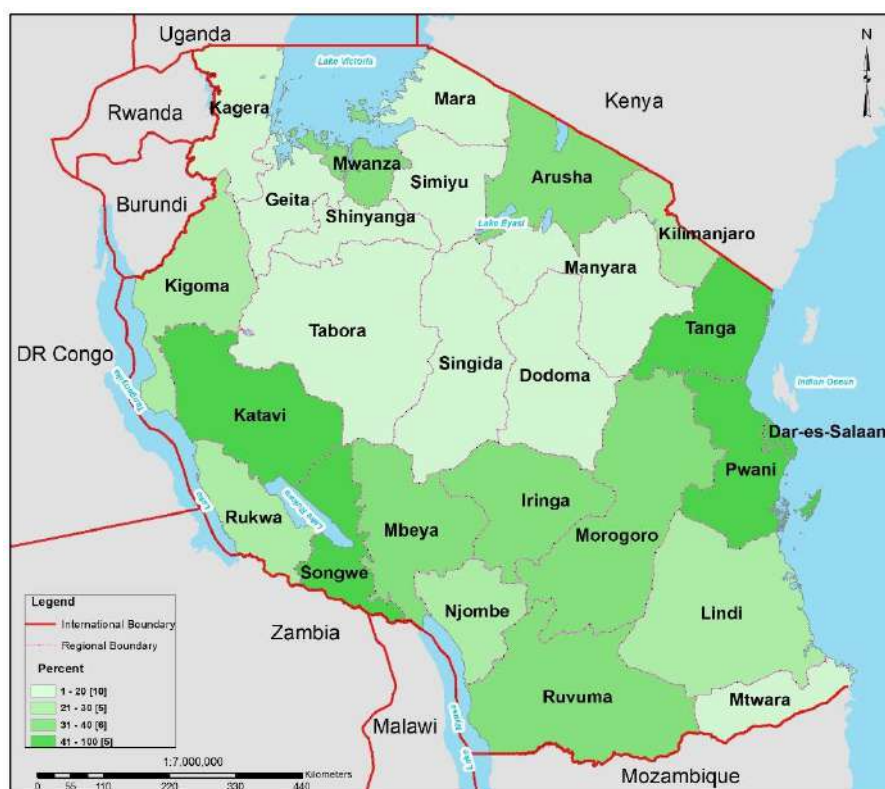


Concerning cooking efficiency, the summed up overall cooking solution underscores two main points.

In rural areas, the share of tier 0 has increased from 85 percent to 89 or to a point where 9 in 10 households face an extremely low efficiency requiring many extra hours for collection of firewood or extra money for buying firewood or charcoal.

In order to reduce the burden of household on provision of energy in rural areas, increase the use of improved cook stoves which will reduce the costs of fuel in a short time.

Figure 5.17 Percentage of Households with Improved Cooking Stoves, Tiers 1-5 by Region, Mainland Tanzania, IASES 2021/22



As for cookstove efficiency, the situation in Dar es Salaam is another story. The mean Tiers are 2 for both dimensions. But it may obviously give a proper return to use some additional resources when acquiring a new oven and ensure an oven with high insulation in the fire chamber or a chimney.

The situation in other urban areas is a mixture of the situation in rural areas and in Dar es Salaam. Some households have additional problems with the cooking solution and end up at Tier 0. In this case the possible benefits of moving to modern improved cookstoves would be even larger. May be a special effort in urban areas outside Dar es Salaam would give the best return addressing the SDG 7 goal with less deforestation, reduced the time-burden on women collecting firewood and reduced costs for families buying charcoal.

Table 5.13 Percentage of Households and Persons by Cooking Solution Tiers 0-5, Mainland Tanzania, IASES 2021/22

ATTRIBUTES		TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Cooking Emission Exposure	Percent	50	21	11	9	1	8
Cookstove Efficiency	ISO's Vol.	< 10	10 <	20 <	30 <	40 <	50 <
	Performance Targets (TBC), Percent	65	6	18	2	0	8
Convenience	Fuel acquisition & preparation time	7 h <		< 7 h	< 3 h	< 1.5 h	< 0.5 h
	Stove preparation time	15 min <		< 15 min	< 10 min	< 5 min	< 2 min
	Percent	36		19	22	11	12
Safety of Primary Cookstove		Serious accidents past 12 months				No serious accidents past 12 m	
	Percent	4				96	
Affordability		Levelized cost of fuel more than 5 of household income				Levelized cost of fuel less than 5 percent of household income	
	Percent	18				83	
Fuel Availability		Primary fuel available < 80 days of the year				Primary fuel available 80 days < of the year	Primary fuel available all year
	Percent	54				1	45
Overall cooking solution	Households, Percent	66	12	13	5	1	3
Overall cooking solution	Persons, Percent	72	11	11	3	1	2

5.5 Overall cooking solutions by sex of household head

In the distribution of main cooking stove by type of fuel and improved efficiency only small differences were found between male and female-headed households in Dar es Salaam and in the rural areas but about the same in other urban areas. When for overall cooking solution, households are cross tabulated by area, sex of household head, and tier 0-5, a similar pattern is found. In Dar es Salaam 40 percent of the female headed households are in tier 3 to 5 compared to 35 percent of the male headed households. For the rural areas the observed differences are small and not significant. In the other urban areas, the situation seems to be more or less the same for male and female-headed households.

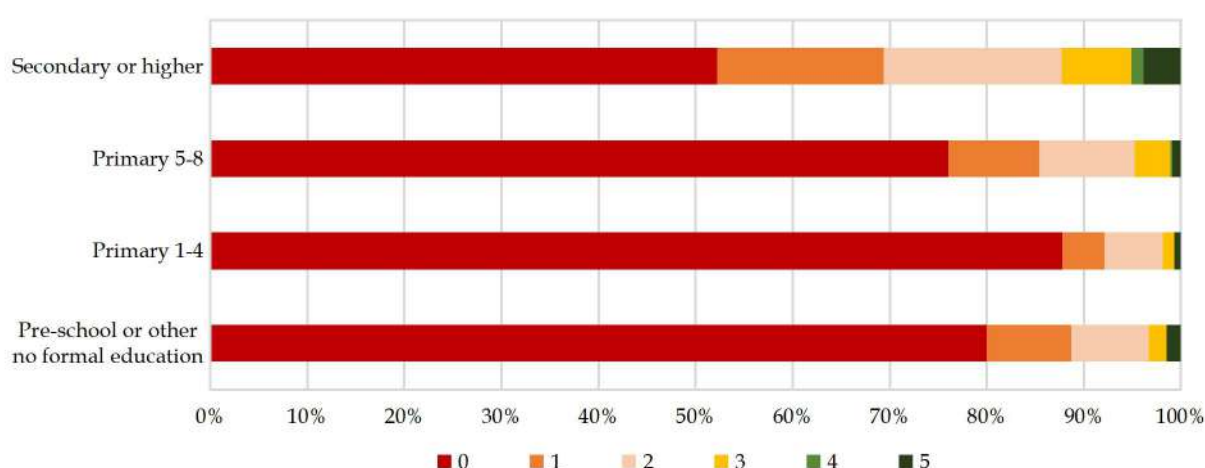
Table 5.14 Percentage of Households by Area, Sex of Household Head and Cooking Solution Tiers 0-5 Mainland Tanzania, IASES 2021/22

Area	Household head	TIER 0	TIER 1	TIER 2	TIER 3	TIER 4	TIER 5
Dar es Salaam	Male	7	27	32	27	2	6
	Female	7	22	31	30	6	4
	Total	7	25	31	28	3	6
Other urban	Male	33	24	28	12	0	3
	Female	35	23	27	12	0	2
	Total	34	24	28	12	0	3
Rural	Male	85	7	6	2	0	0
	Female	88	6	5	2	0	0
	Total	86	7	6	2	0	0

5.6 Overall cooking solutions by education of household head and by household income

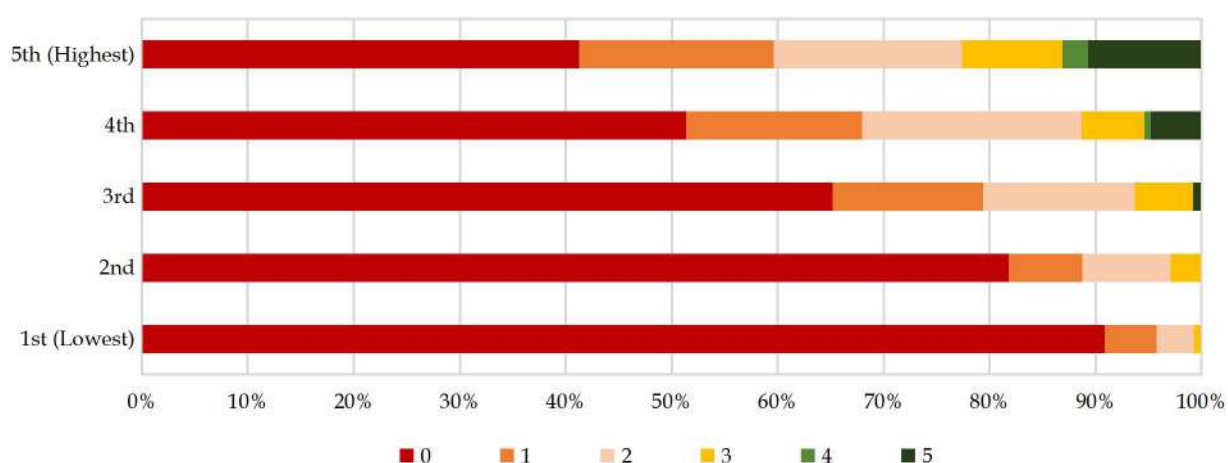
We have already seen that households end up in different tiers depending on area and sex. Figure 5.18 shows that the educational background of household head is even more effective than sex. In tiers 3 to 5, there are twelve (12) percent of households whose heads have secondary education or higher but only 2 percent of households whose heads have no formal education.

Figure 5.18 Percentage of Households by Education of Household Head and Cooking Solution Tiers 0-5, Mainland Tanzania, IASES 2021/22



In this survey, household income is measured by the household's total annual expenditure. Figure 5.19 shows the distribution of the households, quintiles and tiers. The expenditure is then divided into quintiles from the first (lowest) to the fifth (highest). The findings are similar to the distribution based on education. In the highest quintile, 23 percent of the households are in tier 3 to 5 compared to only one percentage in the lowest expenditure quintile.

Figure 5.19 Percentage of Households by Household Income and Cooking Solution Tiers 0-5, Mainland Tanzania, IASES 2021/22



5.7 What we learn from statistics on main cooking ovens

The following are important lessons learnt from combining statistics of main cooking ovens and the six dimensions of cooking solutions:

- In Mainland Tanzania 66 percent of all households are in tier 0 for access to modern cooking solutions because they use a traditional oven and have poor ventilation. One third (32%) of households are in tiers 1 to 3 because they use a self-built or manufactured biomass stove. Only 2 percent of households are in tier 4 and 5, because few households use modern cooking solutions.
- One of six (18%) of households are unable to access modern cooking solutions as fuel for cooking costs more than 5 percent of their total income. The remaining 82 percent can afford modern cooking solutions.
- Traditional fuel and cooking ovens with high emissions and low efficiency still dominate. Half the households use cooking ovens with high emissions of smoke and burning gases. More than half the households have cooking solutions with very low efficiency. Low efficiency contributes to deforestation as the need of firewood and charcoal is high with low efficiency cooking-stoves.
- In Rural areas, traditional open fireplaces dominate. These ovens are inefficient because they burn firewood without regulating airflow. They consequently demand a lot of money for buying firewood or a lot of time for collecting it.
- The majority of households in urban areas use charcoal burners with regulated airflow, lower emission and higher efficiency. These improved charcoal burners regulate the airflow either by closing the inflow of air to reduce capacity when the food preparation only requires simmering, an ability to regulate the airflow, or by insulating burning chambers with increased efficiency.
- LPG ovens are common in Dar es Salaam (almost 35 per cent of households but less common in other urban areas (14 per cent). In rural areas gas is seldom. LPG is a lot more efficient than charcoal, and much cleaner. Two problems with LPG are it is costly and unlike charcoal, it is not sold in small packages. You may buy a small cylinder of gas for for TZS 24,000, while a small package of charcoal costs TZS 500. Gas however, may be cheaper than charcoal over time, but requires more money at once. In addition, gas is not available in all areas, and therefore there are problems of buying and having the container refilled.
- The majority of the households take time to start a fire for each meal and spend more than 1.5 hours on food preparation. For most households, the high emissions during the considerable time spent at the cooking oven are neutralized by either an open cooking place or a highly ventilated kitchen.
- A range of cooking ovens are used even though by a few households. Hence one expects that many households have knowledge of alternative more efficient solutions. The question is then what prevents the households from investing in more efficient solutions.

- Serious accidents happen such that, 1 out of 25 households reports a serious accident in a year due to the cooking-oven.
- Fuel is affordable for the majority of households. The estimated volume of charcoal according to NBS, the 2011-12 Household Budget Survey and the mean costs in the current IAES survey, indicate that, about 5 out of 6 households may cover their fuel costs by 5 percent of the total income. Firewood is cheaper in rural areas than urban areas and this compensates for the lower income in rural areas. The costs for charcoal are at the same level as LPG, but somewhat more expensive than firewood.
- Fuel is however not available throughout the year for the average household. For more than half of the households (54 percent) there are fuel shortages for 2 months or more in a year.

5.8 Conclusion or why this report is important

The main mandate for both National Bureau of Statistics and the partner Statistics Norway is to provide fact-based information. Between 2015 and 2030 a main goal has been to develop a system of systematic information for all 17 Sustainable Development Goals including goal 7 of providing affordable, reliable, sustainable and modern energy for all by 2030.

The global initiative Access to energy for all as presented in the report Beyond Connection – Energy Access outlines a further need for information. The National Bureau of Statistics and the Rural Energy Agency have already presented two reports on the development of access to energy. The current survey Access to Electricity and Modern Cooking Solutions has continued this tradition, providing information for a wider energy sector as well as providing information on the impact of improved access to energy.

The current report presents the overall information and will be followed by reports on the drivers and barriers for access to energy as well as the impact of improved access. This information is hereby made available for the government, the energy sector, the private energy business and public at large.

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Appendix A: Technical Notes

Sampling

The sample for the IASES in Mainland Tanzania is designed as a two-stage sample. The base for the sampling is the number of households according to the 2012 census in each domain, comprising urban areas and rural areas in each region. A so-called Hirsch approach is applied to ensure that even the smaller domains have a proper sampling size. Hence each household in the very large domains will have slightly less probability of being selected, but the estimates for these regions will still have a considerably larger accuracy.

At the first stage the enumeration areas (EAs) are selected within each domain by random systematic probability proportional to size (PPS) sampling based on the number of households in each EA as registered in the 2012 census.

At the second stage all households in a given EA are listed and a fixed take of households are selected by random systematic sampling. The urban cluster-take is 20 households. The rural cluster-take is slightly large in order to reduce traveling costs, 24 households.

The final sample comprised 2,580 urban households and 3,984 rural households and total of 6,564 households across Mainland Tanzania.

There was a total of 9,109,150 households and 43,625,354 persons in the 2012 Census. Based on the census results, the total number of persons have been projected to be 61,289,743 in 2022. Assuming the same number of persons in each household and a distribution across domains, the number of households in urban and rural EAs domains are listed in Table A1 . The total number of households in Mainland Tanzania in 2022 is projected to be 12,795,666 or 12,796 '000.

Weights

The weights are the inverse probability of being selected. When the weights are applied, the estimates of the total number of households will be proportional to the total number of households in the 2012 census but updated to 2022. In order to tell public at large that these are estimates rather than actual counts, the weighted number of households are given in thousands. The domain household weights vary from 0.38 to 3.34.

Since each household in a given domain has the same probability of being selected, they will have the same original weight. But for EAs with less than 100 percent response-rate the weight is adjusted accordingly.

In order to get population weights, the household weights should be multiplied with the number of persons. In order to avoid any bias due to household-size, this calculation should be done for each household. Hence the person weights are calculated as the household weight times the number of persons in the household.

Table A1 Sample for the IASES 2022

Region	Projection Households	Household sample		Household weights in thousands	
		Urban	Rural	Urban	Rural
Dodoma	637 517	80	192	1,23	2,81
Arusha	532 137	100	144	1,76	2,48
Kilimanjaro	540 625	100	168	1,31	2,44
Tanga	615 650	100	192	1,33	2,52
Morogoro	711 187	120	192	1,70	2,64
Pwani	361 727	100	120	1,19	2,03
Dar es Salaam	1 538 285	420	0	3,66	
Lindi	317 424	60	144	0,99	1,79
Mtwara	484 390	80	168	1,39	2,22
Ruvuma	425 725	80	144	1,31	2,23
Iringa	313 288	80	120	1,07	1,90
Mbeya	551 976	100	144	1,92	2,50
Singida	362 807	60	144	0,75	2,21
Tabora	538 609	80	192	0,84	2,45
Rukwa	280 612	80	120	0,83	1,79
Kigoma	526 045	80	168	1,13	2,59
Shinyanga	367 656	80	144	0,76	2,13
Kagera	737 179	80	240	0,85	2,79
Mwanza	682 945	140	168	1,63	2,71
Mara	438 892	80	168	0,95	2,16
Manyara	383 883	60	168	0,87	1,98
Njombe	239 025	80	168	0,71	1,09
Katavi	142 190	100	168	0,40	0,61
Simiyu	323 006	60	144	0,38	2,09
Geita	402 809	80	144	0,81	2,35
Songwe	340 077	100	120	1,04	1,97
Mainland Tanzania	12 795 666	2580	3984	1,55	2,21

Replacement of EAs

A total of 8 EAs were replaced for technical reasons due to lack of proper digital maps in time for the field work. The team managers were instructed to select a new EA adjacent to the original EA on the list of EAs. As the replacement EA is probably similar to the originally selected EA, it may well be assumed that the replacement is not causing any bias.

Sampling within EAs

This sampling procedure is based upon systematic sampling within each EA. However, in order to compare households within each EA to learn about the potential impact within an EA, it is a must to stratify the households according to access to sustainable energy, i.e. to the grid and to solar/wind energy supply. There will usually be either none or many households with access to the grid or no access at all to sustainable energy. Hence a standard reordering of the households according to the strata and systematic sampling would ensure a proper distribution and avoiding large variability.

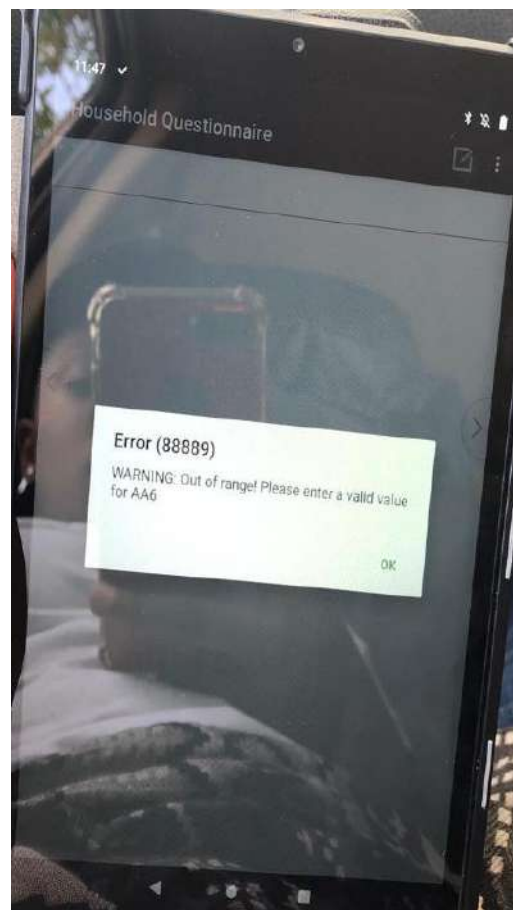
However, there are often just a few households with access to solar or wind power. Hence a special design is needed in order to ensure at least one of these households in the sample.

For the weighing for specific analysis, it is necessary to document the number of households within each stratum.

The proposed cluster take is 24 in rural areas and 20 in urban areas in order to balance the budget constraints and the need for as large sample size as possible.

Questionnaire software

- The questionnaires were programmed in CSPro a highly programmable questionnaire tool developed by US Census Bureau. As the enumerator teams were going to be out in the fields most of the time, and would probably be offline, the system was made so that the whole work cycle could be done offline:
- The enumerators do the listing
- The team use Bluetooth to sync all data with the supervisor
- The supervisor draws the sample on their tablet
- The sample data is synced back to the enumerators – again using Bluetooth
- The enumerator navigates to the selected households using google maps in satellite view mode.
- Enumerators are guided through the questionnaire, getting warnings about inconsistent answers and possible errors.



Questionnaire Design

The survey comprises three questionnaires; listing form, household questionnaire and community questionnaire.

The listing form on a tablet PC was used for counting all households in the EA and served as the base for selection of 24 households in rural EAs or 20 households in urban EAs.

The listing form comprised the following issues:

- Geo coordinates (filled by the CSPro software)
- Presence of household
- Name of the head of household
- Address/ location description in EA
- Source of electricity

The household questionnaire was filled by the enumerators using a tablet PC for each of the selected households.

The household questionnaire consisted of the following thematic sections:

- AA Interview particulars
- AB Household members - Core demographics
- AC Household members - Education
- B Household characteristics
- C Supply and demand of electricity
- D Willingness to pay for a grid connection
- E Willingness to pay for solar home system
- G Dry-Cell Batteries
- F Lamps and candles: kerosene/paraffin/fuel-based lighting
- I Use of Cooking Solutions

Health Impacts:

- K Willingness to pay for an improved cookstove
- J Space and water heating
- L Household assets: transportation, electrical appliances, agricultural equipment
- M Street lighting
- N Time Use - Day Time and After Dark
- Q Consumption / expenditure
- S Attitudes
- U Livelihood means
- T Women's empowerment
- W Social life and physical security

- GP The global pandemic and period of closed schools
- X Telephone number for future contact

During the listing process, the supervisor would ask the chairman to arrange for a community interview with 3-6 knowledgeable men and women in the EA.

The community questionnaire comprised consisted of the following thematic sections:

- A Community identification
- B Community leaders
- C Background
- D Supply of electricity
- H Energy development project
- F Infrastructure
- G Business
- I Cooking
- J Street lighting
- GP Global pandemic

Fieldwork organization

The field-teams each comprised one supervisor, a driver and 3-4 enumerators. The teams were provided with a car, technical equipment/survey-tools and camping gear. Most of the field-teams covered 2 regions out of the total 26 regions in Mainland Tanzania. The first data reported from the field was downloaded to the central NBS HQ server on 21st December 2021. The practical fieldwork was organized as follows:

Step	Activity/Description
1	At arrival in a new EA, the field team established local admin formal contact and a camp. Supervisor contacted the NBS HQ controller to report arrival/status Supervisor agreed with the local admin on appointment for community interview and shared a paper version of the community questionnaire Supervisor and enumerators downloaded google maps for the actual EA to their tablets WIFI/4G net was required at this step
2	Supervisor together with local guide and enumerators identified the boundaries of the EA. Supervisor divided the EA into 3 or 4 sectors for listing of all households, giving each enumerator their own sector to list
3	Enumerators listed all households in their EA sector Supervisor checked the progress on enumerators tablets frequently
4	When listing was completed, data from all the enumerator's tablets were transferred to the supervisor's tablet (blue-tooth sync) for final check and sampling Supervisor did the sampling of the households to be interviewed (24 in urban areas and 20 in rural EAs.) A subset for household to be interviewed was transferred back to the enumerators tablets (blue-tooth sync)
5	Enumerator conducted all the household interviews in his/her sector (HH questionnaire) Supervisor did the community interview (Community questionnaire)
6	When all household interviews were completed and checked on the enumerators tablet by the supervisor, all interviews were transferred to supervisor's tablet (blue-tooth sync) Supervisor transferred all data (household interviews, community interview and total listing) to the central NBS HQ server. WIFI/4G net required at this step
7	When NBS HQ controller had accepted the data, and was informed about the field-team status, the team could move to a new EA.

Appendix B: Persons Involved in the 2021/22 IASES

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Appendix C: Household Questionnaire

  		Statistisk sentralbyrå Statistics Norway															
CONFIDENTIAL																	
Impact of Access to Sustainable Energy Survey 2021/22																	
Household Questionnaire																	
THE NATIONAL BUREAU OF STATISTICS (NBS), TANZANIA																	
STATISTICS NORWAY (SSB)																	
Codes in the questionnaire: Questions and codes Instructions for the enumerator Instructions for Capso programme		<table border="1"> <thead> <tr> <th>Standard codes</th> <th></th> </tr> </thead> <tbody> <tr> <td>Outside household</td> <td>44</td> </tr> <tr> <td>Other</td> <td>55, 66</td> </tr> <tr> <td>No issue</td> <td>66, 77</td> </tr> <tr> <td>All</td> <td>77, 88</td> </tr> <tr> <td>Don't know</td> <td>88</td> </tr> <tr> <td>Not applicable</td> <td>99</td> </tr> </tbody> </table>		Standard codes		Outside household	44	Other	55, 66	No issue	66, 77	All	77, 88	Don't know	88	Not applicable	99
Standard codes																	
Outside household	44																
Other	55, 66																
No issue	66, 77																
All	77, 88																
Don't know	88																
Not applicable	99																
Household questionnaire March 16, 2021																	

		Question	Instruction for enumerator	Cspro programming	Response Code
AA	AA	Interview particulars		12 digits:	
AA	1			Regional code (2 digits)	
AA	2			District code (2 digits)	
AA	3			Ward code (3 digits)	
AA	4			Village code (2 digits)	
AA	5			Fixed code '11'	
AA	6			Enumeration area (EA) number (3 digits)	
AA	7			Urban / Rural location of household (Copy from listing sheet)	Urban...1 Rural...2
AA	8			Building, Dwelling and Household number in EA (Copy from listing sheet)	Household number
AA	7A			North coordinate (Decimal degrees from GPS reading) Tablet to record.	Latitude N (-XX.XXXXX south of equator)
AA	7B			East coordinate (Decimal degrees from GPS reading). Tablet to record.	Longitude E (-XXX.XXXXX east of Prime meridian and -XXX.XXXXX west of prime meridian)
AA	9			Date of visit/ interview started	Day Month Year
AA	10	Thank you for allowing us to collect information on the use of energy in this household. The information from you and other households will provide important information for the energy planning in the country.	Accept of interview: (Read out explanatory text about the survey. Then ask if the interview is accepted and can continue.)		Yes, accepted for start now...1 -> Skip to AA14 Yes, accepted but return later...2 -> Skip to AA12 No, refused...3 -> continue No, vacant...4 -> quit questionnaire
AA	10A		Why does the household/respondent refuse to participate?		I'm sick/injured/handicapped to participate...1 Refusing...2 For both 1 & 2 -> Skip to AA20 at the end of the Q.
AA	11		If enumerator should come back later, make appointment /contact details	Must be visible for the enumerator between interviews	Later today...1 Tomorrow...2
AA	12	Enter time for appointment	If enumerator should come back later, make appointment /contact details	Must be visible for the enumerator between interviews	Time -> Intermediate saving of questionnaire
AA	13	Who do I ask for when I return for the interview?	If enumerator should come back later, make appointment /contact details	Must be visible for the enumerator between interviews	Name
AA	14	Who is the head of this household?	The head of the household should be decided by the household members at the start of the interview. Should be 15 years old or more. Only one head per household.		Name
AA	15	How many of the last 12 months did [NAME], the head of household, reside in the household?			Less than 3 months...1 3-5 months...2 -> Skip to AA17 6 months or more...3 -> Skip to AA17
AA	16	Did the head send or bring back any cash or provisions to the household during the last 12 months?			Yes, both in cash and kind...1 Yes, but only in cash...2 Yes, but only in kind...3 No...4
AA	17	Is the main respondent and the head of household the same person?	The main respondent should be identified by the household members at the start of the interview. Should be 12 years old or more.		Yes...1 -> Skip to section AB No...2
AA	18	What is the name of the main respondent in the household?	Name		Name

AA20-25 at the end of the questionnaire to be filled in after the interview

AB	Household members - Core demographics						
	Now we would like to make a list of all members of the household. We would like you to include members who are temporarily away, but to exclude temporary visitors who are staying less than half the year in the household.						
	AB1\$	AB2\$	AB3\$	AB3\$	AB4\$	AB5\$	AB6\$
	Fill in for all members of the household. Name	Is this the main respondent in the household?	What is [NAME]'s relationship to the head of the household?	Was [NAME] the head of household 5 years ago?	Is [NAME] male or female?	How old is [NAME]?	What is [NAME]'s current marital status?
	Fill in all AB questions for each member. Start with the head of the household as member number "1" e.g. AB1a	Enumerator to fill in	Restriction: Only one head per household Head of household...1 Spouse of head...2 -> skip to AB4 Daughter/son of head...3 -> skip to AB4 Grandchild of head...4 -> skip to AB4 Relative of head...5 -> skip to AB4 Other relative of head...6 -> skip to AB4 New visitor (if headspouse)...7 -> skip to AB4	Yes...1 No...2	Male...1 Female...2	Write 00 if less than 1 year Completed years	Fill in AB6 for all members 15 years old or more only. Leave other person columns unfilled Never married...1 Married...2 Polygamous married...3 Living together...4 Widowed...5 Separated...6 Divorced...7
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

A	Household chores (Cooking) & Employment		Unit Household member's MemberNo				
	For all household members 12 years and above we would like to know about their work and other economic activities during the last 12 months.						
	A25	A35	A35	A35	A65	A75	A55
	What was [NAME]'s main occupation for the last 12 months?	What was the main activity at [Name]'s place of work during the last 12 months?	Out of the last 12 months, how many months were [NAME] engaged in this activity?	How many days per month does [NAME] work in this activity?	What was [NAME]'s main occupation 5 years ago?	What was the main activity at [Name]'s place of work 5 years ago?	How frequently does [NAME] cook food for the household?
		(Codes based on ISIC rev. 4)	Max 12	Max 30	Only for household members 12 years and above 5 years ago	Country specific codes (Codes based on ISIC rev. 4)	
		(Codes based on ISIC rev. 4)	Max 12	Max 30	Only for household members 12 years and above 5 years ago	Country specific codes (Codes based on ISIC rev. 4)	
	Farmer with non-family employees...01	Agriculture - crop harvest...11			Farmer with non-family employees...01	Agriculture - crop harvest...11	Ever/never...1
	Farmer with only family members...02	Agriculture - animal husbandry...12			Farmer with only family members...02	Agriculture - animal husbandry...12	A few times in a week...2
	Fish vendor...03	Fishing...13			Fish vendor...03	Fishing...13	Once a week...3
	Non-firm business with non-family employees...04	Mining & quarrying...14			Non-firm business with non-family employees...04	Mining & quarrying...14	A few times in a month...4
	Non-firm business with only family employees...05	Manufacturing...15			Non-firm business with only family employees...05	Manufacturing...15	Once a month...5
	Unpaid assistance in family enterprise (Casual/Day Laborer)...06	Electricity and water supply...16			Unpaid assistance in family enterprise (Casual/Day Laborer)...06	Electricity and water supply...16	Never...6
	Wage Employee in Private Company (with contract)...08	Building and construction...17			Wage Employee in Private Company (with contract)...08	Building and construction...17	
	Wage Employee in Private Company (without contract)...09	Trade...18			Wage Employee in Private Company (without contract)...09	Trade...18	
	Wage Employee in Government...10	Transportation...20			Wage Employee in Government...10	Transportation...20	
	Wage Employee in (Parental) government owned company...11	Accommodation and food service...21			Wage Employee in (Parental) government owned company...11	Accommodation and food service...21	
	Was not working, but was looking for work and had worked previously...15 Skip >A5	Information and communication...22	MONTHS	DAYS	Was not working, but was looking for work and had worked previously...15 Skip >A5	Information and communication...22	
	Was not working, but was looking for work. Had never worked before...16 Skip >A5	Financial, professional...23 administrative and support services			Was not working, but was looking for work. Had never worked before...16 Skip >A5	Financial, professional...23 administrative and support services	
	Was not working, and was not looking for work. (retired, retired, disabled etc.)...17 Skip >A5	Public administration and defense...24			Was not working, and was not looking for work. (retired, retired, disabled etc.)...17 Skip >A5	Public administration and defense...24	
		Education...25				Education...25	
		Human health and social work...26				Human health and social work...26	
		Arts, entertainment and recreation...27				Arts, entertainment and recreation...27	
		Personal services...28				Personal services...28	
		Domestic services...29				Domestic services...29	
		Exhibition and international organizations...30				Exhibition and international organizations...30	

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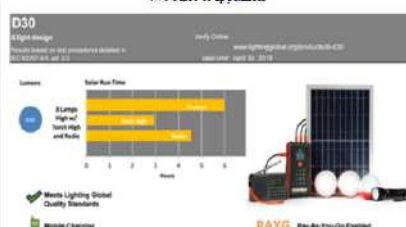
B	8	The roof of the dwelling is mainly made of what material?	Check with observation		- Wood and mud...1 - Wood and thatch...2 - Stone and Cement...3 - Brick tiles...4 - Corrugated iron sheet...5 - Asbestos...6 - Reed/bamboo/canoe...7 - Plastic/ canvas...8
B	9	The floor of the dwelling is mainly made of what material?	Check with observation		- Mud Dug/no floor...1 - Reed/bamboo/canoe...2 - Wood planks...3 - Parquet or polished wood...4 - Cement screed...5 - Plastic tiles...6 - Cement tiles...7 - Brick tiles...8 - Ceramic/terrazzo tiles...9
B	10	What type of toilet facility does your household use?			- No toilet / bush / field...1 - Open pit without slab/Open Pit...2 - Pit latrine with slab (not washable)...3 - Pit latrine with slab (washable)...4 - Ventilated improved pit latrine...5 - Pour flush toilet...6 - Flush toilet with cistern...7 - Composting toilet / access latrine...8
B	11	What is your household's main source of drinking water?			- Pipe borne water...1 - Bore hole/ hand pump...2 - Electric water pump...3 - Protected well/spring...4 - Unprotected well/spring...5 - River/spring...6 - Lake/reservoir...7 - Rain water...8 - Tanker/truck/vender...9 - Satchet water...10 - Bottle water...11
B	12	What do you usually do to make the water safer to drink?			- None...1 - Boil...2 - Add bleach/chlorine...3 - Use a water filter...4 - Solar disinfection...5 - Let it stand and settle...6 - Other...7
B	13	What is the main source of energy used for Lighting?		Country specific question/codes, see right	- Electricity (TANESCO/ZECO)...1 - Solar...2 - Generator/private source...3 - Gas(industrial)...4 - Gas(house)...5 - Electricity (wind)...6 - Acetylene lamp...7 - Kerosene(lantern chimney)...8 - Kerosene(Wick lamp)...9 - Candles...10 - Firewood...11
B	14	What is the main source of energy used for Cooking?		Country specific question/codes, see right	- Electricity (TANESCO/ZECO)...1 - Solar...2 - Generator/private source...3 - Cooking gas...4 - Gas(house)...5 - Electricity (wind)...6 - Darfim...7 - Coal...8 - Charcoal...9 - Firewood/Wood residues...10 - Animal residue...11 - Not applicable...99
The next questions is about the households use of bank services					
B	15	Does anybody in this household have an account or savings in a bank, credit union, micro-finance bank or mobile banking like mpesa, amola, M-kesa?			- Yes...1 - No...2 → Skip to B17
B	16	At which formal institution does this household have an account or savings?	Read options aloud		- Commercial bank...1 - Cooperative credit union...2 - Microfinance institution...3 - Mobile bank like mpesa, amola, M-kesa...4 - Other...55
B	17	Does anybody in this household participate in a rotating saving scheme or an informal saving institution?			- Yes...1 - No...2 F145
B	18	At which informal institution does this household have an account or savings?	Multiple responses possible	Multiple responses possible	- Group savings (rotational)...a - Group savings (one-time disbursement)...b - Other...c
B	19	If you can get a loan/credit, what are the sources of credit/loans?	Multiple responses possible	Multiple responses possible	- Commercial/government bank...a - Cooperative credit union...b - Microfinance institution...c - Rural bank...d - State loan...e - NGO...f - Business firm...g - Employer...h - SACCO/Moneylender...i - Shop...j - Relative/friend/neighbor...k - Mobile money services...l - Cannot get a loan/credit...m
B	20	Do you use mobile money to send money to friends and family or to make payments over the mobile phone?			- Yes...1 - No...2 → Skip to next section
B	21	Have you used the account in the past 90 days?			- Yes...1 - No...2
B	22	How do you use the mobile money services?	Multiple responses possible	Multiple responses possible	- Receive money from family/friends/other...a - Transfer credit or money to family/friends/other...b - Top up credit...c - Receive NGO/State support...d - Pay for Electricity...e - Pay for Water...f - Internet top-up/credit...g - Commercial purchases...h - Insurance...i - Loan payments...j - Savings...k - Get small loans from mobile provider...l - Other...o

C	C	Supply and demand of electricity			
C	1	The respondent for the next section should be the most knowledgeable household member on household electricity. Are you well informed about these issues or would you like to have somebody else in the household to answer these questions?	Record Respondent Member No for this section	MemberNo and name from listing of persons 15 years and older.	MemberNo
		The next questions is about the use and sources of energy in this household. We start with electricity and then move to other energy sources. First we would like to know if you have any electrical power in this household.			
C	2	Do you have a grid connection?		Yes...1 No...2 → Skip to C4	
C	3	Is this the national grid or a local grid?		National grid...1 Local grid...2 Don't know...8	
C	4	Do you have any devices or power supply using solar power?	Probe if respondent hesitates or ask to see the lantern system: Can be anything from a single solar lantern to lights or appliances powered by a solar panel. SHS: Most advanced. Separate solar panel and a separate battery. Can power appliances (e.g. radio, fan). SOLAR MULTILIGHT PRODUCT: Medium advanced. Can power more than one light and charge mobile phone. Separate solar panel. Integrated battery, no separate battery. SOLAR LANTERN: Least advanced. Single light. All-in-one. Might charge mobile phone and some also have a radio. Illustrative photos. MULTIPLE ANSWER.		Yes...1 No...2 → Skip to C6
C	5	What kind of solar power supply do you have?		Multiple answer	Solar home system (SHS) with a separate battery...a Solar multilight product...b Solar lantern...c

Solar home system comes with a self-standing battery, 2+ light bulbs AND mobile charging AND/OR radio, television, fan and other appliances



Solar multi-light product comes with integrated battery and will energy to at least two bulbs or appliances



Solar lantern comes with only one light bulb



C	6	Do you use an electric generator?		Yes...1 No...2	
C	7	Do you use pico-hydro power?		Yes...1 No...2	
C	8	Do you use rechargeable batteries (not linked to a solar device)?		Yes...1 No...2	
C	9	Do you use dry cell batteries?		Yes...1 No...2	
		If 0 "yes" in (C2, C5, C6, C7, C8 and C9) then skip to C12 If 1-2 "yes" in (C2, C5, C6, C7, C8 and C9) then continue with C10 and skip to C12 If >2 "yes" in (C2, C5, C6, C7, C8 and C9) then continue with C10 and C11			
C	10	Which of these power sources is your main electrical power source?	Read options aloud if needed. If only one source, mark the source and continue. Main source. Leave this to the respondent. If they ask, say that we are after the source providing most energy.	Only allow answer codes = "yes" in C2, C4, C7, C8 and C9, or code 1,2,3 in C5	Grid...1 Solar Home System...3 Electric generator...4 Pico-Hydro...5 Rechargeable Battery (Not linked to a solar system)...6 Solar Multi-Light Product...7 Solar Lantern...8 Dry-cell battery...9
C	11	Which of these power sources is your main back-up source?	Read options aloud if needed.	Only ask C11 if more than one "yes" in C2, C5, C6, C7, C8, C9. Only allow answer codes = "yes" answer in C2, C4, C7, C8 and C9, or code 1,2,3 in C5. Answer in C11 can not be the	Grid...1 Solar Home System...3 Electric generator...4 Pico-Hydro...5 Rechargeable Battery (Not linked to a solar system)...6 Solar Multi-Light Product...7 Solar Lantern...8 Dry-cell battery...9 No electricity...66

C	12	Did you have any electricity five years ago? If yes, which was the main electrical power source in the household ?	Main source: Leave this to the respondent. If they ask, say that we are after the source providing most energy.	National Grid Connection...1 Local grid connection...2 Solar Home System...3 Electric generator...4 Pico-Hydro...5 Rechargeable Battery (Not linked to a solar system)...6 Solar Multi-Light Product...7 Solar Lantern...8 Dry-cell battery...9 No electricity...66	
C13-C15 only for those households that are not connected to the grid; if C2 NE 1 then continue with C13. Others skip to C16.					
C	13	What is the MAIN reason why your household is not connected to the grid?	Record the MAIN reason.	Grid is not available in the community...0 Grid is too far from household...1 Cost of initial connection is too expensive...2 Monthly fee is too expensive...3 Satisfied with current energy solution...4 Renting, Landlord decision...5 Service Unreliable...6 Administrative procedure is too complicated...7 Submitted application and waiting for connection...8 Company refused to connect the household...9 Other...55 Yes...1 No...66 → Skip to C53 Don't know...88 → Skip to C53	
C	14	Do you expect to get grid connection?		Less than 6 months...1 6-12 months...2 1-2 years...3 More than 2 years...4 ALL → skip to C53	
C	15	When do you expect to get grid connection?	Approximately. If not in the foreseeable future, choose "More than 2 years".		
C	C	Electricity from National Grid or local grid This section is only for those that have national grid as main source of energy. Before C16: if C10 ne 1 then skip to C53.			
We would now like to ask you some questions about your grid connection.					
C	16	Did [ELECTRICITY COMPANY] connect your household to the grid, did you do it yourself, did someone else do it or was the house connected when your household moved into this house?	YOU MAY ANSWER BY OBSERVATION	ELECTRICITY COMPANY: Tanzania: TANESCO/GREA Mozambique: EDM	[ELECTRICITY COMPANY]...1 By the household...2 By others...3 Was connected when they moved in...4 Don't know...88
C	17	How many years have you had this grid connection?	Record in years, if less than 1 year record 1. Cannot be greater than years lived in community. Refer to connection fee ONLY. If dwelling was already connected to the grid when the household moved in, record Don't know...88 For those that rent the dwelling, choose 99	Cannot be greater than 81	Record in years
C	18	How much did your household pay to get connected to the grid?	Do not include the connection fee from C18 here. If dwelling was already connected to the grid when the household moved in, record Don't know...88 For those that rent the	8 digits	Local currency Don't know...88 The dwelling was already connected when household moved in...89 Not applicable...99
C	19	How much did your household pay for the internal wiring?		8 digits	Local currency Don't know...88 The dwelling was already connected when household moved in...89 Not applicable...99
C	20	How many days after you applied for the grid connection did your household get connected?	Insert 0 if less than 1 day		Number of days Don't know...88
C	21	How many weeks after you were connected were you able to use electricity in your home?	Insert 0 if Less than 1 week Don't know...88		Number of weeks Don't know...88
C	22	Now we would like to know more about the capacity of your connection. That is limited by the tariff, the fuse or the meter. First we would like to know what kind of tariff do you have?		Country specific tariff	D1...1 T1...2 T2...3 T3...4 T5...5 Do not know...55
C	23	Does your household have an electric meter jointly with other households or by your own?			Yes, alone...1 → Skip to C25 Yes, sharing with other households...2 No...3 → Skip to C28
C	24	How many households are sharing the meter?			Number of Households
C	25	We would now like to know the capacity of the main fuse. What is the Ampere (A) stated?	The respondent might know this. If not, check the main fuse. Select the highest number of Ampere (A). Capacity is in Ampere (A). A is always below 150. The Voltage is always 220 V (0,23 kV), do not record this.	Range 5-150	Range 5-150 A Don't know...88
C	26	We would now like to know the capacity of the meter. What are the watts (W) stated?	The respondent might know this. If not, check the meter box or the bill. Capacity is in Watt (W). Always more than 1000. 1kW=1000 W. The Voltage is always 220 V (0,23 kV), do not record this.	Range: more than 1000, 5 digits	Range: more than 1000 Don't know...88
C	27	Is this a pre-paid meter?			Yes...1 No...2

C	28	Who receives the payment for your electricity service?			Energy company...1 Pre-paid meter card seller...2 Community/village municipality...3 Relative...4 Neighbor...5 Landlord...6 Local store ...7 Utility office ...8 Bank . 9 Post office .10 No one ...66 → Skip to C36 Other...55
			If C27=1 skip to C33		
C	29	Do you have an electricity bill for the last payment?	Enumerator: If the respondent pays the energy company or has a record of the electricity payment, ask to see the electricity bill invoice and use it for C30 and C31 and C32 Record the amount paid from the last bill if available.	8 digits	Respondent has energy bill and shows it...1 Respondent has energy bill but refuses to show it or could not locate it...2 Respondent does not have an energy bill...3
C	30	How much did you pay the last time you paid?	Record the amount paid from the last bill if available.	8 digits	Local Currency Don't Know...88
C	31	How many kiloWattour (kWh) did you pay for?	Record the consumption from the last bill if available.		Quantity in Kilowatt Hour (kWh) Don't Know...88
C	32	How many weeks did the bill cover?			Numer of weeks ALL→skip to C36
			C33-C34 only if C27=1		
C	33	How much did you spend the last time you bought electricity?		8 digits	Local Currency Don't Know...88
C	34	How long does this last?			Number of days
C	35	How many kWh did you pay for?	Look at the card or the app.	4 digits	Number of kWh Don't Know...88
C	36	Is the quality of electricity service the same all year?			Yes...1 No...2
C	37	Do you receive information about a "load-shedding" schedule?	Load shedding is the set hours of electricity available from the grid for certain customers.		Yes...1 No...2 Sometimes...3 No load-shedding in this area...4
C	38	How many hours was electricity available each day and night from the grid, during the last seven days?	On average max 4 hours	max 24 hours	Hours of supply → if hours = 24, then skip to C40, and set C39 to 4.
C	39	How many hours was electricity available each evening, from 6:00 pm to 10:00 pm from the grid, during the last seven days ?	On average max 4 hours	max 4 hours	Hours of supply
C	40	How many outages/blackouts occurred during the last seven days?			Number of outages/blackouts No outages/blackouts...66 → Skip to C45 Don't know...88 → Skip to C45
C	41	What was the total duration of all the outages/blackouts during the last seven days?		Hours	Hours. Don't know...88
C	42	Do you have a back up source for lighting? IF SO: What is your main back-up source of lighting during outages/blackouts of the grid?			Electric generator...2 Rechargeable battery and storage devices (e.g.: car battery)...3 Solar Lantern...4 Solar Multi-Light Product...5 Solar Home System ...6 Pico-hydro...7 Kerosene paraffin lamp...8 Fuel-based lighting...9 Dry-cell (non-rechargeable) battery/ Torch/ Flashlight...10 Candle...11 Other...55 No back-up source...66
C	43	Do you have a back up source for electricity for appliances? IF SO: What is your main back-up source of electricity for appliances (including mobile phone charging) during outages/blackouts of the grid?			Electric Generator...2 Rechargeable battery and storage devices (e.g.: car battery)...3 Solar Lantern...4 Solar Multi-Light Product...5 Solar Home System ...6 Pico-hydro...7 Other...55 No back-up source...66
C	44	Have you ever asked for assistance in a power failure? And if yes, did they show up?			Never asked...1 Yes, and they showed up in a reasonable time...2 Yes, but it took some time...3 They nevzner showed up...4
C	45	In the last 12 months, did any of your appliances get damaged because the voltage was too high or too low or going up and down from the grid?	Usual sign of this is flickering lights		Yes...1 No...2 Don't know...88

C	46	What are the MOST serious problem you experience with your grid electricity?			Supply shortage/not enough hours of electricity...1 Low/high voltage problems or voltage fluctuations...2 Unpredictable interruptions...3 Unexpectedly high bills...4 High cost of electricity...5 Do not trust the supplier...6 Cannot power large appliances...7 Maintenance/service problems...8 Unpredictable bills...9 Other...55 No problems...66
C	47	What are the SECONDD most serious problems you experience with your grid electricity?			Supply shortage/not enough hours of electricity...1 Low/high voltage problems or voltage fluctuations...2 Unpredictable interruptions...3 Unexpectedly high bills...4 High cost of electricity...5 Do not trust the supplier...6 Cannot power large appliances...7 Maintenance/service problems...8 Unpredictable bills...9 Other...55 No problems...66
C	48	In the last 12 months, did any household members have permanent limb (bodily injury) damage or even passed away because of the grid electricity?			Yes...1 No...2 → Skip to C50
C	49	What was the cause of this injury?			Carelessness or error...1 Lack of knowledge about the use of the appliance...2 Faulty wiring/ connection...3 Other...55
C50-C52 only if C3=2					
C	50	Is there a limit for the load and/or appliances you are allowed to power from this local grid?			Yes...1 No...2 Don't know...88
C	51	Were you involved in setting the tariff for the local grid?			Yes...1 No...2 → Skip to C53
C	52	How were you involved in the tariff setting?			Community meeting...1 Contacted by local grid company...2 Member of electricity committee...3 Member of cooperative...4 Other...55
C	C	Solar power - Solar lantern/ Solar multilight product/ Solar home system			
Only for those that have solar power as MAIN source of electricity: Before C53: If C10 ne (3,7 or 8) then skip to C89					
You said that your main source of electrical power is a [DEVICE]. We would now like to ask you some questions about this device. We would like you to consider only devices in working condition. If you have more than one device, think about the MAIN solar device.					
Continue with C53-C61 if C10=3. Others skip to C62.					
C	53	What is the manufacturer and model of the solar home system?	Read the information plate of the solar panel if available. Unknown=88	Alphanumeric max 32 characters	Alphanumeric max 32 characters
C	54	Do you share this solar home system with other households?			Yes...1 No...2 → Skip to C56
C	55	How many households share this solar home system?			Number of households don't know...88
C	56	What is the total power rating of the solar panels (Watt)?	Read the information plate of the solar panel if available. Unknown=88	Range: 20-900	Quantity in Watt (W) Unknown...88
C	57	What is the total Amp-hours (Ah) stated on the batteries?	Read the information plate of the batteries if available. Sum up Ah for all batteries. Unknown=88	Range: 20-900	Amp-hours (Ah) Unknown...88
C	58	What is the voltage (V) of the rechargeable batteries?	If multiple batteries, they usually have the same voltage. Record voltage for the most used battery. Volts (V). Read the information plate of the battery if available. Unknown=88	2 digits Range: 6-24	Volts Don't know...88
C	59	What is the total watt hours (Wh) stated on the batteries?	Read the information plate of the batteries if available. Sum up Wh for all batteries. Unknown=88	Range: 200-6000	Wh Unknown...88
C	60	Do you have an inverter?			Yes...F2321 No...2 → Skip to C62
C	61	What is the capacity of the inverter?	Given in Watt (W). Read the information plate of the inverter if available. Unknown=88	Range: 5-5000	Watts (W)

C	62	How many years have you had this [DEVICE]?	Record in years, if less than 1, record 1		NUMBER OF YEARS
C	63	Who decided to purchase/ acquire this [DEVICE]?		MemberID	MEMBER ID Added "Person not member of the household anymore" as an
C	64	How did you get this [DEVICE]?	Read options aloud if needed		Bought...1 → Skip to C66 Rent/pay fee to use...2 → Skip to C73 Received for free...3 Local private organizations (NGO)...1 Chief of village...2 Local government...3 Relative/Friend...4 Other...F24055 ALL → Skip to C73
C	65	Who gave you this [DEVICE]?			Full amount...1 → Skip to C70 Partial amount...2
C	66	Did you pay full or partial amount for your [DEVICE]?			Months
C	67	What is the term period for the payment?	If less than 1 month record 0		Mobile Pay-as-you-go...1 Other Pay-as-you go (scratch card, etc.)...2 Fixed fee...3
C	68	What payment system do you use?			LOCAL CURRENCY
C	69	What is the monthly payment for this [DEVICE] (installment/ fee to rent/use)?		8 digits	Yes...1 No...2
C	70	Did/do you borrow money to make your payment for [DEVICE]?			LOCAL CURRENCY
C	71	How much did you pay for this [DEVICE] upfront?		8 digits	Yes...1 No...2
C	72	Does this [DEVICE] have a warranty ?	I.e to exchange or repair if the device does not work		Yes...1 No...2
C	73	Did you receive some information on the use and maintenance of this [DEVICE]?			Yes...1 No...2
C	74	Are there certain months/seasons every year when the service is not as strong from [DEVICE]?			Yes...1 No...2
C	75	How many hours did you receive service from this [DEVICE] each day and night, during the last seven days?	Max 24 hours	Max 24 hours	Hours of supply Don't know...88 If C75 = 24 then skip to C82 and set C76 to 4
C	76	How many hours was service available from this [DEVICE] each evening, from 6:00 pm to 10:00 pm, during last seven days?	Max 4 hours	Max 4 hours	Hours of supply
C	77	What is the most serious problem you experience with [DEVICE]?			Duration of service too short...1 Too expensive...2 Cannot power large appliances...3 Breaks too often...4 Maintenance and availability of spare parts...5 Quality of light...6 Battery problems...7 Other...55 No problems...66
C	78	Is there a service to repair or replace easily available?			Yes...1 No...2
C	79	Can you charge a mobile phone with the [DEVICE] ?			Yes...1 No...2
C	80	Does this [DEVICE] have a radio?			Yes...1 No...2
C	81	How many light bulbs are there?			If C10 = 8 → skip to C83 NUMBER OF LIGHT BULBS Television...a Fan...b Refrigerator...c Tablet/laptop/computer...d Mobile phone charger...e Other...q No appliances...x
C	82	What appliances do you currently use with your solar device?	Multiple response. Read options aloud one by one.	Multiple response	Yes...1 No...2 → Skip to C85 Don't know...88
C	83	Is there any appliance you do not have that you would like to have?			Television...a Fan...b Refrigerator...c Tablet/laptop/computer...d Mobile phone charger...e Other...q No appliances...x
C	84	What appliances would you like to have?	Multiple response (Up to three devices)	Multiple response (Up to three devices)	Satisfied...1 Neutral...2 Unsatisfied...3
C	85	Are you satisfied with the service provided by the [DEVICE]?			Year Don't know...88
C	86	In what year did you get your first solar device?			Use more solar lighting...1 Use about the same solar lighting...2 Use less solar lighting...3 → Skip to C89 Don't know...88
C	87	Compared to the first time period you used solar lighting, do you currently...	Read aloud options		

C	88	What appliances do you use today that you did not use with your first solar lighting device?	Multiple response possible	Multiple response possible	Mobile phone charger...a Radio...b TV...c Fan...d Refrigerator...e No change...f Other...q
C	C	Electric Generator			
				Before C89: C10 ne 4 then skip to C1112	
				We would now like to ask you some questions about your electric generator	
C	89	Do you share this generator with other households?	If more than one generator, ask about main generator.		Yes...1 No...2 → Skip to C91
C	90	How many households are sharing electricity from this generator?	If more than one generator, ask about main generator.		Number of households Don't know...\$
C	91	What is the capacity of the generator?	Capacity is given in Watt (W) or Volt Amps (VA). Enumerator can also observe for confirmation. Read information plate of the MAIN generator.	5 digits	Watt (W) = Volt Amps (kVA) - 5 digits Don't know...\$
C	92	In the last 12 months, what did your household use this generator for?	Multiple response possible. Read options aloud if needed.	Multiple response possible	Lighting...a Appliances...b Home-based income activity...c Other...q
C	93	In the last 12 months, in which months did you use this generator?	Multiple response possible Record 44 if all year.	Multiple response possible	January...a February...b March...c April...d May...e June...f July...g August...h September...i October...j November...k December...l All year...z
C	94	In the months you did use the generator, on average, how many days per month did you use this generator?			Number of days Don't know...\$
C	95	How many years have you used this generator?	Record in years, if less than 1 year record 1		Number of Years Don't know...\$
C	96	Does your household own, rent or use the generator for free?			Own the generator...1 Rent the generator...2 Use the generator for free...3
C	97	In the months that you use it, how much did you pay to use the generator each month?	Do not include any cost of fuel, only fee for using the generator.	8 digits	Local currency Don't know...\$
C	98	In the last 12 months, did you spend anything on repairs/parts/maintenance of the generator?			Yes...1 No...2 → Skip to C100
C	99	In the last 12 months, how much did you spend?		8 digits	Local currency Don't know...\$
C	100	What fuel is used to power the generator?			Diesel...1 Gasoline...2 Other...5 Don't know...\$
C	101	In the last 30 days, what was the total quantity of fuel used to power the generator?			Liters Don't know...\$
C	102	Is it your household that pays for the fuel used to power the generator?			Yes...1 No...2 → Skip to C104
C	103	In the last 30 days, how much did your household spend on fuel for this generator?		8 digits	Local currency Don't know...\$
C	104	Are there certain months/seasons of the year when less fuel is available to power the generator?			Yes...1 No...2
C	105	How many hours did you use this generator each day and night, during the last seven days?	(max 24 hours)	max 24 hours	Hours of supply Don't know...\$ if C105 = 24 → skip to C107 and set C106=4
C	106	How many hours did you use this generator each evening, from 6:00 pm to 10:00 pm, during the last seven days?	(max 4 hours)	Max 4 hours	Hours
C	107	In the last 12 months, did any of your appliances get damaged because the voltage was too high, too low or going up and down from the generator?			Yes...1 No...2 Don't know...\$

C	108	What is the most serious problems you experience with the generator?			Limited power supply...1 Cannot power large appliances...2 Too expensive to use (including high cost of fuel/rent)...3 Availability of the fuel...4 Hard to maintain/service...5 Loud/Noisy...6 Unpredictable interruptions...7 Other...55 No problems...66
C	109	What is the second most serious problems you experience with the generator?			Limited power supply...1 Cannot power large appliances...2 Too expensive to use (including high cost of fuel/rent)...3 Availability of the fuel...4 Hard to maintain/service...5 Loud/Noisy...6 Unpredictable interruptions...7 Other...55 No problems...66
C	110	In the last 12 months, did any household members have permanent limb (bodily injury) damage because of the generator?			Yes...1 No...2 → Skip to C112
C	111	What was the cause of this injury?			Carelessness or error...1 Lack of knowledge about the use of the appliance...2 Faulty wiring/connection...3 Other...55
C	C	Externally Recharged Battery (Car Battery, etc)			
		Change to Before C112: Only answer C112-C127 if C10=6 or (C10=4 and C11=6) Otherwise skip to C128			
		We would now like to ask you some questions about your externally recharged battery.			
C	112	How many years have you had this battery?	Record in years, if less than 1 year record 0		Record in years
C	113	In the last 12 months, in which months did you use rechargeable batteries?	Multiple response possible Record 77 if used all year.	Multiple response possible	January...a February...b March...c April...d May...e June...f July...g August...h September...i October...j November...k December...l All year...z
C	114	In the last 12 months, what did your household use rechargeable batteries for?	Multiple response possible Batteries supply DC power. Many household appliances need AC power to run. The inverter converts DC power to AC power. Given in Watt (W). Read the information plate of the inverter if available.	Multiple response possible	Lighting...a Appliances...b Home-based income activity...c Outside torch...d Other...q
C	115	Does your household have an inverter that allows you to use AC appliances?			Yes...1 No...2 → Skip to C117
C	116	What is the capacity of the inverter?		Range: 5-1500	Watts (W)
C	117	What is the total number of rechargeable batteries that you use in a typical month?		2 digits	Total number of rechargeable batteries. Don't know...88
C	118	How much did you pay for the rechargeable battery?		8 digits	Local currency Don't know...88
C	119	How much does your household spend in a typical month to recharge the batteries (in total)?		8 digits	Local currency Don't know...88
C	120	What is the electricity source used to recharge the battery?			National grid...1 Local grid...2 Electric generator...3 Solar...4 Other...55
C	121	How many hours can you use rechargeable batteries for electricity supply each day and night when fully charged if you wanted to?	(max 24 hours)	(max 24 hours)	Hours Don't know...88
C	122	How many hours can you use rechargeable batteries for electricity supply each evening, from 6:00 pm to 10:00 pm if you wanted to?	(max 4 hours)	(max 4 hours)	Hours
C	123	What is the Amp-hours (Ah) stated on the battery?	Capacity: ampere-hours (Ah). Read the information plate of the battery if available. Unknown=88 If multiple batteries, sum up the Ah of all the batteries.	Range: 20-500	Ampere-hour Don't know...88
C	124	What is the voltage (V) of the rechargeable batteries?	If multiple batteries, record voltage for the most used battery. Volts (V). Read the information plate of the battery if available. Unknown=88	2 digits Range: 6-24	Volts Don't know...88

C	125	What is the watt hours (Wh) stated on the battery?	Read the information plate of the battery if available. If multiple batteries, sum up the Wh of all the batteries. Unknown=88	Range: 200-6000	Wh Unknown...F31388
C	126	What is the most serious problems you experience with the rechargeable batteries?			Supply shortage/not enough hours of electricity...1 Too expensive...2 Cannot power large appliances...3 Recharging is not convenient...4 Maintenance & repair is difficult...5 Cannot recharge battery to full capacity...6 Other, specify...55 No problems...66
C	127	What is the second most serious problems you experience with the rechargeable batteries?			Supply shortage/not enough hours of electricity...1 Too expensive...2 Cannot power large appliances...3 Recharging is not convenient...4 Maintenance & repair is difficult...5 Cannot recharge battery to full capacity...6 Other, specify...55 No problems...66
C	C	Main Source of energy for Charging Mobile Phone The next questions are about mobile phones in the household.			
C	128	How many mobile phones do the household members own combined?	If none, input "0"	If none, input "0" → Skip to D1	Number
C	129	Are members of your household able to charge all their mobile phones as often as they need inside your dwelling?			Yes...1 → Skip to C134 No...2 Don't know...88
C	130	Can you charge at least one mobile phone to full charge every day inside your dwelling?			Yes...1 → Skip to C134 No...2
C	131	Can you charge at least one mobile phone to full charge in 3 days inside your dwelling?			Yes...1 No...2
C	132	How many mobile phones of your household members do you charge outside your dwelling?		If 0 → Skip to C134	Number of mobile phones
C	133	How much does your household spend each month (in total) on charging the mobile phone(s) outside your dwelling?		8 digits	Local currency
C	134	Does your household have a solar charger or solar power bank that can be used for charging mobile phones?			Yes...1 No...2
D	D	Willingness to Pay for a Grid Connection Before D1: If (C10 eq 1 or C11 eq 1) then skip to E1			
		The next questions are about willingness to pay for a grid connection. There are several steps of getting connected to the grid, each with their own cost: 1. To use electricity you first need a wire from the nearest pole to a meter in your house. That is the connection. 2. Within your house you need wires that connect appliances to the meter. This is the wiring. 3. Finally, to keep using electricity you must pay for the electricity that you use, or it will be turned off. This is the cost of monthly use. I would now like to ask you questions ONLY about the first cost of connecting -- getting a wire from the electricity poles to a meter in your house.			
D	1	Would you be able to pay \${CF} upfront for an electricity connection?		For each household, CAPI will randomly assign one of the following amounts in the placeholder \${CF}: 50% of the connection fee in local currency or 100%. Same amount in D1 and D2.	Yes...1 → Skip to E1 No...2
D	2	Would you be able to pay \${CF} for an electricity connection, if you were given 12 months to make the payment?		For each household, CAPI will randomly assign one of the three following amounts in the placeholder \${CF}: 50% of the connection fee in local currency or 100%. Same amount in D1 and D2.	Yes...1 → Skip to E1 No...2 Don't Know...88
D	3	Would you be interested in getting a grid connection if you could get connected for free?			Yes...1 → Skip to E1 No...2 Don't Know...88
D	4	Why not?			Still cannot afford the wiring costs...1 Do not need electricity...2 Electricity service is unreliable...3 Monthly fee is too expensive...4 Other...55

E	E	Willingness to Pay for Solar home system		
		Before E1: If C10 in 3 or C11 in 3 then skip to G1.		
		Before E1: If C10 in (1) or C11 in (1) then continue with Intro 1. All others skip to Intro 2.		
		We will now ask you questions about your willingness to pay for a solar home system. A solar home system can be installed even in remote households with no access to the grid. It uses solar power and can provide power to lights and appliances like a radio, fan, TV etc. The full price of the solar home system is buying and installing the system, then there is no cost of using electricity. We know that you already have a grid connection, but as you answer the next few questions, keep in mind the benefits of a solar home system, as well as your household budget.		
		We will now ask you questions about your willingness to pay for a solar home system. A solar home system can be installed even in remote households with no access to the grid. It uses solar power and can provide power to lights and appliances like a radio, fan, TV etc. The full price of the solar home system is buying and installing the system, then there is no cost of using electricity. As you answer the next few questions, keep in mind the benefits of a solar home system, as well as your household budget.		
E	1	Would you be willing to pay \$(CF) upfront for this solar device?	For each household, CAPI will randomly assign a Tier 2 (high capacity: enough to power a television) randomly one of the three following amounts in the placeholder \$(CF): 50% or 100% of the solar device in local currency. We will have the market price for the selected. Same amount in E1 and E2.	Yes...1 → Skip to G1 No...2
E	2	Would you be willing to pay \$(CF) for this solar device, if you were given 12 months to make the payment?	For each household, CAPI will randomly assign a Tier 2 (high capacity: enough to power a television) randomly one of the three following amounts in the placeholder \$(CF): 50% or 100% of the solar device in local currency. We will have the market price for the selected. Same amount in E1 and E2.	Yes...1 → Skip to G1 No...2 Don't Know...35
E	3	Why would you not accept the offer?		Cannot afford the payment...1 Do not need electricity...2 Maintenance/servicing of device is not available...3 Other, specify...55

G	G	Dry-Cell Batteries			
		Before G1: C10 ne 9 then skip to F1			
		You said that your main source of electricity is dry cell batteries. We would now like to ask you some questions about these batteries			
G	1	Which of the following devices did you use dry cell batteries to power?	multiple responses. Read options aloud.	multiple responses	Lanterns...1 flashlight...2 task lights...3 none...66 -> skip to F1 other devices...55
G	2				
	Categories		a	b	c
			How many of [ITEM] does your household power with dry cell batteries?	How much did you pay for each [ITEM] on average?	How many hours did you use the [ITEM] per day during the last 7 days?
			NUMBER OF EACH DEVICE If 0 skip to next item	If paying in installment, enter total value of payments. If more than 1 device, input the average.	If more than 1 device, input the average.
				8 digits	
			Number	Local currency	Hours
	1	Lanterns			
	2	Flashlights			
	3	Task lights			
	55	Other devices			
	66	None			

G	3	How many of dry cell batteries do you purchase each month ?			NUMBER OF BATTERIES FOR ALL DEVICES
G	4	How much do you spend each month on dry cell batteries?		8 digits	LOCAL CURRENCY
F	F	Lamps and candles: Kerosene/Paraffin/Fuel-Based Lighting			
F	1	The next questions is about the households use of lamps/candles and fuel used for lighting. Are you well informed about these issues, or would you like somebody else in the household to answer these questions?	Record Respondent MemberNo for this section	MemberNo and name from listing of persons 15 years and older.	MemberNo
		F2 only for households with school children, (ie. Between 5 and 18 and AC6=1). Others skip to F3			
F	2	First we would like to know What is the main source of lighting the children who are currently enrolled in school usually use for studying/doing homework?	Single response		Electric lighting/lamp...1 Solar powered light source...2 Battery-operated light source...3 Street lighting...4 Kerosene/paraffin lamp...5 Candles...6 Open wick lamp...7 Fireplace...8 Other...55 Studying and homework only during daylight hours...66
		Before F3: if C10 in 1,3,4 then skip to I1.			
		This section is only for those that do not have national grid, local grid, generator or solar home system as main source of electricity.			
		Then we would like to know some more about light sources and lamps in the household.			
F	3	Which of these is the main source of lighting in the household?	Read options aloud. Main: the type you use the most.		Candle...1 → skip to F6 Open wick lamp...2 Wick lamp with glass cover...3 Pressurized mantle lamp...4 Solar powered light source...5 → I1 Battery-operated light source...6 → I1 None...7 → I1 Other...55
F	4	How many of these lamps does your household have?			NUMBER OF LAMPS
F	5	How much did you pay for each [LAMP]?	If paying in installment, enter total value of payments.		
F	6	In the last 30 days, how many days did you use [LAMP/CANDLE]?	If more than 1 device, input the average.	8 digits	LOCAL CURRENCY
F	7	How many hours do you use [LAMP/CANDLE] each day?		Max 30	NUMBER OF DAYS
F	8	What are the most important problem when using the [LAMP/ CANDLE]?		Max 24	HOURS Lantern too expensive to operate...1 Fuel too expensive...2 Fuel not available...3 Accidents can happen...4 Bad for health...5 Subsidies needed...6 Time spent to collect fuel...7 Other...55 No problems...66 → skip to F10
F	9	What are the second most important problem when using the [LAMP/ CANDLE]?			Lantern too expensive to operate...1 Fuel too expensive...2 Fuel not available...3 Accidents can happen...4 Bad for health...5 Subsidies needed...6 Time spent to collect fuel...7 Other...55 No problems...66
F	10	In the last 12 months, did anybody in your household face any serious harm/injury from [LAMP/CANDLE]?			Yes...1 No...2
		F11 not to be asked to candle users (F3=1)			
F	11	Which of the following do you mainly use as fuel for your [MAIN SOURCE OF LIGHTNING]?			Kerosene/paraffin...2 Diesel...3 Gasoline...4 Biogas...5 Paraffin...6 None...7 → skip to G1
F	12	What is the total quantity of [FUEL/CANDLES] you purchase at a typical time?		Needs comma: 1 digit behind comma.	LITERS OF FUEL/Number of Candles
F	13	How long does this quantity of [FUEL/CANDLES] typically last?			DAYS

F	14	How much do you pay in total for the amount you purchase?		8 digits	LOCAL CURRENCY All...1 More than half...2 Half...3 Less than half...4
F	15	How much of the fuel you bought was used for [MAIN SOURCE OF LIGHTING]?			
I	1	Use of Cooking Solutions			
I	1	Now we would like to talk to [NAME from A8] about cooking and fuels used for cooking	If [NAME] is not present, ask to speak to another person knowledgeable about cooking. Record respondent: MemberNo for this section	[NAME]: The household member who most frequently cooks food for the household, as identified in A8. If not present any adult member of household. MemberNo and name from listing of persons 15 years and older. This person should answer both	MemberNo
		In this section we would like to ask you about the kind of stoves you use for cooking and its details.			
I	2	Have you used any stoves using firewood, dung, twigs and leaves during the last 12 months?			Yes...1 No...2 -> skip to 14
I	3	Which type of stove is this?	Ask to see the oven or show pictures. The enumerator should make sure to identify the right type of stove.	Multiple answer	Three-stone stove...101 Round mud stove...102 ICS w/ ceramic fire chamber...111 ICS w/ metal ring...112 Rocket stove...121 High traditional burned mud/clay stove...122 Lorena 1 Rocket stove with high insulation...131 Rocket stove metal w/internal chimney (Canamakeivugunye)...132 Lorena 2 Rocket stove with well-sealed chimney...141 Moz Metal rocket stove...142
I	4	Have you used any stoves using charcoal or kerosene during the last 12 months?			Yes...1 No...2 -> skip to 16
I	5	Which type of stove is this?	Ask to see the oven or show pictures. The enumerator should make sure to identify the right type of stove.	Multiple answer	Traditional charcoal stove - Open access for air...201 Traditional raised charcoal stove...202 Charcoal stove, Old ICS Opening for air may be closed...211 Ceramic lined charcoal ICS...221 Ceramic lined and insulated charcoal ICS...231 Kerosene cooking stove (Mchima)...233 Efficient charcoal stove with controlled airflow...241
I	6	Have you used any stoves using rice husks, pellets or briquettes?			Yes...1 No...2 -> skip to 18
I	7	Which type of stove is this?	Ask to see the oven or show pictures. The enumerator should make sure to identify the right type of stove.	Multiple answer	Gasifier stove...331 Jiko Safi Gasifier stove w/forced air & chimney...341
I	8	Have you used any stoves using LPG, biogas, electricity (grid or solar), solar oven (non-electric)?			Yes...1 No...2 -> skip to 110
I	9	Which type of stove is this?	Ask to see the oven or show pictures. The enumerator should make sure to identify the right type of stove.		Biogas stove...451 Multiple LPG stove...452 Electrical stove...461 Solar oven (Non-electric)...471
I	10	Which one is your main stove?		Only show marked codes from 13, 15, 17 and 19	Three-stone stove...101 Round mud stove...102 ICS w/ ceramic fire chamber...111 ICS w/ metal ring...112 Rocket stove...121 High traditional burned mud/clay stove...122 Lorena 1 Rocket stove w high insulation...131 Rocket stove metal w/internal chimney/ Canamakeivugunye...132 Lorena 2 Rocket stove with well-sealed chimney...141 Metal rocket stove...142 Traditional charcoal stove - Open access for air...201 Traditional raised charcoal stove...202 Charcoal stove, Old ICS Opening for air may be closed...211 Ceramic lined charcoal ICS...221 Ceramic lined and insulated charcoal ICS...231 Kerosene cooking stove (Mchima)...233 Efficient charcoal stove with controlled airflow...241 Gasifier stove...331 Saw dust, risk husk gasifier stove...332 Jiko Safi Gasifier stove w/forced air & chimney...341 Biogas stove...451 Multiple LPG stove...452 Single LPG stove...453 Electrical stove...461 Electrical plates without oven...462 LPG/ gas and electrical stove...463 Solar cooker (Non-electric)...471

Cookstoves in Tanzania		Photos to appear in CSPro			
Time 3	Time 1	Time 2	Time 3	Time 4	Time 5
Fuel: Firewood, dung, twigs and leaves					
					
101 Three-stove stove	100 Brick mud stove	111 ICS w/ ceramic fire chamber 112 ICS w/ metal ring	121 Rocket stove 122 High traditional burned mud clay stove	131 Looma 1 Rocket stove or high insulation 132 Rocket stove metal/whitewashed chamber Gawankari ngwano	141 Looma 2 Rocket stove with well-sealed chimney 142 Metal rocket stove
Fuel: Charcoal or kerosene					
					
211 Improved charcoal stove. Open cavity for air flow 212 Traditional metal charcoal stove	210 Charcoal stove, Old ICS Opening for air may be closed	221 Ceramic lined charcoal ICS	231 Ceramic lined and hardened charcoal ICS	213 Kerosene rocket stove (Mikma)	241 Efficient charcoal stove with controlled airflow

Fuel: Rice husks, pellets and briquettes		Fuel: LPG and biogas, electricity (grid or solar), solar oven (non-electric)			
					
311 Gasifier stove 312 Saw dust, tick bark gasifier stove	341 Jiko Ball Gasifier stove refined air & chimney	411 Biogas stove	412 Multiple LPG stove 413 Single LPG stove	461 Electrical stove 462 Electrical plates without oven 463 120V, 240V and electrical ovens	471 Solar cooker (Non electric)

We would now like to ask you some more questions about your main stove.					
I	11	How did you obtain this [STOVE]?			CODE: Purchased, upfront...1 Purchase, in installment...2 Receive for free...3 → Skip to 114 Built ourselves...4 → Skip to 118
I	12	Who decided to purchase this [STOVE]?	Member ID from HH roster	Member ID from HH roster	Member ID
I	13	How much did you pay for the [STOVE]?		8 digits	Amount in Local currency ALL → Skip to 115
I	14	Who gave the [STOVE] to you?			Local private organizations (NGO)...1 Chief of village...2 Local govt...3 Friend/relative...4 Other...55
I	15	Did you receive training or information on the [STOVE]?			Yes...1 No...2
I	16	What is the manufacturer and model of the [STOVE]?		Alphanumeric, 32 characters	Alphanumeric
I	17	If you want to sell the [STOVE] in your community today, how much would you receive?		8 digits	Amount in local currency Don't know...88
I	18	How long have you been using this [STOVE]?	If less than 1 year, record 0		Number of years
I	19	How many years do you expect to continue using this [STOVE]?	If less than 1 year, record 0		Number of years
I	20	In the last 12 months, during which part of the year did you use this [STOVE]?			All year round...1 Mainly dry season...2 Mainly rain season...3
I	21	Is the [STOVE] fixed in one place or moveable?	Might be answered by observation		Fixed...1 Moveable...2

I	22	In the last 12 months, where did you normally cook with [STOVE] in the dry season?			In dwelling NOT in sleeping area...1 In dwelling in a sleeping area...2 In a separate kitchen...3 In a veranda (roofed platform with at least two open sides)...4 In a separate open kitchenhouse...5 Open air...6
I	23	In the last 12 months, where did you normally cook with [STOVE] in the rainy season?			In dwelling NOT in sleeping area...1 In dwelling in a sleeping area...2 In a separate kitchen...3 In a veranda (roofed platform with at least two open sides)...4 In a separate open kitchenhouse...5 Open air...6
(If I22 = (1,2,3) or I23 =(1,2,3)) and (I2=1 or I4=1 or I6=1) then continue with I24. Others skip to I25.					
I	24	Do you use a chimney, hood or other exhaust system while using this stove?			Yes...1 No...2
I	25	In the last 12 months, what are the fuels you used the most on [STOVE]?	A Most Used Single response		LPG/cooking gas...1 Wood purchased...2 Wood collected...3 Charcoal...4 Kerosene/paraffin...5 Piped Natural Gas...6 Coal/lignite...7 Animal Waste/Dung...8 Crop Residue/Plant Biomass...9 Saw Dust...10 Coal Briquette...11 Biomass Briquette...12 Electric...13 → Skip to I37 Processed biomass (pellets)/ woodchips...14 Biogas...15 Ethanol...16 Garbage/plastic...17 Solar...18 Other...55 Not applicable...99
I	26	In the last 12 months, what are the second most used fuel you used on [STOVE]?	B Second most Used Single response If only one type of fuel is used, choose "Not applicable...66"		LPG/cooking gas...1 Wood purchased...2 Wood collected...3 Charcoal...4 Kerosene/paraffin...5 Piped Natural Gas...6 Coal/lignite...7 Animal Waste/Dung...8 Crop Residue/Plant Biomass...9 Saw Dust...10 Coal Briquette...11 Biomass Briquette...12 Electric...13 Processed biomass (pellets)/ woodchips...14 Biogas...15 Ethanol...16 Garbage/plastic...17 Solar...18 Other...55 Not applicable...66
If I25 = 13, 18, 66, 55 then skip to I28					
I	27	In the last 12 months, how often was the [FUEL TYPE] available?	Read aloud options... A Most used	FUEL TYPE from I25 → Skip to I29 if there is no "Second Most Used" fuel in I26.	Always available...1 Available 10-11 months...2 Available 9 months or less...3 Rarely available...4
If I26 = 13, 18, 66, 55 then skip to I29					
I	28	In the last 12 months, how often was the [FUEL TYPE] available?	Read aloud options... B Second most used	FUEL TYPE from I26	Always available...1 Available 10-11 months...2 Available 9 months or less...3 Rarely available...4
I	29	In the last 12 months, how many months did you use [FUEL]?		FUEL TYPE from I25	Number of Months Used all year...12 Skip: If "3 Wood collected" or "8 Animal waste/dung" "9 Crop Residue/Plant Biomass", "10 Saw Dust", "17 garbage/plastic" in I25 then skip to I34

I	30	What kind of unit do you usually buy the [FUEL] in?	Unit	FUEL TYPE from I25	Kg...1 Liters...2 Bundle...3 Pieces...4 Boxes...5 Packets...6
I	31	How much did you pay the last time you purchased one [UNIT] of [FUEL]?	Local currency	FUEL TYPE from I25 UNIT from I30 8 digits	COST (Local Currency)
I	32	How long does a [UNIT] of [FUEL] typically last? NUMBER OF DAYS	Quantity	FUEL TYPE from I25 UNIT from I30 8 digits	No purchase...0 OR Don't know...88
I	33	How much of the fuel you bought was used for cooking?			All...1 More than half...2 Half...3 Less than half...4
I	34	How much time do household members spend preparing the [STOVE] and fuel for each meal on average?	including setting up the fuel and turning on the stove but not gathering fuel or cooking time		Minutes
I	35	In the last 7 days, how many days did you use [STOVE]?			Days
I	36	In the last 7 days, on average, how many times did you light the [STOVE] per day?			Number of times
Now we would like to know how much time your household spend per day to cook or reheat meals at different times of the day on the [STOVE]. Do not include boiling water. Think about the last 7 days when you answer these questions.					
I	37	On average, how much time do you spend in the... morning?			Minutes
I	38	On average, how much time do you spend in the... afternoon?			Minutes
I	39	On average, how much time do you spend in the... evening?			Minutes
I	40	In the last 7 days, on average, how much time did your household use [STOVE] per day to boil water (for cooking, washing, and drinking)?	If the stove is not used for boiling water, record 0.		Minutes
I	41	In the last 12 months, did anybody in your household face any serious harm/injury from [STOVE]?			Yes...1 No...2 → Skip to I43
I	42	Did you seek professional medical assistance for this injury/ any of these injuries?			Yes...1 No...2
Before I43: If I25 in (2,3) or I26 in (2,3)					
We would now like to talk about the time used to collect wood.					
I	43	How many times did the household gather, collect or purchase fuel during the last seven days?			Number of times if 0 skip to I46
I	44	How many members of the household were involved each time?		Can not be more than number of household members	Number of people
I	45	How much time did it typically take to gather, collect or purchase fuel per person each time they did so during the last seven days?			HH MM
IF (I25 or I26 in 2, 3, 4, 7, 8, 9, 10, 11, 12, 14, 17) AND I22 in (1, 2, 3) CONTINUE, IF NOT SKIP TO O1. Only for those that uses solid fuels on their main stove and have said that they cook food indoors.					

May I please have a look at your kitchen? I would like to record the shape and size of the kitchen.				
Enumerator: Estimate the size of the cooking space by filling the following fields. One pace = 3 feet or 0.75 metres. Approximately one walking step.				
I	46	Record the rough shape of the cooking space		Roughly square...1 Roughly rectangular...2 → Skip to 148 Roughly Circular...3 → Skip to 150 Other, estimate the size...4 → Skip to 151
I	47	Record the dimensions of the cooking space in paces-	Square, record one side	... paces → Skip to 152
I	48	Record the dimensions of the cooking space in paces-	Rectangle, record side 1	... paces
I	49	Record the dimensions of the cooking space in paces-	Rectangle, record side 2	... paces → Skip to 152
I	50	Record the dimensions of the cooking space in paces-	Circle, record diameter	... paces → Skip to 152
I	51	Estimates the size of cooking space in square paces	Estimate total size in square paces	... square paces
I	52	Record the type of roof covering the cooking space		Flat...1 Roughly Conical...2 Gable (triangular cross-section)...3 None of the above...4 → Skip to 154 Smaller than me...1
I	53	Estimate the height of the highest point of the ceiling relative to your own height		My height...2 1.5 x my height...3 2 x my height...4 More than 2 x my height...5
I	54	How many doors and windows (opening to the outside) does the cooking space have?	Number of Openings	Only door...1 One window...2 2 or more windows...3 Additional large openings...4
I	55	Does the cooking oven or kitchen have any ventilation, such as a chimney, a hood, or a fan?	May be recorded by observation	Yes, a chimney...1 Yes, a hood...2 Yes a fan...3 Yes, two or three of these...4 No...5
O	O	Health Impacts		
O	1	To learn about the health impacts of cooking we would like to ask you some questions about your health.		
O	2	Did you have persistent coughing or an illness with a cough at any time in the last 14 days?		Yes...1 No...2
O	3	Did you breath faster than usual with short, rapid breaths or had difficulty breathing?		Yes...1 No...2
O	4	Did you also experience a problem in the chest or a blocked or runny nose?		Yes...1 No...2
O	5	Did you have an eye irritation or eye problems in the last 14 days?		Yes...1 No...2
If no "yes...1" in O2, O3, O4 or O5 then skip to O7				
O	6	Did you go to see a doctor/clinic for the illness?		Yes...1 No...2
O	7	If household with children, pick randomly a child aged 0-16 years old. If no children in household skip to K1.		
O	8	Did [NAME] have persistent coughing or an illness with a cough at any time in the last 14 days?		Yes...1 No...2
O	9	Did [NAME] breath faster than usual with short, rapid breaths or had difficulty breathing?		Yes...1 No...2
O	10	Did [NAME] also experience a problem in the chest or a blocked or runny nose?		Yes...1 No...2
O	11	Did [NAME] have an eye irritation or eye problems in the last 14 days?		Yes...1 No...2

O	12	Did [NAME] go to see a doctor/clinic for the illness?		Yes...1 No...2
K	K	Willingness to Pay for an Improved Cookstove		
		This module should be asked to only households WITHOUT an improved cookstove (CAPI/enumerator check). If I10 = 201 then answer as charcoal user If I10 = 101 or 102 then answer as wood user else skip to next section Then randomly assign one of the four following improved cookstoves: Wood users – Popular affordable wood ICS available in local market. Charcoal users – Popular affordable charcoal ICS available in local market.		
K	1	An improved cooking stove can reduce the fuel consumption significantly. it can also reduce the smoke. Possibly, your cooking time per meal will be shortened since firepower of this cookstove is stronger than the traditional cookstove. As you answer the next few questions, keep in mind the various benefits from this device as well as your household budget.		
K	2	Would you be willing to purchase this cookstove at [CAPI: Price]?		Yes...1 → Skip to J1 No...2
K	3	Would you be willing to pay \$(CF) for this stove, if you were given 12 months to make the payment?		Yes...1 → Skip to J1 No...2 Don't Know...88
K	4	Why would you not accept the offer?		Cannot afford the payment...1 Do not need an improved cookstove...2 Fuel for this stove is unreliable...3 Traditional cookstove is better...4 Other...55
J	J	SPACE AND WATER HEATING		
		The next questions are about space and water heating		
J	1	Do you heat water for washing (either for washing dishes and clothes or for bathing)?		Yes...1... No...2 → Skip to J3
J	2	What is the main device you use to heat water?	Select one.	Electric heater/boiler...1 Electric kettle/coil...2 Electric stove...3 Gas heater...4 Gas stove...5 Solar thermal system...7 Same stove as used for cooking...8 Separate solid fuel stove...9
J	3	Do you heat your house?		Yes...1... No...2 → Skip to L1
J	4	What is the main source you use to heat your house?		Electric heater...1 → Skip to L1 Gas heater...2 → Skip to L1 District heating...3 → Skip to L1 Solar thermal system...4 → Skip to L1 Same stove as used for cooking...5 → Skip to L1 Separate solid fuel stove...6
J	5	What is the MAIN fuel you use in this stove?		LPG/cooking gas...1... Wood purchased...2... Wood collected...3... Charcoal...4... Solar...5... Kerosene/paraffin...6... Piped Natural Gas...7... Coal lignite...8... Animal Waste Dung...9... Crop Residue/Plant Biomass...10... Saw Dust...11... Coal Briquette...12... Biomass Briquette...13... Electric...14... Processed biomass (pellets)/woodchips...15... Biogas...16... Ethanol...17... Garbage/plastic...18... Not applicable...99

L	L	Household assets: Transportation, Electrical Appliances, Agricultural Equipment			
L	1	Now we would like to know more about what the household own, material items, electric appliances and domestic animals. Are you well informed about these issues or would you like somebody else in the household to answer these questions?	Record Respondent MemberNo for this section	MemberNo and name from listing of persons 15 years and older.	MemberNo
In all societies there are differences in material welfare between households, and the welfare situation of the household can also change over time. This can be seen in the assets the households own. We will now ask you some questions about what items this household own today. The item must be in working condition. We would also like to know if you owned such an item 5 years ago.					
L	2		a	b	c
		Item	Does your household have a [ITEM] which is regularly used?	How many hours did your household use [ITEM] yesterday? Both day and night	Did your household have a [ITEM] 5 years ago?
	Categories	Item			
	1	Bed	Yes...1 No...2		Yes...1 No...2
	2	Table Might be answered by observation	Yes...1 No...2		Yes...1 No...2
	3	Bicycle	Yes...1 No...2		Yes...1 No...2
	4	Motorcycle	Yes...1 No...2		Yes...1 No...2
	5	Car	Yes...1 No...2		Yes...1 No...2
6	Radio using batteries	Yes...1 No...2			Yes...1 No...2
L7-L9 only for households with electricity as main or back-up source: if C10 or C11 in (1,3,4,5,7). L7c-L9c only for those that had grid electricity 5 years ago C12 in (1,2,3,4,5,7)					
7	Mobile phone charger	Yes...1 No...2			Yes...1 No...2
8	Electric radio	Yes...1 No...2			Yes...1 No...2
9	Fan	Yes...1 No...2 => Skip to 2c9	Number of hours		Yes...1 No...2
L10-L19 only for households with electricity as main or back-up source: if C10 or C11 in (1,3,4,5). L10c-L19c only for those that had grid electricity 5 years ago C12 in (1,2,3,4,5)					
10	Refrigerator	Yes...1 No...2			Yes...1 No...2
11	Microwave oven	Yes...1 No...2			Yes...1 No...2
12	Freezer	Yes...1 No...2			Yes...1 No...2
13	Washing machine	Yes...1 No...2			Yes...1 No...2
14	Electric sewing machine	Yes...1 No...2			Yes...1 No...2
15	Air Conditioner (AC)	Yes...1 No...2			Yes...1 No...2
16	Computer/ Tablet	Yes...1 No...2			Yes...1 No...2
17	Electric hot water pot/kettle	Yes...1 No...2			Yes...1 No...2
18	TV	Yes...1 No...2			Yes...1 No...2
19	Electric water pump	Yes...1 No...2			Yes...1 No...2
L20-L22 only for households with electricity as main or back-up source: if C10 or C11 in (1,3,4,5,7). L20c-L22c only for those that had grid electricity 5 years ago C12 in (1,2,3,4,5,7)					

		Select 0 for none and skip to next row.				
20	Do you have any traditional Light Bulbs? IF SO: How many all together?	None..0 1-4, code number 1 - 4 5 or more...3		Yes...1 No...2		
21	Do you have any LED Light Bulbs? IF SO: How many all together?	None..0 1-4, code number 1 - 4 5 or more...3		Yes...1 No...2		
22	Do you have any light bulbs or tubes of other types? IF SO: How many all together?	None..0 1-4, code number 1 - 4 5 or more...3	Number of hours - all light bulbs and tubes	Yes...1 No...2		
Now we would like to ask you some questions about agriculture activity and domestic animals.						
3	Do you cultivate any land? IF SO: How large is the area?			No land...0 0.5ha...1 <0.5 - 1ha...2 <1-2ha...3 <2ha...4		
4	Did you cultivate any land 5 years ago? IF SO: How large was the area?			No land...0 0.5ha...1 <0.5 - 1ha...2 <1-2ha...3 <2ha...4		
5	Do you keep any domestic animals?			Yes...1 No...2 -> Skip to section M		
6	How many cattle?			None...0 1-2...1 3-5...2 6 or more...3		
7	How many sheep, goat or pigs?			None...0 1-5...1 6-10...2 11 or more...3		
L	8	How many chicken, ducks, turkeys, geese?		None...0 1-10...1 11-20...2 21 or more...3		
M	M	Street Lighting				
Now we would like to ask about security lights in your neighbourhood.						
M	1	Does your neighborhood have any form of outdoor security lights/street lighting?	"Neighborhood" means 0.5 KM from Household	Yes...1 No...2 -> Skip to M3		
M	2	Is the security lights/street lighting used throughout the night?		Yes...1 No...2		
M	3	Does the police or local security groups patrol the streets in your neighbourhood after dark?		Yes...1 No...2		
N	N	Time Use – Day Time and After Dark				
Intro: We would now like to know more about how the members of this household spend their time, both today and 5 years ago. We will ask about time use for women and men and children and grown-ups separately.						
		Are you well informed about these issues or would you like somebody else in the household to answer these questions?	Record Respondent/MemberNo for this section.	MemberNo and name from listing of persons 15 years and older.		
Skip: This section is only for households with women 15 years and older.						
Now we will ask about the time use for adult women which is 15 years or older						
N		a	b	c	d	e
		How many women 15 years and older have been involved in (ACTIVITY) the last 7 days? Number of women If 0 continue with b, if >0 skip to c.	Did women in this age group use any time on this activity 5 years ago? Yes...1 No...2 ALL - skip to next activity	In the last 7 days, how much time did each of these women use? (ACTIVITY) HH MM	How much of this time was spent after dark? HH MM	Do women 15 years and older spend more or less time on this activity than 5 years ago? (ACTIVITY) More time...1 Less time...2 The same amount of time...3
1	Collecting water					
2	Collecting firewood					
3	Income generating activities inside the house/ housing compound (not in the field) Caring for and preparing fodder for animals, shelling maize, cleaning seeds, food processing, making mats, baskets, knitting weaving, tailoring etc. for sale					
4	Watching TV, listening to the radio or using smart phone					
5	Spending time on entertainment and socializing outside the house					

Skip: This section is only for households with girls in the age of 5-14						
Then we continue with the time-use of girls in the age of 5-14 years old						
N		f	g	h	i	j
		How many girls 5-14 years have been involved in (ACTIVITY) the last 7 days?	Did girls 5-14 year in this age group use any time on this activity 5 years ago?	In the last 7 days, how much time did each of these girls use? (ACTIVITY)	How much of this time was spent after dark?	Do girls 5-14 year spend more or less time on this activity than 5 years ago? (ACTIVITY)
Categories		Number of girls	Yes...1 No...2 If 0 continue with g, if >0 skip to h	HH N/A	HH N/A	More time...1 Less time...2 The same amount of time...3
1	Collecting water					
2	Collecting firewood					
3	Income generating activities inside the house/ housing compound (not in the field) Caring for and preparing fodder for animals, shelling maize, cleaning seeds, food processing, making mats, baskets, knitting weaving, tailoring etc for sale.					
4	Only for households with girls in the age of 5-14 Doing own homework					
5	Watching TV, listening to the radio or using smart phone					
6	Spending time on entertainment and socializing outside the house					

Skip: This section is only for households with men 15 years and older						
Then we continue with the time-use of men 15 years and older						
N		k	l	m	n	o
		How many men 15 years and older have been involved in (ACTIVITY) the last 7 days?	Did men in this age group use any time on this activity 5 years ago?	In the last 7 days, how much time did each of these men use? (ACTIVITY)	How much of this time was spent after dark?	Do men 15 years and older spend more or less time on this activity than 5 years ago? (ACTIVITY)
Categories		Number of men	Yes...1 No...2 If 0 continue with k, if >0 skip to m	HH N/A	HH N/A	More time...1 Less time...2 The same amount of time...3
1	Collecting water					
2	Collecting firewood					
3	Income generating activities inside the house/ housing compound (not in the field) Caring for and preparing fodder for animals, shelling maize, cleaning seeds, food processing, making mats, baskets, knitting weaving, tailoring etc for sale.					
4	Watching TV, listening to the radio or using smart phone					
5	Spending time on entertainment and socializing outside the house					

Skip: This section is only for households with boys in the age of 5-14						
Lastly, we would like to know about the time-use of boys in the age of 5-14 years old						
N		p	q	r	s	t
		How many boys 5-14 years have been involved in (ACTIVITY) the last 7 days?	Did boys in this age group use any time on this activity 5 years ago?	In the last 7 days, how much time did each of these boys use? (ACTIVITY)	How much of this time was spent after dark?	Do boys 5-14 years spend more or less time on this activity than 5 years ago? (ACTIVITY)
Categories		Number of boys	Yes...1 No...2 If 0 continue with p, if >0 skip to r	HH N/A	HH N/A	More time...1 Less time...2 The same amount of time...3
1	Collecting water					
2	Collecting firewood					
3	Income generating activities inside the house/ housing compound (not in the field) Caring for and preparing fodder for animals, shelling maize, cleaning seeds, food processing, making mats, baskets, knitting weaving, tailoring etc for sale.					
4	Only for households with boys in the age of 5-15 Doing own homework					
5	Watching TV, listening to the radio or using smart phone					
6	Spending time on entertainment and socializing outside the house					

Q	Q	Consumption / expenditure			
Q	1	The next section is about household expenditure. Are you well informed about this issue or would you like somebody else in the household to answer these questions?	Record Respondent MemberNo for this section	MemberNo and name from listing of persons 15 years and older.	MemberNo
		Now we would like to ask you for some information on the households expenditures for food and for non-food during the last 7 days.			
Q		Consumption (include items purchased, produced/acquired and received as a gift/donation) Enumerator to estimate amounts	A. How much did you spend to buy [ITEM]?	B. What is the value of [ITEM] that you produced yourself, and consumed during the last 7 days, if you had to buy it in the market? Enumerator to estimate the value based upon local prices.	C. What is the value of [ITEM] that you received as a gift or donation? Enumerator to estimate the value based upon local prices
	3	Cereal and cereal products (e.g. rice, maize, wheat, flour, millet) and starchy staples (e.g. cassava, plantain, yam, cocoyam)	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know
	4	Pulses & nuts (e.g.: beans, groundnuts, palm nuts, soy beans)	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know
	5	Milk & milk products (e.g.: powder, tinmed, fresh)	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know
	6	Edible oil (e.g.: palm oil, groundnut oil, coconut oil)	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know
	7	Vegetables (e.g.: okra, tomato, onion, carrot, cabbage, garden egg) and Fruits (e.g.: bananas, coconut, pineapple, mango, orange, pawpaw)	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know
	8	Meat, fish, poultry and egg	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know
	9	Sugar and sweets	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know
	10	Other food items (e.g. pepper, salt, spices, jam, bread, meals outside house, beverages etc.) Include all processed foods not prepared by household using raw ingredients	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know	8 digits Amount in local currency \$8=don't know
	11	How much did you spend buying firewood and charcoal and other fuel during the last 30 days?		8 digits	Nothing...0 Amount in TSh/Meticais
	12	How much did you spend on water, electricity, mobile phone top-ups, internet and other communication and transportation during the last 30 days?		8 digits	Nothing...0 Amount in TSh/Meticais
	13	How much did you spend on clothes and shoes the last 30 days?		8 digits	Nothing...0 Amount in TSh/Meticais
	14	How much did you spend on household items, such as soap, cleaning supplies, drugs, batteries etc during the last 30 days?		8 digits	Nothing...0 Amount in TSh/Meticais
	15	Only for households with members attending school this school year (AC6=1): How much did you spend on education related expenses (school fees, uniforms, supplies) during the last year?		8 digits	Nothing...0 Amount in TSh/Meticais
	16	How much did you spend on other needs during the last year?	e.g. furniture, health services, electronic equipment.	10 digits	Nothing...0 Amount in TSh/Meticais
S	S	Attitudes			
S	1	Now I would like to ask your opinion on some energy related questions, who would be the right person to answer these questions?	Record Respondent MemberNo for this section	MemberNo and name from listing of persons 15 years and older.	MemberNo
		If 0 "yes" in (C2, C4, C6, C7, C8 and C9) then skip to S3			
S	2	Are you satisfied with the service from [MAIN SOURCE OF ELECTRICITY]?	Read aloud these options.	MAIN SOURCE OF ELECTRICITY from C10	Satisfied 1 Neutral 2 Unsatisfied 4
		There may be a number of reasons why people keep a traditional stove. Do you agree or disagree that the following statements are important arguments for keeping the traditional stove?			
S	3	Smoke from traditional stove is good for chasing insects away.	Read aloud options if needed.		Agrees 1 No Opinion 2 Disagrees 3
S	4	Certain food tastes better when cooked on a traditional stove.	Read aloud options if needed.		Agrees 1 No Opinion 2 Disagrees 3
S	5	The traditional stove is good for lighting up in the evening	Read aloud options if needed.		Agrees 1 No Opinion 2 Disagrees 3
S	6	The monthly electric bill is or would be a financial burden for my family, if household connected to the grid.	Read aloud options if needed.		Agrees 1 No Opinion 2 Disagrees 3
S	7	Today, the quality of life of my household is better than it was 5 years ago.	Read aloud options if needed.		Agrees 1 No Opinion 2 Disagrees 3

U	U	Livelihood means We would now like to know what the household members are doing for the livelihood in addition to their main work. Are you well informed about these issues or would you like somebody else in the household to answer these questions?				
U	1	Record Respondent Member No for this section	Member No and name from listing of persons 15 years and older	Member No		
For households where the head is at least 25 yrs (AB5 >=25) and lived in the same community 5 yrs ago (B1 >=5), ask also questions about 5 years ago: b and g. First ask all products today (U2a) and 5 years ago (U2b). Then ask U2c-U2g for the products produced.						
Now we would like to know if anybody in the household produce or process anything to be sold.						
U	2		a	b	c	d
	Categories	Do you produce or process [PRODUCT] in the household today?	Did you produce [PRODUCT] in the household 5 years ago? (Describe event 5 yrs ago - DROUGHT, FLOOD, PRESIDENT, ETC.)	You said that your household produce/process this type of product. Who is the (main) manager in the household for this production?	Where and how is this sale done?	
	1	Agricultural by-products, including flour, starch, rice, beer, jam, oil, seed, bran, etc.	Yes 1 -> c No...2	Yes 1 -> h No...2 -> skip to next product	HH member #	To traders coming home...1 To traders elsewhere...2 Through com trading business...3 To customers coming home...4
	2	Livestock by-products (milk, cheese)				
	3	Fresh/processed fish				
	4	Firewood, home-made charcoal				
	5	Construction timber, wood-poles or other construction material				
	6	Mats, bricks, cane furniture, weave baskets, thatch grass etc.		Yes 1 -> h No...2 -> skip to U3a1		
U	2		e	f	g	h
	Categories	Was any electricity used for light or machinery for this processing/production?	Did this person or anybody else in the household do this type of production 5 years ago? (Describe events 5 yrs ago - DROUGHT, FLOOD, PRESIDENT, ETC.)	Did this production make less money 5 years ago, the same amount of money or more money? (PRODUCT)	Was any electricity used for this processing/production 5 years ago?	
	1	Agricultural by-products, including flour, starch, rice, beer, jam, oil, seed, bran, etc.	Yes...1 No...2	Yes 1 No...2 -> skip to next product	Less money 5 yrs ago...1 Same amount of money 5 yrs ago...2 More money 5 yrs ago...3	Yes 1 No...2
	2	Livestock by-products (milk, cheese)				
	3	Fresh/processed fish				
	4	Firewood, home-made charcoal				
	5	Construction timber, wood-poles or other construction material				
	6	Mats, bricks, cane furniture, weave baskets, thatch grass etc.		Yes 1 No...2 -> skip to U3a1		
First ask all products (U3a) today and 5 years ago (U3b). Then ask U3c-U3g for the products produced.						
Now we would like to know if anybody in the household own a business or provide a service. We would like you to exclude agricultural businesses/services.						
U	3		a	b	c	d
	Categories	Does anybody in the household [BUSINESS] today?	Does anybody in the household [BUSINESS] in the household 5 years ago? (Describe event 5 yrs ago - DROUGHT, FLOOD, PRESIDENT, ETC.)	You said that your household run this type of business. Who is the (main) manager for this business/service?	Where is this business/service operated?	
	1	offer professional services as a doctor, accountant, lawyer, translator, private tutor, midwife, mason, etc.?	Yes 1 -> e No...2	Yes 1 -> h No...2 -> skip to next product	HH member #	Home (inside residence)...1 Home (outside residence)...2 Industrial site...3 Traditional market place...4 Commercial area shop...5 Roadside...6 Other fixed place...7 Mobile location...8
	2	run a household-owned shop or provide a service from home such as a carwash, metal worker, mechanic, carpenter, barber, tailor etc?				
	3	own a trading or service business on a street or in a market?				
	4	drive a household-owned taxi or pick-up truck to provide transportation or moving services?				
	5	own a bar or restaurant?				
	6	own any other non-agricultural business, even if it is a small business run from home or on a street?		Yes 1 -> h No...2 -> skip to U4		
U	3		e	f	g	h
	Categories	Was any electricity used for light or machinery for this business/service?	Was the profit from this business 5 years ago, smaller, the same or larger than now? [BUSINESS]	Was any electricity used for this processing/production 5 years ago?		
	1	offer professional services as a doctor, accountant, lawyer, translator, private tutor, midwife, mason, etc.?	Yes...1 No...2	Yes 1 No...2 -> skip to next product	Smaller 5 yrs ago...1 Same 5 yrs ago...2 Larger 5 yrs ago...3	Yes...1 No...2
	2	run a household-owned shop or provide a service from home such as a carwash, metal worker, mechanic, carpenter, barber, tailor etc?				
	3	own a trading or service business on a street or in a market?				
	4	drive a household-owned taxi or pick-up truck to provide transportation or moving services?				
	5	own a bar or restaurant?				
	6	own any other non-agricultural business, even if it is a small business run from home or on a street?		Yes 1 No...2 -> skip to U4		

		U4, U6, U8, U10: for all households. For households where the head is at least 25 yrs (AB5 >=25) and lived in the same community 5 yrs ago (B2 >=5), ask also question U5, U7, U9 and U11: Did this person or anybody else in the household do the same type of work 5 years ago?		
		We would now like to know whether any household members have been working outside the household during the last 12 months		
U	4	Has anybody in the household done some piecemeal farm work during the last 12 months?		Yes...1 No...2
U	5	Did household members do this type of work during a 12 months period 5-6 yrs	Describe events 5 yrs ago – DROUGHT, FLOOD, PRESIDENT ETC.	Yes...1 No...2
U	6	Has anybody in the household done some other piecemeal work for a business or somebody outside the household during the last 12 months?		Yes...1 No...2
U	7	Did household members do this type of work during a 12 months period 5-6 yrs	Describe events 5 yrs ago – DROUGHT, FLOOD, PRESIDENT ETC.	Yes...1 No...2
U	8	Has anybody in the household done some public work (for the government, donors, charities) such as cash-for-work during the last 12 months?		Yes...1 No...2
U	9	Did household members do this type of work during a 12 months period 5-6 yrs	Describe events 5 yrs ago – DROUGHT, FLOOD, PRESIDENT ETC.	Yes...1 No...2
U	10	Did anybody in this household go for work outside the community during the last 12 months?	Describe events 5 yrs ago – DROUGHT, FLOOD, PRESIDENT ETC.	Yes...1 No...2
U	11	Did household members do this type of work 5-6 yrs ago?		Yes...1 No...2

T	T	Women's Empowerment		
T	1	Now I will ask you some questions regarding decision making in your household. We would now like to talk to [NAME OF FEMALE HOUSEHOLD HEAD], [NAME OF FEMALE SPOUSE OF HOUSEHOLD HEAD] or another adult female in the household.	Record Respondent: MemberNo for this section Respondent according to the following priorities: Female household head, female spouse of the household head, adult female member in the household >=15 years old.	Member ID list of females >=15 years old. Respondents should be a female. According to the following priorities: Female household head, female spouse of the household head, adult female member in the household >=15 years old.
T	2	Who usually makes decisions about health care for yourself?	Read options aloud	MemberNo You 1 Your husband/partner 2 You and your husband/ partner 3 Someone else 4
T	3	Who usually makes decisions about major household purchases?	Read options aloud	You 1 Your husband/partner 2 You and your husband/ partner 3 Someone else 4
T	4	Who usually makes decisions about visits to your family or relatives?	Read options aloud	You 1 Your husband/partner 2 You and your husband/ partner 3 Someone else 4

W	W	Social life and physical security	
W	1	We will now ask you some questions about how safe you feel in different situations.	
		a) How safe you feel in the following situations today? b) How safe did you feel 5 years ago?	
W	2		a b
		Categories	Today 5 years ago
	1	Walking alone in your area during daytime	Not safe 1. Fairly safe 2. Completely safe 3. Not applicable...99
	2	Walking alone in your area at night	Not safe 1. Fairly safe 2. Completely safe 3. Not applicable...99
	3	Being alone at home during daytime	Not safe 1. Fairly safe 2. Completely safe 3. Not applicable...99
	4	Being alone at home at night	Not safe 1. Fairly safe 2. Completely safe 3. Not applicable...99
	5	Waiting for, or in public transport (in your area)	Not safe 1. Fairly safe 2. Completely safe 3. Not applicable...99
	6	At the workplace (e.g. fields, market, job, etc.)	Not safe 1. Fairly safe 2. Completely safe 3. Not applicable...99
	7	In public places, e.g. shopping centre, church	Not safe 1. Fairly safe 2. Completely safe 3. Not applicable...99
	8	When collecting firewood	Not safe 1. Fairly safe 2. Completely safe 3. Not applicable...99
	9	When fetching water	Not safe 1. Fairly safe 2. Completely safe 3. Not applicable...99

This last section presents a few questions related to the Global pandemic and period of closed schools.				
Unit: Household				
GP	1	Has anybody 12 years or above in this household changed their main occupation over the last year during the global pandemic up to today?		Yes...1 No...2 -> GP 5
Section GP 2-4 is for members 12 years old and above only.				
Unit: Household members: MemberNo				
GP	2	Which household members have changed their main occupation over the last year during the global pandemic up to today?	CSPro to present roster of household member numbers and names for persons 12 years and above	Household member number
GP	3	What was [NAME]'s main occupation before the global pandemic started last year?	CSPro to present questions for persons who have changed main occupation only.	Farmer with non-family employees...01 Farmer with only family members...02 Farm worker...03 Non-firm business with non-family employees...04 Non-firm business with only family employees...05 Unpaid assistance in family enterprise/Casual/Day Laborer...06 Wage Employee in Private Company (with contract)...08 Wage Employee in Private Company (without contract)...09 Wage Employee for Government...10 Wage Employee in Parastatal (government owned company)...11 Was not working, but was looking for work and has worked previously...15 Skip ->GP 3 Next person, If last person -> GP 5 Was not working, but was looking for work. Had never worked before...16 Skip ->GP 3 Next person, If last person -> GP 5 Was not working, and was not looking for work (student, retired, disabled etc)...17 Skip ->GP 3 Next person, If last person -> GP 5
GP	4	What was the main activity at [NAME]'s place of work before the global pandemic started last year?	(Codes based on ISIC rev. 4)	Agriculture - crops/forestry...11 Agriculture - animal husbandry...12 Fishing...13 Mining & quarrying...14 Manufacturing...15 Electricity and water supply...16 Building and construction...17 Trade...18 Repair...19 Transportation...20 Accommodation and food service...21 Information and communication...22 Financial, professional...23 administrative and support service Public administration and defence...24 Education...25 Human health and social work...26 Arts, entertainment and recreation...27 Personal service...28 Domestic service...29 Embassies and international organizations...30 All ->GP 3 Next person, If last person -> GP 5
Section GP 5-13 is for households				
Unit: Household				
GP		Has the household income from the following sources increased, stayed the same or decreased over the last year during the global pandemic up to today?		
GP	5	Family farming, livestock or fishing		Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	6	Non-agricultural family businesses, including family businesses		Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	7	Salaried employment of household members		Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	8	Unemployment benefits		Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	9	Remittances from abroad		Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	10	Remittances within the country		Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	11	Income from property, investments or savings		Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	12	Pension		Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	13	Government Assistance		Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4

GP	14	Financial assistance from friends / family			Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	15	Assistance from NGOs / charity organizations			Increased...1 Stayed the same...2 Decreased...3 No such income, not applicable...4
GP	16	Thank you for all this detailed information! What about the total household income, has that increased, stayed the same or decreased			Increased...1 Stayed the same...2 Decreased...3
GP	17	Have your use of electrical power increased, stayed the same or decreased over the last year during the global pandemic up to today?			Increased...1 Stayed the same...2 Decreased...3 We have no electricity, not applicable...4
GP	18	Have you changed the type of fuel you have been using over the last year during the global pandemic up to today?			No, continued with the same fuel...1 -> GP20 Yes, switched fuel...2
GP	19	What type of fuel did you use before the global pandemic started last year for your main stove?			Firewood, dung, twigs and leaves...1 Charcoal...2 Kerosene...3 Rice husks, pellets or briquettes...4 LPG, biogas...5 Electricity...6 Solar oven (non-electric)...7
GP	20	Have your consumption of fuel for cooking increased, stayed the same or decreased over the last year during the global pandemic up to today?			Increased...1 Stayed the same...2 Decreased...3
GP	21	Have you changed which stove to use as your main stove over the last year during the global pandemic up to today?			No, continued with the same stove...1 -> GP23 Yes, have changed to another main stove...2
GP	22	Which type of stove did you use as your main stove before the global pandemic started last year?			No change of oven.....999 Three-stone stove101 Round mud stove102 ICS w/ ceramic fire chamber111 ICS w/ metal ring.....112 Rocket stove121 High traditional burned mud/clay stove122 Lorena 1 Rocket stove w high insulation131 Rocket stove metal w/internal chimney/132 Lorena 2 Rocket stove with wall- sealed chimney ...141 Metal rocket stove.....142 Traditional charcoal stove - Open access for air201 Traditional raised charcoal stove.....202 Charcoal stove, Old ICS Opening for air may be closed...211 Ceramic lined charcoal ICS221 Ceramic lined and insulated charcoal ICS231 Kerosene cooking stove (Mchima).....233 Efficient charcoal stove with controlled airflow.....241 Gasifier stove.....331 Saw dust, risk husk gasifier stove.....332 Jiko Safi Gasifier stove w/forced air & chimney.....341 Biogas stove.....451 Multiple LPG stove.....452 Single LPG stove453 Electrical stove.....461 Electrical plates without oven.....462 LPG/ gas and electrical stove.....463 Solar cooker (Non-electric).....471
GP	23	Have you sold any of household items since before the global pandemic started last year?			Yes...1 No...2 skip to GP 25

GP	24	Which type of items did you sell?	Multiple answers	1...Bed 2...Table 3...Bicycle 4...Motorcycle 5...Car 6...Radio using batteries 7... Mobile phone charger 8... Electric radio 9...Fan 10...Refrigerator 11...Microwave oven 12...Freezer 13...Washing machine 14...Electric sewing machine 15...Air Conditioner (AC) 16...Computer/ Tablet 17...Electric hot water pot/kettle 18...TV 19...Electric water pump
GP	25	Have your total consumption increased, stayed the same or decreased over the last year during the global pandemic up to today?		Increased...1 Stayed the same...2 Decreased...3
GP	26	The final section is about the livelihood of your household. Did you have to close down any household production over the last year during the global pandemic up to today? [ANSWER YES, EVEN IF YOU STILL HAVE SOME LEFT]	CSPro to make adequate skips Skip to the first Yes answer and then continue with the remaining Yes - productions	Multiple answers - Follow up questions for all positive product groups Yes, agricultural by-products, including flour, starch, juice, beer, jam, oil, seed, bran...a Yes, livestock by-products (milk, cheese)...b Yes, fresh/processed fish...c Yes, firewood, home-made charcoal...d Yes, construction timber, wood-poles or other construction material...e Yes, mats, bricks, cane furniture, weave baskets, thatch grass...f No...x
		[PRODUCT]		Was any electricity used for light or machinery for this production?
GP	27	Agricultural by-products, including flour, starch, juice, beer, jam, oil, seed, bran, etc		Yes 1 No...2
GP	28	Livestock by-products (milk, cheese)		Yes 1 No...2
GP	29	Fresh/processed fish		Yes 1 No...2
GP	30	Firewood, home-made charcoal		Yes 1 No...2
GP	31	Construction timber, wood-poles or other construction material		Yes 1 No...2
GP	32	Mats, bricks, cane furniture, weave baskets, thatch grass etc		Yes 1 No...2
GP	33	Did you have to close down any household business or service over the last year during the global pandemic up to today? [ANSWER YES, EVEN IF YOU STILL HAVE SOME LEFT]	CSPro to make adequate skips Skip to the first Yes answer and then continue with the remaining Yes - businesses/services	Multiple answers - Follow up questions for all positive businesses/ services Yes, offer professional services as a doctor, accountant, lawyer, translator, private tutor, midwife, mason, etc...a Yes, run a household-owned shop or provide a service from home such as a carwash, metal worker, mechanic, carpenter, barber, tailor etc...b Yes, own a trading or service business on a street or in a market...c Yes, drive a household-owned taxi or pick-up truck to provide transportation or moving services...d Yes, own a bar or restaurant...e Yes, own any other non-agricultural business, even if it is a small business run from home or on a street...f
		Did you close down any [BUSINESS] or any [SERVICE]?		Was any electricity used for light or machinery for this business/service?
GP	34	offer professional services as a doctor, accountant, lawyer, translator, private tutor, midwife, mason, etc.?		Yes 1 No...2
GP	35	run a household-owned shop or provide a service from home such as a carwash, metal worker, mechanic, carpenter, barber, tailor etc?		Yes 1 No...2
GP	36	own a trading or service business on a street or in a market?		Yes 1 No...2
GP	37	drive a household-owned taxi or pick-up truck to provide transportation or moving services?		Yes 1 No...2
GP	38	own a bar or restaurant?		Yes 1 No...2
GP	39	own any other non-agricultural business, even if it is a small business run from home or on a street?		Yes 1 No...2
GP	40	Did anybody in the household do some piecemeal farm work before the global pandemic started last year?		Yes 1 No...2
GP	41	Did anybody in the household do some other piecemeal work for a business or somebody outside the household before the global pandemic started last year?		Yes 1 No...2
GP	42	Did anybody in the household do some public work (for the government, donors, charities) such as cash-for-work before the global pandemic started last year?		Yes 1 No...2
GP	43	Did anybody in this household go for work outside the community before the global pandemic started last year?		Yes 1 No...2

X	X	Telephone number for future contact		
		Only for households with at least 1 telephone (C128 > 0).		
X	1	It is important for INE/NBS to follow up on the energy situation in the households in [Tanzania/Mozambique]. We would therefore like to do a follow up of this interview in a year or two. Is it all right with you that INE/NBS contact you by telephone for this purpose?	The cost of being interviewed over the phone will be covered by [NBS/INE]. The respondent will be contacted by phone. We will first send a text message with information about the interview and one week later we will call you to do the interview.	Yes...1 No...2 ->skip to AA20
X	2	Thank you. On which telephone number or numbers can we contact you?	Enumerator may record up to 3 telephone numbers.	Up to 3 telephone numbers. XX digits Telephone number
AA	AA	Interview particulars - continued		
AA	20		Date of interview completed/ended	Day Month
AA	21		Final status for the interview	Completed...1 Never completed (vacant or refusal)...2
AA	22		Enumerator's ID number and check mark	Enumerator ID
AA	23		Checked by the Enumerator according to instructions	Day Month
AA	24		Supervisor's ID number and check mark	Supervisor ID
AA	25		Checked by the Supervisor according to instructions	Day Month

Appendix D: Community Questionnaire

  		CONFIDENTIAL															
Impact of Access to Sustainable Energy Survey 2021 Community Questionnaire																	
THE NATIONAL BUREAU OF STATISTICS (NBS), TANZANIA STATISTICS NORWAY (SSB)																	
For the community interview we ask the village chief/chairperson/village executive officer (VEO) to gather a small group of people. The group should preferably consist of: -the village chief/VEO himself/herself or another authority person appointed by the village chief/VEO. -1 adult woman -1 adult man -1 youth. To prepare for the interview the village chief/VEO in the community will be given a paper questionnaire by the IASES team. Some of the questions require in-depth knowledge about different topics. The specialists within these areas in the community may be invited to the join the group or you may prefer to talk to specialists in advance. The topics covered are energy supply, health, education, agriculture, business, manufacturing etc. We ask the village chief/VEO to tick the which specialists the chief/VEO has talked to in question B1.		<table border="1"> <tr> <td>Standard codes</td> <td></td> </tr> <tr> <td>Outside household</td> <td>44</td> </tr> <tr> <td>Other, specify</td> <td>55,9</td> </tr> <tr> <td>No/ none</td> <td>66,4</td> </tr> <tr> <td>All</td> <td>77,3</td> </tr> <tr> <td>Don't know</td> <td>88</td> </tr> <tr> <td>Not applicable</td> <td>99</td> </tr> </table>		Standard codes		Outside household	44	Other, specify	55,9	No/ none	66,4	All	77,3	Don't know	88	Not applicable	99
Standard codes																	
Outside household	44																
Other, specify	55,9																
No/ none	66,4																
All	77,3																
Don't know	88																
Not applicable	99																
Codes in the questionnaire: Questions and codes Instructions for the enumerator Instructions for Csprio programmer		Community questionnaire 15 February 2021															

Question		Response Code	
A	A	Community identification	
A	1	Regional ID codes (Copy from listing sheet)	Tanzania: Regional code (2 digits)
A	2	District ID codes (Copy from listing sheet)	District code (2 digits)
A	3	Ward ID codes (Copy from listing sheet)	Ward code (2 digits)
A	4	Village ID codes (Copy from listing sheet)	Village code (2 digits)
A	5	Fixed code	Fixed code "11"
A	6	EA ID codes (Copy from listing sheet)	Enumeration area (EA) number (3 digits)
A	6a	Urban / Rural location of household (Copy from listing sheet)	Urban - 1 Rural - 2
A	7	Interview language	See codebook
A	8	Community ID	See codebook
A	9	North coordinate (Decimal degrees from GPS reading)	Latitude N (-xx.xxxxx south of equator) Longitude E (+xxx.xxxxx east of Prime meridian and -xxx.xxxxx west of prime meridian)
A	10	East coordinate (Decimal degrees from GPS reading)	

B	B	Community leaders			
	1	Who did the village chief talk to to prepare for the interview? If the village chief is knowledgeable with some of the topics, this should also be recorded.	Multiple answer	Multiple answer	Chief / Chairperson...a Electricity / energy...b Village committee...c Elderly...d School...e Agriculture...f Health...g Business...h Religious issues...i Young adult...j Adult woman/man...k None of these...x
These questions should be asked to knowledgeable or Persons working at that particular community					
	2		a	b	c
		Categories	Full Name	Sex	Is the participant chair or knowledgeable in a specific topic?
				Male...1 Female...2	Chief / Chairperson...1 Electricity / energy...2 Village committee...3 Elderly...4 School...5 Agriculture...6 Health...8 Business...9 Religious issues...10 Young adult...12 Adult woman/man...13 None of these...66
					For how many years have you lived in this community?
					Less than 5 years...1 5-10 years...2 More than 10 years...3
	1				
	2				
	3				
	4				
	5				
	6				

C	C	Background			
	1	First we start with some questions about the people living in this community. How many households are currently living in the entire community?	An approximate number will do.		Number of households More...1 Less...2 Same as 5 years ago...3
	2	Is there more or less households in the community now than five years ago?			Crop cultivation...a Livestock...b Fishing/hunting...c Trading...d Services...e Small-scale industry (non-farm)...f Large-scale commercial industry (non-farm)...g Transport...h Professional occupations...i Civil service...j Other...q
	3	What are the two most widespread economic activities in this community/quarter?	Two responses possible	Two responses possible	

D	D	Supply of electricity			
		Then we continue with the main topic for this survey, which is electricity.			
	1	What are all the different sources of electricity that are available in this community for households or businesses?	Multiple response	Multiple response	National grid connection...a Local mini-grid...b Diesel/gasoline generator...c Solar home system...d Solar lantern/lighting system...e Rechargeable battery...f Wind power...g No electric power in community, but grid in neighbour community...h -> Skip to D4 No electric power in community, but can charge batteries and mobiles in neighbour community...i -> Skip to D4 No electric power in this or the neighbour community, but can charge mobiles further away within walking distance...j -> Skip to D4 No electric power in this or neighbour...
	2	How far is the nearest [TANESCO]-office?		TANESCO/REA	Kilometres (if in EA write 0) Don't know...88 99 km or more...99
	3	Interviewer-CAPI check: Is the community connected to the national grid or a local mini-grid?			Yes, national...1 -> Skip to D8 Yes, both national and local mini-grid...2 -> Skip to D6 Yes, local mini-grid...3 -> Skip to D6 No...4
	4	What is the main reason why the community is not connected to the grid (TANESCO/REA)?			Grid is not available...1 Households do not want to connect to grid...2 Utility would not connect community...3 Service unreliable...4 Administrative procedure is too complicated...5 Submitted application and waiting for connection...6 Other...55
	5	Does the community expect to get grid connection in the next two years?			Yes...1 No...2 ALL -> skip to D31

D	6	Who is running the local mini-grid system in this community?			Individual...1 Private firm...2 National government...3 Municipal/local government...4 NGO donor...5 Community/cooperative...6 Other...55 If 1,3,4,5,6,55 skip to D8	
D	7	What is the name of the local mini-grid company?			Name of company	
D	8	How many years has the community had this grid connection?	Record in years. If less than 1 year record 0. If more than 10 approximate number of years.		Number of years	
D	9	Did the community have to pay anything to get the grid connection to the community?	Refer to any community cost to have the infrastructure installed.		Yes...1 No...2 -> skip to D11 Don't know...55 -> skip to D11	
D	10	How much did the community pay to get the grid connection?	Refer to any community cost to have the infrastructure installed.		Local currency Don't know...55	
D	11	Is grid service available in the whole community or only in a part of the community?	Read options aloud		Small part of community...1 Half of the community...2 Most of the community...3 Entire community...4	
D	12	How many households are connected to the grid?			Small part of the households...1 Half of the households...2 Most of the households...3 All households...4 -> Skip to D14	
D	13	What is the main reason that some households are not connected to the grid?			Household is far from the grid and hence have to pay more to be connected...1 Grid is too far from some households/not available...2 Cost of initial connection is too expensive...3 Running fee is too expensive...4 Satisfied with current energy solution...5 Renting, landlord decision...6 Service Unreliable...7 Administrative procedure is too complicated...8 Submitted application and waiting for connection...9 Company refused to connect the household...10 Other...55	
D	14	How many businesses are connected to the grid?			None...0 Small part of the businesses...1 Half of the businesses...2 Most of the businesses...3 All businesses...4	
D	15	Are there certain months/seasons every year when the community experiences bad electricity service from the grid?			Yes...1 No...2 -> skip to D17	
D	16	What are the worst months for service from the grid?	Record the months when community has the lowest number of hours of electricity supply. Up to three months are possible.	Up to three months are possible.	January...a February...b March...c April...d May...e June...f July...g August...h September...i October...j November...k December...l	
D	17	Do you practice load shedding in this area in the rainy season?	Load shedding is the set hours of electricity available from the grid for certain customers.		Yes...1 No...2	
D	18	Do you practice load shedding in this area in the dry season?	Load shedding is the set hours of electricity available from the grid for certain customers.		Yes...1 No...2 If no in D17 and D18 -> skip to D20	
D	19	Does TANESCO (or the community) publish a "load-shedding" schedule?	Load shedding is the set hours of electricity available from the grid for certain customers.		Yes...1 No...2	
D	20	What was the total duration of all the outages/blackouts during last week?	If no outages occurred, record 0.		Hours	
D	21	In the last 12 months, did the power at any time go out for more than 24 hours for multiple households in the community at the same			Yes...1 No...2 -> skip to D24	
D	22	When was the last time the power went out for more than 24 hours in this community?			January...1 February...2 March...3 April...4 May...5 June...6 July...7 August...8 September...9 October...10 November...11 December...12	
D	23	How many days did it take to fix the issue and for the community to regain power?	If less than a day fill in 0	If less than a day fill in 0	Number of days	

D	24	What are the two most serious problems this community experiences with the grid electricity?	Multiple responses possible. Up to two answers	Multiple responses possible. Two answers	Supply/shor tage/not enough hours of electricity...a Low/high voltage problems...of voltage fluctuations...b unpredictable interruptions...c unexpectedly high bills...d too expensive...e do not trust the supplier...f cannot power large appliances...g maintenance service problems...h unpredictable bills...i other...q no problems...x
D	25	[Over the past 5 years /Since the community first got access to the grid], has it gotten easier or harder for new households to connect to the grid, or is the situation about the same?		If D1 in (1,2) then continue with D27-D30 If the community has had access 5 years or more (D8 >=5) Ask [Over the past 5 years] If the community has had grid access less than 5 years (D8 <5) ask [Since the community first got access to the grid]	Easier...1 About the same...2 Harder...3
D	26	[Over the past 5 years /Since the community first got access to the grid], has it gotten cheaper or more expensive to connect to the grid, or is the price about the same?	If no payment necessary, choose option 1	If the community has had access 5 years or more (D8 >=5) Ask [Over the past 5 years] If the community has had grid access less than 5 years (D8 <5) ask [Since the community first got access to the grid]	No payment then, no payment no...1 Cheaper...2 About the same...3 More expensive...4
D	27	[Over the past 5 years /Since the community first got access to the grid], has there been less or more black-out or brown-outs in your community, or is the frequency about the same?	A brown-out is an intentional or unintentional drop or peak in voltage in an electrical power supply system	If the community has had access 5 years or more (D8 >=5) Ask [Over the past 5 years] If the community has had grid access less than 5 years (D8 <5) ask [Since the community first got access to the grid]	Less black-outs and brown-outs...1 Stayed the same...2 More black-outs and brown-outs...3
D	28	[Over the past 5 years /Since the community first got access to the grid], has the price of using electricity become higher or lower, or is the price about the same?		If the community has had access 5 years or more (D8 >=5) Ask [Over the past 5 years] If the community has had grid access less than 5 years (D8 <5) ask [Since the community first got access to the grid]	Lower...1 About the same...2 Higher...3
D	29	[Over the past 5 years /Since the community first got access to the grid], is there electricity available for more or less hours at night, or is the hours of electricity supply at night about the same?		If the community has had access 5 years or more (D8 >=5) Ask [Over the past 5 years] If the community has had grid access less than 5 years (D8 <5) ask [Since the community first got access to the grid]	Less hours...1 Stayed the same...2 More hours...3
D	30	[Over the past 5 years /Since the community first got access to the grid], has the repair and maintenance service from the provider gotten worse or better, or has it stayed the same?		If the community has had access 5 years or more (D8 >=5) Ask [Over the past 5 years] If the community has had grid access less than 5 years (D8 <5) ask [Since the community first got access to the grid]	Worse...1 Stayed the same...2 Better...3
D	31	Do any households own a solar home system/solar lighting in this community?			Yes...1 No...2 -> Skip to D34
D	32	Is it just a few households or is it many households that use solar systems/solar lighting systems in this community?			Just a few households...1 Many households...2
D	33	Can you buy or lease a solar home system/solar lighting system in this area?	Multiple responses possible	Multiple responses possible	Purchase from shops...a Purchase/lease from private companies...b Purchase/lease from NGOs...c Free...d Other...q
D	34	Are there any shared solar/electricity driven irrigation systems used by farmers in this community?		If A6a=1 (URBAN) SKIP TO Question D35	Yes...1 No...2
D	35	Are there any shared solar electric water pumps in this community for drinking water?			Yes...1 No...2
H	H	Energy development project			
H	1	Power lines program Construction, maintenance or rehabilitation	Has any of the following programs been implemented in the community in the last 5 years?		
H	2	Solar based community mini grid program	Devices using solar power can be used even by remote households with no access to the grid. It uses solar power and dependent on the capacity of the system it can power everything from a single light up to appliances like a radio, fan, TV etc.		Yes...1 No...2
H	3	Off-grid energy distribution program for individual households, e.g. solar lanterns, solar home systems, electric generator	Devices using solar power can be used even by remote households with no access to the grid. It uses solar power and dependent on the capacity of the system it can power everything from a single light up to appliances like a radio, fan, TV etc.		Yes...1 No...2
H	4	Other development program related to power supply			Yes...1 No...2
H	5	Solar irrigation program for farmers			Yes...1 No...2

F	F	Infrastructure			
		Now we would like to know more about the access to the community and to various service infrastructures that are available in this community.			
F	1	Is the community accessible by motor vehicle (car or truck) during the dry season?			Yes, by paved road...1 Yes, by unpaved gravel/dirt road...2 No...3
F	2	Is the community accessible by motor vehicle (car or truck) during the rainy season?			Yes, by paved road...1 Yes, by unpaved gravel/dirt road...2 No...3
F	3	Is there a bus connection in the community?			Yes...1 No...2
F	4	What is the distance in kilometers from the community to the nearest town/city?	If community in a town/city code distance as 0 km without asking. Enumerator may fill in.		Kilometres
F	5	What is the distance in kilometers from the community to the district center?	If community in a district center code distance as 0 km without asking. Enumerator may fill in.	Kilometres Max F4	Kilometres
F	6	What is the distance in kilometers from the community to the nearest bank branch?	Enumerator may fill in appropriate number of KM. If bank branch within community code distance as 0 km.		Kilometres
F	7	What is the distance in kilometers from the community to the nearest microfinance institution?	Enumerator may fill in appropriate number of KM. If microfinance institution within community code distance as 0 km.		Kilometres Don't know (85)
F	8	Can a mobile phone get a working signal in the community?			Yes, everywhere in the community...1 Yes, most parts of the community...2 Yes, half of the community...3 Yes, only a few parts of the community...4 No, nowhere in the community...5
			Read options aloud		

We would now like to know about the presence of markets, educational institutions, and health services in this community.						
F	9		a	b	c	d
	Categories	SERVICE	Are there any [SERVICE] in this community?	What is the distance to the nearest facility of this type? → skip to d	Do at least one of these [SERVICE] have access to electricity?	Did this service exist in the community five years ago? [SERVICE]
	1	Permanent market	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	2	Weekly or fortnight market	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	3	Local market	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	4	Pre-primary school / Kindergarten	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	5	Primary school	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	6	Secondary school/high school	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	7	TVET (technical and vocational education and	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	8	Private clinic	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	9	Government clinic/Public Health Center	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	10	Dispensary or pharmacy	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2
	11	Hospital	Yes...1 → c No...2	km	Yes...1 No...2	Yes...1 No...2

G	G	Business			
		We would now like to know about the presence of different types of businesses and services in this community. We would like to know both about the situation today and 5 years ago.			
		It is the type of business we are interested in, not if the exact same business existed five years ago.			
G	1	MANUFACTURING—MAKING GOODS	a	b	
	Categories	Business Types	Are there any [Business types] in this community?	Was there any [business type] in the community 5 years ago?	
	1	Tailor, shoe manufacturer or shoe repair	Yes...1 No...2	Yes...1 No...2	
	2	Baker or business making baked goods	Yes...1 No...2	Yes...1 No...2	
	3	business making Coffee, tea, sugar, oil, dry fruits and other processed foods	Yes...1 No...2	Yes...1 No...2	
	4	business of making Handicrafts	Yes...1 No...2	Yes...1 No...2	
	5	business of making Furniture	Yes...1 No...2	Yes...1 No...2	
	6	business of making Metal Products	Yes...1 No...2	Yes...1 No...2	
	7	business of making Household Items	Yes...1 No...2	Yes...1 No...2	
	8	business of making Tools and Instruments	Yes...1 No...2	Yes...1 No...2	
	9	business of making Bikes	Yes...1 No...2	Yes...1 No...2	
	10	business of doing Other Manufacturing	Yes...1 No...2	Yes...1 No...2	
		SERVICES—SELLING GOODS	a	b	
	11	business of Selling food or Groceries (street food sellers, restaurants)	Yes...1 No...2	Yes...1 No...2	
	12	business of Selling clothing or household items	Yes...1 No...2	Yes...1 No...2	

	13	business of Selling computer or phone services	Yes....1 No.....2	Yes....1 No.....2
	14	business of Selling other goods	Yes....1 No.....2	Yes....1 No.....2
	15	business of providing Transport	Yes....1 No.....2	Yes....1 No.....2
	16	providing Cleaning and washing	Yes....1 No.....2	Yes....1 No.....2
	17	Hairdressers or barber shops	Yes....1 No.....2	Yes....1 No.....2
	18	Doctor, lawyer, accountant, or other professional services	Yes....1 No.....2	Yes....1 No.....2
	19	business Selling or giving service to Solar Home Systems or Solar Lighting Systems	Yes....1 No.....2	Yes....1 No.....2
	20	business providing Construction work	Yes....1 No.....2	Yes....1 No.....2
	21	Grain or oil mill	Yes....1 No.....2	Yes....1 No.....2
	22	Internet or TV café	Yes....1 No.....2	Yes....1 No.....2
	23	Restaurant, tea or coffee shop	Yes....1 No.....2	Yes....1 No.....2
	24	Mobile phone charging or repairing service	Yes....1 No.....2	Yes....1 No.....2

I	I	Cookstoves			
		Now we would like to know what kind of cookstoves that are used in this community.			
I	1	What is the most common type of cookstove people use in this community?	Read options aloud if needed.	3-stone stove...1 Charcoal stove...2 Other stoves for firewood or other solid fuel...3 Stoves for other type of energy...4	
		An improved cooking stove can reduce the fuel consumption significantly. It can also reduce the smoke. Possibly, the cooking time per meal will be shortened since fire power of this cookstove is stronger than the traditional cookstove. We would now like to know if such ovens are being used in this community.			
I	2	Do any of the households in this community use improved cookstoves using firewood, dung, twigs, rice husks or leaves?	Show example pictures	Yes...1 No...2	
I	3	Do any of the households in this community use improved cookstoves using charcoal?	Show example pictures	Yes...1 No...2	
I	4	Do any of the households in this community use improved cookstoves using pellets or briquettes?	Show example pictures	Yes...1 No...2	
I	5	Do any of the households in this community use stoves with LPG, biogas, electrical stove or solar cooker?	Show example pictures	Yes...1 No...2	
I	6	Is it possible to buy an improved cookstove in this community?	Show example pictures	Yes...1 No...2 → skip to 18 Don't know...88 → skip to 18	
I	7	Where is the closest location to buy an improved cookstove in this community?		Within village...1 In neighbouring village...2 Closest permanent market...3 District centre...4	
I	8	Are there programs that distribute improved cookstoves in this community?		Yes...1 No...2	
I	9	Are there programs that campaign for the awareness of health risks of cookstoves?		Yes...1 No...2	

J	J	Street lighting			
		Now we would like to know whether there are any community street lights, security lights or private lights outside businesses or private homes.			
J	1	Does your community have any form of public street lights or other kinds of outdoor lights, e.g. private security light?	Multiple response	Yes, public street lights...1 Yes, outdoor lights/security lights...2 No...3 → end page	
J	2	To what extent is your community covered by street lighting/ security lights?	Read options aloud	None/ hardly any...1 Minor Part...2 Partially...3 Largely...4 Entirely...5	

GP	GP	Global pandemic			
		This last section presents a few questions related to the global pandemic and period of closed schools from March 2020.			
		The other sections of this community questionnaire include a number of questions on livelihood and economic situation as well as living conditions today and 5 years ago.			
		This would allow us to estimate the change during these years for communities with long term access to energy versus only short term access or still no access to energy.			
		We would like to ask you whether the situation for people in this community has changed over the last year from March 2020 up to today.			
GP	1	Have the job opportunities in this community increased, remained the same or decreased over the last year from March 2020 up to today?		Increased...1 Remained the same...2 Decreased...3	
GP	2	Have the business opportunities in this community increased, remained the same or decreased over the last year from March 2020 up to today?		Increased...1 Remained the same...2 Decreased...3	
GP	3	Have the market access in this community increased, remained the same or decreased over the last year from March 2020 up to today?		Increased...1 Remained the same...2 Decreased...3	

